Clinically oriented physiology teaching: strategy for developing critical-thinking skills in undergraduate medical students

Reem Rachel Abraham, Subramanya Upadhyya, Sharmila Torke, and K. Ramnarayan
Melaka Manipal Medical College (Manipal Campus), International Centre for Health Sciences, Manipal 576 104, Karnataka, India
Submitted 13 January 2004; accepted in final form 25 March 2004

Abraham, Reem Rachel, Subramanya Upadhya, Sharmila Torke, and K. Ramnarayan. Clinically oriented physiology teaching: strategy for developing critical-thinking skills in undergraduate medical students. Adv Physiol Educ 28: 102–104, 2004; 10.1152/advan.00001.2004.—Medicine is an applied science, interpreting evidence and applying it to real life by using clinical reasoning skills and experience. COPT (clinically oriented physiology teaching) was incorporated in physiology instruction aiming to relate the study of physiology to real-life problems, to generate enthusiasm and motivation for learning, and to demonstrate the vocational relevance of physiology among students by integrating clinical experience with teaching. COPT consisted of two elements: 1) critical-thinking questions (CTQ) and 2) clinical case studies. After a few topics were taught, CTQ and case studies were given as an assignment. Answers were discussed in the next class. Two exams, each of which contained CTQ and recall questions, were conducted, one before (exam 1) and one after (exam 2) the implementation of COPT. Analysis of student performance in the examinations revealed that the students did better in exam 2 (P < 0.0001). Feedback from students indicated that this method was useful and challenging. The main focus of the students is to pass the examination or to get a high score. If the students’ understanding about basic physiological concepts is measured by incorporating some reasoning questions in an examination, the outcome is unsatisfactory. Skill in studying involves the display of understanding of a given material through special skills of performance in examinations. Most of our examinations demand mere recall of the subject matter (17), so the students tend to see the examination as a task requiring them to memorize facts. On the other hand, if the examination demands student understanding of the subject matter, they place more emphasis on it. Teaching knowledge as sets of facts to be stored and retrieved to answer anticipated test questions is hardly a form of learning and certainly not effective for long term retention (13).

Taking the facts above into consideration, COPT has been implemented to achieve two goals: first, to develop critical-thinking skills in undergraduate medical students to help them understand and apply the basic physiological concepts in clinical practice later, and second to motivate the students to learn physiology.

METHODS

The undergraduate medical program at Melaka Manipal Medical College (MMMC) Manipal campus, is a five-year, intense academic program. The students are taught preclinical subjects in the first year. The first-year subjects include:- Anatomy, Physiology, and Biochemistry. This study was conducted at the department of Physiology, MMMC, Manipal campus. The first-year curriculum is divided into four blocks as follows:

- Block 1: basic concepts, blood and nerve-muscle physiology
- Block 2: cardiovascular, respiratory, and gastrointestinal physiology
- Block 3: endocrine, reproductive, and renal physiology
- Block 4: central nervous system and special senses

COPT was incorporated in the third block to a class of 136 students. After basic concepts in each system were introduced, students were administered critical-thinking questions (CTQ) and clinical case studies. Case studies were followed by a series of questions, and requests for rationale were given as student assignments. The answers were discussed in the next class. Any misconceptions and doubts were clarified during classroom discussions. This was continued until the end of the block. Two examinations were conducted, one before the incorporation of COPT (exam 1) and one after (exam 2). The examination pattern consisted of CTQ and recall type of questions, both having equal scores. The students’ scores on recall questions and CTQ were determined in both examinations. Also, feedback containing nine items on the Likert scale, from Strongly Agree to Strongly Disagree, were collected from the students. Students were asked to indicate their responses in the appropriate column as shown in Table 1.

Critical thinking is the process of actively and skillfully applying, relating, creating, or evaluating information that one has gathered. Learning by critical thinking consists of various stages of problem-solving processes, with each stage characterized by reasoning skills (6). Developing the ability to think critically is an important element of undergraduate physiology education and is influenced by learning environment as well as by the instructor’s approach to teaching. Good critical-thinking skills are essential for life-long learning. Instead of merely providing knowledge, the medical curricula should challenge students to strive for critical scientific thinking, solving clinical problems, and communicating with the patients (12). The goals of critical thinking are to assess the credibility of information and to work through problems in the best way (7).

Medical students must use critical-thinking skills to relate basic concepts to real-life situations. In the process of becoming an expert clinician, medical undergraduates acquire knowledge not only through listening to lectures and reading recommended textbooks but also through solving scientific problems (15). Research has proven that, when used in conjunction with other teaching methods, lectures create an active learning environment (11). It was reported that medical students had factual information imposed on them and little care had been taken to foster clinical reasoning (15). The main focus of the
A significant increase in the mean percentage score was observed when comparing recall questions and CTQ in exam 1 and exam 2, indicating that students showed better performance on recall questions and CTQ in exam 2 compared with those in exam 1. Even though the percentage mean score was higher for recall questions than for CTQ in both exams, a significant increase in the mean percentage score was observed in CTQ between the two exams. A majority of the students felt that CTQ enhances their reasoning skills and helps them gain an in-depth knowledge about the topic.

**DISCUSSION**

To emphasize the role of understanding and critical thinking in undergraduate medical education, several new methods in teaching and evaluation have been recommended. In this study, we introduced a teaching methodology that was useful for enhancing critical-thinking skills of students. Our results specifically document that the students performed better after implementation of COPT.

The significantly increased performance of CTQ in exam 2 over that in exam 1 may be due to the demand of a greater understanding of the subject matter by the students. Students were informed at the beginning of the block about the testing pattern. Anticipation that a test will require a greater degree of understanding may have changed the students' intention from memorization to understanding the subject matter. Both examinations engaged the students in active thinking, and COPT promoted active learning in the students.

Knowledge without the ability to apply it is rightly seen as a very poor commodity. The concept of problem solving to teaching is not new in education in general or in medical education in particular. Problem solving in medicine generally refers to the ability to use clinical reasoning skills. According to De Bono, thinking is a skill and therefore teachable. Brookfield characterized critical thinking as a lived activity. Sackett et al. started to teach critical appraisal skills at MacMaster University. COPT tries to create a deep approach in the students as it requires a deep understanding of the subject matter. Research has proved that students who spend more time in independent study tend to adopt a deep approach. The assignments administered to the students require them to spend more time in independent study as they require them to study beyond the learning issues. During COPT, students are taught to relate basic concepts to everyday experience and to relate evidence to conclusions. These are the features of the deep approach.

The instructor also plays a pivotal role in cultivating critical-thinking skills. Effective teachers facilitate the development of critical-thinking skills when they implement learning activities that have authentic, real-world contexts and personal relevance to the students. Additionally, well-designed, open-ended questions and investigative activities by the instructor facilitate critical thinking. Instructors promote critical thinking when they pose questions that require explanatory answers that demand that students think before they respond. Clinical case studies reflect real-life situations and, hence, promote problem solving in an effective manner.

COPT has tried to create an intrinsic motivation in the students for learning. This concept and our results were supported by Seale et al., who reported that assessment had the potential to motivate students and thus influence their learning. Studies have suggested that intrinsic motivation is created when the relevance of the subject matter is the primary driving force in the students’ motivation.
force (8). This was made clear to the students when they had to work through the case studies and CTQ.

COPT was well received by the students. The students’ attitude toward medical knowledge had changed, and they reported an increase in their critical-appraisal skills. COPT served as a stimulus for critical-thinking insights. Many students realized the relevance of physiology in medicine and that it was related to and dependent on the context where it was applied. They started thinking of the rapid turnover of information in medicine and the need for lifelong learning. With the incorporation of COPT, learning is facilitated by allowing learning to take place in meaningful contexts by activating prior knowledge and by requiring the students to be actively engaged in the learning process.

REFERENCES