Active teaching and learning for a deeper understanding of physiology

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This letter is intended to contribute to the discussion of active versus passive learning in physiology. Here are some thoughts for consideration: are we, as teachers, making a difference in the learning process? How do we ensure that we emphasize the acquisition of knowledge rather than short-term memorization?

Considering the pertinent discussion regarding the quality of learning in physiology by undergraduate students, a short survey with cardiorespiratory questions was distributed at the end of a physiology course (Table 1). Students were informed that the survey was voluntary. It was emphasized that students did not have to answer questions if they did not know the answer. Of 50 students, 40 students returned the questionnaire. The outcome shows results similar to surveys conducted in several different educational institutions across the country (1, 2, 4).

The first part of the survey asked questions about physiological parameters familiar from everyday experiences. Students were asked what would happen to the strength of the heart beat after exercise. While most students (88%) responded that it would increase, only 15% of them were able to explain the action of the sympathetic nervous system (4 correct answers among 26 that attempted to respond). This result is in agreement with those of Michael et al. (2), who concluded that many students memorize facts but do not develop a deeper understanding of how physiological phenomena occur.

Another important point brought out by this survey was the presence of misconceptions. When students were asked about the respiratory changes after quickly climbing a set of stairs, the majority of them (85%) knew that the respiratory rate would increase, but only 40% of them correctly responded that the depth of respiration would increase as well. Among these students, only 24% of them could explain the role of chemoreceptors. Similar findings have been described in a previously published survey including seven United States institutions (1).

There are many possible interpretations for the results of the survey, but it is clear that despite our efforts to provide high-quality lectures and computerized laboratory exercises, only a small proportion of the material taught is effectively learned, and student performance does not meet our expectations.

In our survey, student performance on questions that aimed to test the application of understanding of the material was significantly lower than questions testing for the assimilation of information. How do we then prepare our students so that they assimilate facts but are able to integrated them and apply them into new situations that they have not previously encountered?

This issue of students not accomplishing a deeper understanding of physiology is also a reflection of teacher’s ineffectiveness. In reality, what has been repeated for generations is standing of physiology is also a reflection of teacher’s ineffec-

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Table 1. Survey

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<th>Questions</th>
<th>Please choose one answer from the options presented.</th>
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| 1. You have just finished playing a soccer game. The exercise was very rigorous, and you note that your heart rate increased. What do you believe happened with the strength of your heart beat? | A. It increased.*  
B. It decreased.  
C. It remained unchanged.  
Please give a short explanation of your answer including the action of the nervous system. |
| 2. You arrived late for the physiology exam and found out that it will take place on the sixth floor. Because the line for the elevator was too long, you decided to run up the stairs. When you arrived in class, you could barely focus because of the change in your respiratory pattern. What happened with the depth (increased*, decreased, or remained unchanged) and rate (increased*, decreased, or remained unchanged) of your respiration? Explain your choice including the role of chemoreceptors in your answer. | |
| 3. When the metabolism of the body increases, ventilation will (increase*, decrease, or stay the same). | |
| 4. A large vein in the leg is cut during an accident, and the individual loses 2 liters of blood. The pressure in her veins will (increase, decrease*, or stay the same). | |
| 5. The ventricle fills only when: | A. the atrium contracts.  
B. the pressure in the ventricle is less then the pressure in the atrium.*  
C. the papillary muscles contract and open the atrioventricular valve. |
| 6. When the heart beats, the right ventricle pumps (the same*, more, or less) volume of blood than the left ventricle. | |
| 7. If all of the nerves innervating the heart are cut, will the heart (continue* or stop) beating? Why? | |
| 8. The left ventricle contracts now. The right ventricle contracts (before, after, or at the same time*). | |
| 9. The blood flow through the pulmonary circulation is (the same as*, greater than, or less than) the blood flow through the systemic circulation. | |

*Correct answers. Questions were adapted from Ref. 2.
as is available, often neglecting how much our students are able to apply the information. Teachers budget their time in class in favor of comprehensive coverage of the material and at the expense of ensuring learning and application. Instructors tend to overestimate the students’ abilities to apply their knowledge, as described in a survey (6) given to the instructors questioning their impressions with regard to student knowledge.

The teaching method based on students passively receiving material that has already been “digested” does not meet the desired outcome for the future health professional. Richardson (5) demonstrated that naïve students (those without previous exposure to formal physiology teaching) performed similarly to two other student groups of experienced students when asked questions that tested for the mastery of concepts and their application. According to the author, the low retention of the experienced students probably relates to the passive didactic lecture style of teaching in elementary physiology courses (5).

Laboratory sessions that are complimentary to the lecture can serve as a great supplement, but for them to be effective the student must be engaged in the activities and not merely following the steps dictated in a laboratory manual. The practical laboratory could be the ideal opportunity for active learning, but it is often ineffective when the laboratory manual is used merely as a “cookbook.”

To help the students learn in an everlasting way, we are implementing changes to engage students in active learning and consequently develop a better understanding of physiology. At the beginning of each laboratory session, one teaching assistant (TA) reviews the laboratory exercises that are about to take place. Students are then divided into small groups, and, before they begin the exercises, they predict the results and discuss them with the TA that oversees their work. After the laboratory, the TA reviews the results and clarifies differences from the predictions. The opportunity to predict and verbalize expected outcomes seems to promote better understanding to correct misconceptions, as previously described (3).

According to the constructivist theory of learning, a student’s conceptual understanding improves when the student is actively engaged in the learning process. When we attempt to bring a strategy to introduce active learning into the classroom, students resist it because they are used to the conventional passive lecture style. We all know that students, as well as teachers, are not always open to change, but if we are committed to improving learning toward a deeper understanding of the material, we must search for alternative ways to produce future health professionals who can effectively address the health challenges our society faces.

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REFERENCES