Whither the Art of Teaching?

To the Editor:

Life science educators including physiologists are increasingly challenged by a myriad of issues, ranging from “teaching medical teachers to teach” (1) at one end of the spectrum to tackling the problem of “scientific illiteracy” among the general population at the other (4). In the December 1998 issue of *Advances in Physiology Education*, a number of questions concerning the current status and future direction of physiology education, in the era of fast-advancing technology and exponential growth of information, were addressed (2, 5, 6). I was a teacher of physiology for a few years before pursuing the PhD program in physiological sciences. This gave me an opportunity to look at the education scenario from the dual perspective of a student and a teacher.

Advanced technology (computer software, the Internet, animation, simulation, and other audiovisual aids) is now incorporated with an information package of basic facts. It makes the course content “exciting” to students so that they have “fun” in learning. Teachers discuss in class the most current concepts of biological phenomena or experimental observations of physiological systems. They often refer to the most recent issue of the Journal to keep the students abreast of developments in the fast-changing field. So that problem-solving or analytical skills are acquired, students are given appropriate assignments and assessed accordingly. These sincere efforts of concerned teachers are noteworthy and deserve admiration.

However, I have felt time and again, particularly during the course of my program, that “something” is missing in all these endeavors! I cannot test the hypothesis of whether “something” (or anything, for that matter) is missing in present-day science education. Feeling is difficult to narrate and more so to explain on empirical grounds. As graduate students, we had almost everything that is supposed to be there in advanced education: a structured course with learning objectives, lectures as well as problem-solving assignments, designing of experiments and testing of hypotheses, etc. However, my feeling that “something” is indeed missing persisted. Surprisingly, I found that many graduate students and some professors, too, had similar feelings. I reflected upon it and came to the realization that the art of teaching, among other aspects of education, is sadly missing amidst too much science of teaching. Perhaps as a teacher I might not have realized that, had I not been a student again.

Lest I am misunderstood, let me be very clear: I am not opposed to the science of education at all. From my personal experience, I can say that I am strongly in favor of training at least some scientists (“accidental teachers”) how to teach, i.e., how to minimize the pain experienced by students. At least, the science of teaching will make a bad teacher (maybe a good scientist) a mediocre teacher, an average teacher a good one; but what is needed today is more than just the science of education.

Techniques, technology, training of teachers, active learning, problem-based learning, evidence-based medicine—all these notions are reflective of what can be considered the science of education. Thus designing a course with well-defined learning objectives incorporated with the most appropriate technology for a particular student group is mostly concerned only with the science of teach-
ing. However, the science of teaching does not necessarily make a scientist a great teacher, nor can it make a science education the best one. The reasoning is simple: any house is made of bricks, cement, and wood, but a beautiful house is more than an assembly of building materials, i.e., the science of construction. The science of education makes it more purpose oriented; the art of teaching adds beauty to educational process. Although the science of education may make a learning experience more “exciting,” the art of teaching makes it more fulfilling and inspiring. Both undergraduate and graduate students recognize this intuitively. In the focus only on the science of teaching, the art of teaching and education is, or rather has been, neglected so much as to be on the way to being lost and extinct. Physiology teachers today need to go beyond the realm of the science of education to search for and bring back that missing art. I believe that in many physiology departments of the economically underdeveloped or developing countries, where there are few, if any, resources or teaching tools, some excellent teachers compensate for their lack of the science of teaching by heavily relying on and using the art of teaching.

I am a “card-carrying” physiologist who is old enough to have had senior professors of “classical” physiology as colleagues and young enough to have friends in the MTV generation. Putting spectacular advances in biomedical sciences aside for a while, it is important to ponder on broader perspective of physiology education. It is also a time of introspection for physiologists. What are the students really expected to be during and after the educational process? Is developing the faculty of analytical reasoning or acquiring problem-solving skills the most important aim of medical education? Is there any limitation of “scientific truth” in application, such as medicine? What is the relationship of good science and good clinical practice?

Science, as it is generally understood, and clinical practice move in opposite directions. Science moves from individual observations to generalizable theories and laws. Clinical practice brings this generalized body of knowledge to bear to benefit an individual. Science has a unique and essential role in clinical practice. Clinical practice is not a science but an endeavour that uses science. Good science is necessary but insufficient for good practice [from Ref. 3].

Historically and more justifiably, medicine has been stated to be the art of healing (7). Likewise, nursing and allied health disciplines are both science and art. It needs to be emphasized that education is both as much art as science, and physiology education is no exception. Some teachers inform, others train, few educate, very, very few inspire. Maybe this mystery lies in the art of teaching.

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References

Report from Russia
To the Editor:

First of all, I would like to thank you and American Physiological Society for free subscriptions to News in Physiological Sciences and Advances in Physiology Education. My colleagues and I have received all copies of NIPS, and I have received two issues of Advances in Physiology Education. It would be very useful for my colleagues and I if you also could help us to receive these journals in the future (I would greatly appreciate this), or at least some issues of NIPS, because due to the very dramatic economic situation in Russia and the extremely scarce funding of science and education it is very difficult for us to subscribe to these journals.

I was one of the Russian participants in the workshop and training course “Teaching Physiology” in Repino in July 1997. The workshop was very interesting for us, and we learned more about some aspects of teaching physiology. (Let me again thank Dr. G. Somjen for making that possible.)

In the December issue of Advances in Physiology Education, Dr. A. F.
Sefton wrote concerning the different models of teaching physiology in different countries. Unfortunately, there was too little information about the situation in Russia. In my letter I would like to say a few words about the problems of teaching physiology in our department, and I do hope that my remarks will be interesting to you.

From reading Dr. Silverton’s paper “Physiology education today, what comes next?” I have found that here in the Russia, in quite different conditions than in the United States, we have the same problems with the “new generation” of students. Many of them have computers and work on the Web. Many of them do not like reading books . . . when sometimes I ask them about Russian literature, I learn that some of them have watched the great Leo Tolstoy’s War and Peace on TV, but they have not read the book! (In the United States, I know some of the students also have not read Walt Whitman and Theodor Dreiser.) It is a pity, of course, but this is the reality of our life and time. For this reason, the main question in Russia always has been, and will be in the future, “What to do?” How we can find the true answer? How will modern students study physiology without reading the books? Let us remember the experience of I. P. Pavlov, who demonstrated the main physiological principles on animal models during his lectures and thus explained to students the complex things . . . I remember my astonishment when I was a medical student and for the first time in my life saw the microelectrode and the cat with the flow probe on the aortal. It was incredible and wonderful! And it is a pity that the modern students can see only the display of the computer and not the live animal.

The great Russian writer Leo Tolstoy in his Way of Life wrote, “knowledge is only true knowledge when it has been gained by efforts of thought and reflection, but not by memory.” Modern students can memorize a lot of facts, but only a few of them can make logical conclusions. For example, if you ask a student about “Bell’s law” he may answer that the posterior roots of the spinal cord are sensitive, and the anterior ones are motors. But if you ask him how to prove it, I am not sure that you will hear the answer.

The paradox of medical education nowadays in Russia is also evident in the fact that the students know complex things and do not understand the simple ones. For example, they can write Nernst’s equation and Fick’s law, but many of them do not know Ohm’s law and some of them have problems with the percents count. As to computers . . . of course, it would have been foolish if they were not used in the teaching of physiology, but there are two different situations: first, when the students understand the main principles of programming, the logic of how programs work, and second, when the students use the keys and mouse without any progress in mathematics and the art of programming. What will be the difference, in this case, whether he or she uses MacLab System or a mechanical kymograph for the registration of the physiological processes? Of course, the medical student cannot be an advanced programmer, and we teach physiology, but “That’s the question . . .”

From my point of view it is necessary to use different levels in teaching physiology: 1) physical models; 2) animal models; and 3) human observations. For example, it is very difficult for students to understand the systemic circulation because of pulsatile blood flow, the many parameters, and the necessity of knowledge of physical laws of hydrodynamics. For this reason at first they should see the physical model which includes the pulsatile pump and the system of rigid (glass) and elastic (rubber) pipes. Without the resistance the flow is interruptive in both glass and rubber pipes. However, when the resistance is increased (with the help of clamps), the flow in the glass pipe rests interruptive, and the flow in the rubber pipe will become pulsatile and constant. The students can understand the role of the so-called “compression chamber” in Frank’s model. Second, they can observe the experiment on the animal (it may be, of course, on video film). In the experiment they see the measurement of cardiac output (with the electromagnetic or ultrasound flow probe) and the arterial pressure in the femoral artery; they also can see the measurement of venous return (inferior vena cava flow) and pressure in the left ventricle. And only after this, on the third step, can they measure some of the parameters of systemic hemodynamics on the human. So, from my point of view, the main goal of physiological education is to teach the students to think, to analyze the facts, and to make conclusions. Problem-based learning can be one of the approaches, at least in the student’s groups. However, I believe that we could do more if we worked with the students in a scientific manner.
One of the interesting forms of teaching physiology is the Students Scientific Society. In our University since 1922 there have been Students Scientific Societies in different departments. In our department there is such a society. If the students want to know more, they can begin their own scientific work when they are freshmen or sophomores. They can come into the laboratory and carry out the classical experiments on animals (e.g., Starling's preparation, Donders model, etc.) or help our postgraduates in their research work and then begin their own research. They can also discuss their results with the scientists under informal conditions with a cup of tea, for example. They also learn how to care for animals. The students can write their own simple program on Pascal to analyze the results!

Of course, the organization of a Student Scientific Society needs great expenses (animal's cost, teacher's time, etc.) and, unfortunately, nowadays in Russia the economic situation is very dramatic; also, the level of education is declining catastrophically, and the interest of the students in physiology is decreasing, because there are so many other problems. For example, in recent times in Russia the number of medical students, who do not like the experiments on animals, has also increased. They say that "it is cruelty and the animals should not be used in the science and teaching." [However, traditionally in Russia there were no problems (and I would like to believe that there will be no problems in the future) with the use of experimental animals in the laboratory, and the opinion of the people to this question is tolerant in most of the cases.] In that case I usually tell them the words of the great Russian physiologist I. P. Pavlov, who said, "... When I begin my experiment, which leads in the end to the death of the animal, I feel the hard feeling of distress that I interrupt the existing life, that I'm the hangman of the animal. When I cut and dissect the animal, I hear in myself the caustic reproach, that with my horny hand I broke the incredibly wonderful mechanism. But I overcome this for the truth and the human's life. And my experimental work some people want to control constantly! But how many animals are exterminated only for pleasure and empty caprice! And all this rests without any attention. . . . And then with indignation and deep conviction I can say to myself and other people, 'No, this is not loftily feeling for the suffering of all living, but this is only one of the badly disguised manifestations of the eternal enmity of ignorance against science, the darkness against the light!' . . ." I also try to explain to the students that using animals in the experiment is not the goal of the scientist, but this is the necessity for future treatment of humans and maybe animal diseases. Let us remember the words of C. Wiggers, "The students should leave the laboratory tired, but satisfied. They should feel the joy of the discovery."

And when I see the burning and excited eyes of the students who are looking on the beating cat's heart, when I see their joy when they insert the cannulae into the artery and measure the arterial pressure, I understand that "the game is worth the candle."

At the end of my letter I would like to say a few words about the exchange of ideas. Of course, the systems of education in Russia and in the United States are very different; the approaches to teaching are also different. Of course, we live after the end of the "cold war" era, and the teachers and the students in Russia are in a bad financial situation, but I am convinced that the isolation of Russia from international scientific society will be the greatest mistake for the West and the United States. Moreover, there are no countries as different as Russia and the United States, but there are no countries, no people, which need each other more than the other. What we can do for the future? Of course, if some American students could work, for example, one to two weeks with Russian students in the Russian laboratories, and if some Russian students could do the same in the United States, it would be the beginning of a process of mutual understanding.

Of course, there are many financial, cultural, and language problems, but from my point of view, only with the exchange of ideas and contacts of ordinary teachers and students can we find together the optimal way of teaching physiology, make new discoveries, and find new ways of treating diseases and saving human life.

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