

How My Students Taught Me Physiology

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J Physiol Biomed Sci. 2017; 30(2): 37-9

“... you then who teach others, do you not teach yourself?”

Epistle to the Romans

Introduction

I have enjoyed teaching Physiology for three decades to a diverse spectrum of students reading Medicine, Dentistry, Pharmacy, Biomedical and Nursing. Much has been said about ‘student-centered curriculum and learning’. Rightly implemented, this approach should not imply less teaching and preparation time for lecturers. Experientially, proper mentoring would mean that the student-directed learning, to be useful and meaningful, needs guidance to help students surf, sift through and extract key Physiology information. Really, the effective pathway is a teacher-directed, student learning.

I have had the privilege to teach in medical schools in Shanghai, Kunming, China and also at the Prince of Songkla University. Their specific physiology syllabus is embedded in medical curriculum that might differ from those in Malaysia (intra-Malaysian variety also exist!). The Medical Faculty in Universiti Malaya (UM) has also moved with the trend from the classical discipline-based lectures to partially and more fully integrated medical curriculum. Having journeyed with UM, with my physiology books in hand, along these curricular fluctuations, I would like to share some thoughts on teaching and learning Physiology.

We mostly associate ‘learning’ with our students,



Teachers think through their teaching, engage in conversations with students with the aim that students take away some good understanding and learning.

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Received 7 September 2017

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Available online at www.j-pbs.org

recipients of our teaching (good or bad!). I would make two personal observations from the start. One, that irrespective of curriculum style, good dedicated teachers will still be effective, deliver and impact their students’ understanding and learning. Two, my focus in this brief narrative, there is much to learn from our students that can fine tune and better our own discernment and insight into teaching well.

1. My students’ distraction taught me how to teach outside the powerpoint boxes

It is increasingly difficult to engage our students for a full 45 min class. Enforced attendance for lectures serve their purpose but we would agree that the physical bodies present in class is no guarantee that the information they hear (unless they sleep) has diffused to them, let alone understood. Powerpoints (Ppt) can become powerless and ineffective if they are not carefully prepared. Interactive thought questions can be included at selective points during a class to stimulate interest and curiosity. I quite often also do not give the answers to such questions and have told my students that these intra-lecture questions could be asked in their tests! I tell them ‘think outside the Ppt boxes’. For fellow teachers, we can also teach outside the Ppt boxes.

There are opportunities to make Physiology learning fun beyond the large lecture classes. I take advantage of Facebook to get students to face their Physiology books! Since 2012, I start a closed, facebook Physiology learning group with each new batch of medical students. Notes, questions, post-test analysis of students’ responses can be shared to benefit all.

My students’ scientific rootlessness taught me to bring in physiological heritage (their PHYStory). Photos and key contributions of e.g., Ernest Staling, August Krogh can be uploaded.

2. My students’ responses taught me to emphasize precision and good definitions

It is common to encounter loose answers and explanations given by our students during tutorials

and class assessments. One example is cardiac output. A loose definition is ‘the blood volume/min pumped out by the heart.’ A precise answer will be the volume/min ejected from EACH cardiac ventricle. The specific description defines subsequent physiology. Functionally, there are 2 cardiac outputs from the 2 ventricular pumps arranged in series in a closed CVS. This then leads to the *in vivo* importance of equalization of the 2 cardiac outputs to prevent potential vascular congestion.

Common errors among students also taught me to tell students to pay attention to quantitative aspects of physiology. Units are uniquely essential for understanding Physiology. Two examples will show this. One, the velocity of capillary blood flow is much less than the arterial blood flow for the microcirculation to serve its exchange functions. However, the total capillary blood flow (volume/min) is the same in every segment of the closed CVS (*in vivo* vascular congestion would occur if this was not the case).

In renal clearance, the excreted load (amount/time) of inulin is the same as its filtered load. However, the inulin urine concentration (amount/volume) is **ALWAYS** higher than the filtrate concentration, since water only is reabsorbed but inulin remains in the tubular fluid.

3. My students' confusion highlights that concepts and themes should be taught

The big picture, cross-organ principles should be highlighted for our students. Within the integrated homeostatic framework, our students will better appreciate the whole body physiology. Autoregulation of tissue perfusion is conceptually the same in the brain, heart, and kidneys. The graphical representation of autoregulation in all the three organs, illustrated on the same x and y axes, demonstrate a similar plateau, the autoregulated blood flow over a defined range of fluctuations in arterial perfusion pressure.

In respiratory physiology, engage the students with the idea that CO_2 is not merely a biochemical metabolic product. CO_2 is a major local arteriolar



Miss Take teaching Misconceptions

vasodilator and this serves to match the tissue perfusion with increasing metabolic demands. In addition, metabolic CO_2 also enhances the unloading of oxygen from hemoglobin in the Bohr's effect. Furthermore, CO_2 is the predominant chemical regulator of breathing. Add on to this multitasking, CO_2 in forming carbonic acid is a component of the major ECF buffer system in pH regulation.

4. My students blinkered learning emphasized to me to be integrative in teaching and not segmental.

The discipline-based syllabus deals with each physiology system in depth before a different system is covered. This can blinker our students in learning Physiology since inter-organ control mechanisms are abundant in homeostasis. For example, when the baroreceptor reflex is taught in CVS, sometimes we only include the baroreflex-activated sympathetic input to the kidneys only a few months later when we teach renal physiology. Our segmented teaching leads to our students' segmented learning.

Although the integrated syllabus helps to provide more of this cross-organ learning, the foundational depth is frequently not discussed and taught sufficiently for students to be able to apply essential physiological knowledge. Cardio-respiratory physiology that includes both the systemic/pulmonary circulations is another area that needs much more thought in our preparations to help students appreciate the big picture of adequate oxygen supply and carbon dioxide removal to and from the cells. The end purpose of combined alveolar ventilatory control and cardiac output/local tissue perfusion regulation is the cellular needs.

Homeostatic teaching

I end this brief sharing with a word I coined. Our students listen to us to learn. As teachers, we need to cultivate active listening to help us to better our teaching. I regularly make notes of students thinking pattern and misperceptions (from tutorials, marking exam scripts). To illustrate this homeostatic teaching, the annual Inter-Medical School Physiology Quiz (IMSPQ) which I chair clearly emphasizes this essential teacher-student feedback. The 15th IMSPQ was just completed recently with 100 medical schools from over 20 countries competing. This is a unique sample of international students taught through diverse curriculums, who come and are tested with the same set of challenging Physiology questions. Insights into common errors and misconceptions have been gleaned from analyzing the responses of the IMSPQ competitors. Some of these observations have been written up and published.

Why are some lecturers not more student focused and centered in their vocation as Physiology

teachers? Perhaps, one negative contributor, I believe not just an issue in Malaysia, is the relatively little weightage given to good effective teaching towards our Key performance index (skewed more to research papers) and promotion. Good teaching is also less quantifiable and is not a key criterion in the annual university ranking exercises (I sometimes get the impression of it being an academic fashion show)!

Whatever, or however, you teach your students, most of them will graduate eventually! Have we made some contribution to their learning, their life's philosophy (*love of wisdom*)?

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