TEACHING PHYSIOLOGY

KEYNOTE ADDRESS

LECTURES

SYMPOSIA

TPK 1

Understanding the changing learner : a critical success factor of higher education of the 21st century

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Exponential growth in information and technology together with rapid development and advancement in information technology make learners of higher education now different from those of the 20th century. They are multitaskers. They prefer learning from media with pictures, sound, and video than from conventional textbooks. Instead of learning in a linear, logical, and sequential pattern, they enjoy random access to content. Study and working in team make them better prepare for class and learn significantly more than independent and individual exercise. The learning environment should be designed to emphasize more on internal or intrinsic motivation than extrinsic one since internal motivation lead them to active engagement in learning, deeper understanding in content, and the desire to learn more. Moreover, they pay more attention to relevant, real world 21st century contexts than the classic theoretical simulation. Understanding the changing learners of this century is the crucial factor of the transformation from industrial model of pedagogy towards collaborative learning and collaborative knowledge production – the most likely successful model of higher education of the 21st century.

TPK 2

Learning from Productive Failure

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In my talk, I will advance a theoretically- and empirically-grounded case for designing for and learning from failure, and instantiate it in a learning design I call Productive Failure (PF). I will describe the key mechanisms and the design principles of PF, and report findings from an on-going program of research in the real ecologies of Singapore Math classrooms. I will end by deriving implications for learning and the design of instruction. No COI.

TPL 1

Teaching challenges in a modern university environment

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Personalised Medicine will become increasingly important in all areas that are susceptible to pharmacological treatments. Understanding and application of personalised medicine requires detailed molecular, cellular and systemic knowledge that is difficult to achieve in current undergraduate teaching curricula. Class sizes have increased significantly and only a fraction of students will end up in research professions for which their training has been designed for. As a result universities have pushed for flexible degrees, reduction of prerequisites and broader skills sets. The challenge is how to combine these without reducing qualification and skills. Due to the enormous body of knowledge that has been accumulated in biology/medicine it is no longer possible to teach a comprehensive understanding of the field. However, due to the attractiveness of advanced knowledge understanding of basic concepts are often underrepresented as they are considered old and unattractive. Basic knowledge and basic concepts are particularly suitable to online delivery, but it must be ensured that content is not getting lost as a result of single exposure of the material during a degree. Repeated learning is a central part of knowledge acquisition. Online material also needs to be attractive to avoid learning fatigue. A combination of online delivery of basic content blended with tutorial modules of advanced content and problem based approaches appears to become a new teaching standard across many universities. No COI.

TPL 2

Creating the Future: complementary approaches to transdisciplinary learning

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There are diversifying pressures on ensuring university science students are graduating with the capabilities and qualities that they require. The traditional attributes of subject knowledge, problem solving and team work skills, though essential, may well not be sufficient for our students to recognize their full potential. The broader workplace of the mid-21st century is looking for what some call "renaissance talent" in graduates. Many employers in the sciences are looking for students that have studied an arts subject as well as an ever-increasing emphasis on statistical analysis. There are also repeated calls, starting from primary school, for students to learn coding skills. At the same time we continue to observe declining lecture attendances and student engagement with their learning. We have long championed a more creative science curriculum, arguing that we should focus more on creating learning environments where students "learn to be scientific" rather that "learn about science" through identify-forming activities that aims in turn to increase engagement and learning outcomes. This involves designing learning environments in which students can use their command over subject content to draw the links between diverse disciplinary areas, react to new ideas and include elements of the unexpected in their work. In response to these challenges, we are investigating the use of creative coding strategies to provide both students and academic staff with platforms that can allow creative exploration and analysis of data sets and pathways. This talk will outline the new approaches and discuss progress to date. No COI.

TPS 1

Technology enabled strategies for student engagement in learning medical sciences

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One of the key challenges in medical science education is developing experimental design and data analysis skills. The wide availability of wearable activity tracking devices provides animmersive opportunity for students to be active participants in these processes through personal engagement and to take part in a real research project.

We have developed a practical class for second year medical students (a cohort size of 250) in which they design an experiment for self-quantification of physical activity. Students are required to consider aspects of experimental design such as sample size, dependent and independent variables and hypothesis generation. Students were provided with a Fitbit zip wireless activity tracker at the beginning of semester and asked to wear the device for 6-8 weeks, except when asleep. Activity data was collected via the Fitbit website and analysis of daily activity levels and the time students wore the devices each day was performed.This practical not only engaged students in collection of personally relevant data around which they learnt elementary data presentation and statistical analysis but also helpedto contextualise understanding of experimental design. This practical also provides an opportunity to enhance awareness of health and wellbeing of individuals and communities. Such projects highlight the potential for future opportunities to use personal activity monitoring for cloud-based global collaboration between large cohorts of students.

TPS 1

Engaging Students to Face the (Physiology) Book

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Teaching Physiology is an evolving art. If ‘the consumer is often right’, then our task as educators should be aimed at better transmission of Physiological information so that the students will ‘buy’ them. The hard copy texts are seldom carried under the arms of students with the availability of electronic versions. Nevertheless, a crowded medical curriculum easily discourages the less diligent student to read and think through chapters in Physiology books. An over-dependence on power point (Ppt) notes to pass assessments is a major factor in shallow, unintegrated understanding of Physiology. Students need to 'think outside the Ppt Box'. We teach to engage and provoke our students to discover more. Posing unanswered Physiology questions during a lecture is one way to stimulate the indifferent audience in class. The use of Facebook Physiology interactive page for each medical class in Universiti Malaya has also help to enhance learning in Physiology. The decreasing number of small tutorials to discuss Physiology in integrated curriculum appears to have a negative impact on the depth of Physiology knowledge among students. Intra-Physiology integration between organ systems in our teaching might be the more useful theme to emphasize to help students conceptualize homeostatically and apply Physiology to the clinical situations.

TPS 1

Integration of Physical Examination with Student Practicum through case-based learning in a vertically integrated module "Cardiovascular System"

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Self-directed learning is an important skill for lifelong learning. Although PBL is considered as a suitable pedagogy for cultivating self-directed learning skills, it is a highly touted Western instructional model but has not had the same success in East Asian institutions. Recent education research regarding Cognitive Load Theory has shown that PBL's effectiveness as an instructional instrument requires participants possess certain skill sets to optimally interact with domain specific knowledge that our medical students, coming straight out high school, simply have not acquired. To address this, a modified Case Based Learning program (CBL+) was developed to provide instructional scaffolding to provide the necessary skill base for the students to effectively participate in the 3rd year cardiovascular system within the NCKU medical school. To integrate all clinical teachings with the case used in the block, case-specific content was integrated with that related to Physiology Practicum. Various class activities related to physical examination were implemented to enhance the skills related to self-directed learning including identifying questions, looking for resources, developing critical thinking skills, and constructing knowledge. Workbooks were used as portfolio to analyze how the questions are formed. Concept map was used to analyze the development of their thinking process. As our data suggested, integration of case-based learning and critical thinking intostudent practicum helps students identify their problems and search for the answers through a structured thinking process. The process lowers students' anxiety in the first experience of self-directed learning.

TPS 1

Learning physiology: Integration, student engagement and collaboration

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At the YLLSOM, physiology is one of the key basic science topic taught in medicine year one along with anatomy and biochemistry. These topics are anchored by their respective departments, Physiology, Anatomy and Biochemistry. These topics were traditionally taught in a discipline-specific fashion until a major change to integrate horizontally the topics into systems biology, cell biology and human structure and function. This provided the framework to incorporate21st century skills such as self-directed learning, life-long learning, collaborative and team learning, communication and professionalism early into the year one curriculum. Initially, the learning of Physiology became more integrated with that of anatomy and biochemistry at the organ system level. However, the increasing sub-specialisation of the basic sciences and teachers made it increasingly a challenge to keep the perspective of the whole in Physiology. This provided a major impetus to further integrate and embed Physiology into the curriculum and engage an increasingly IT savvy and hands-on generation of students incorporating flipped class room , cross discipline case-based learning, simulation learning and collaborative learning approaches. In addition, the challenge also falls on the teachers and faculty who need to respond appropriately to the needs of the curriculum and students by way of faculty development, cross disciplinary approaches to teaching and developing better ways to foster student learning in a relevant and contextual fashion. It is hoped that this will keep the teaching of Physiologyin step with best practices and feedback driven quality improvement in the school.

TPS 2

Engaging Medical Students in Basic Principles of Cell Physiology Using "Hands-on" Practical Class Activities

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Active learning of basic principles of cell physiology in large Medical Schools such as UNSW Australia faces challenges arising from large student numbers, and the delicate experimental procedures and expensive equipment that can be needed to measure single cell properties. Valuing strongly the learning gained by experimentation in Physiology, we have developed a number of practical classes to illustrate basic cell physiology principles. In one of these, a cellular fluid homeostasis practical, we measure the haematocrit of human red blood cells to which we separately add the Na^+ ionophore, monensin (10–20 μM, 0.1–0.2% DMSO), the potassium ionophore, valinomycin (10–20 mM, 0.1–0.2% DMSO), and a DMSO vehicle control. Students fill glass haematocrit tubes with each of the three samples, and then centrifuge the samples to separate the whole blood sample into plasma and red blood cells. The proportion of red blood cells (the haematocrit) is measured using a haematocrit reader (or accurate ruler). Addition of monensin increases the haematocrit by 4–7%, due to Na^+ influx leading to H_2O influx and cell swelling. Typical haematocrit values in the valinomycin samples are 2–5% lower than control, due to cell shrinkage secondary to K^+ efflux. Although each batch of blood is slightly variable, the small drug-induced changes are consistently observed. This novel and simple experiment effectively demonstrates that fluid (H_2O) moves across cell membranes due to osmotic forces induced by ionic fluxes. Students enjoy the experiential activities, get to appreciate variability and the importance of accurate experimental observations, and are further engaged by understanding that antibiotics such as valinomycin act by altering the ion selectivity of the membrane. No COI.

TPS 2

Physiology teaching, asian pacific perspective and new models

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Physiology teaching in the medical schools and other health science consists of giving lectures and experiments to the students and in the traditional curriculum the students get these after the anatomy and histology courses in the first year. This traditional way is a discipline based system and long hours of physiology lectures are given After the era of the reform of medical education which PBL (Problem Based Learning) was introduced, physiology lectures is given in blocks and is an organ based system and integrated horizontal and vertical in the organ blocks. Many medical schools in the Asian Pacific region adopted the PBL system with many models of the hybrid PBL (I, II, III, IV) Examples of these new models will be discussed and examples will be given. No COI.

TPS 2

Unique Role of Physiology in an Integrated Curriculum

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The need for greater integration of subjects in the medical curriculum and even in life sciences is featured consistently in pedagogical literature. Approaching curriculum goals by employing curriculum design and teaching and learning strategies in an integrated manner is meant to achieve the goals more efficiently. Although, the discussion about integration often lead to polarization amongst teachers that argue for it emphatically and those that still insist for dominance of discipline-based teaching while some approach with intermediate steps between the two extremes. The question to be asked to teachers and curriculum planners is not whether they are for or against integration but rather where on the continuum between the two extremes should they place their teaching. Leaving teaching and learning strategies aside the most important fact is the place that discipline of physiology enjoys in an integrated physiology curriculum. Not only in curriculum for undergraduate program in medicine but also basic science curriculum at most life science institutions consist of courses (e.g. general anatomy, physiology, biochemistry, pharmacology etc) learning can be made more contextual and enjoyable by employing an integrated approach rather taught as stand-alone content domains. This review highlights that how truly and deeply place of discipline of physiology is recognized in an integrated curriculum. No COI.

TPS 2

Current trends in Physiology education in Japan - Physiology educator accreditation and government-supported MD-PhD course

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Physiological Society of Japan (PSJ) has provided opportunities to exchange skill, findings and knowledge in research. However, a systematic education program was not held until 2012. Education Committee of PSJ has started education program since 2013 to provide opportunities to learn teaching skills and to obtain up-to-date knowledge in Physiology. PSJ members who attend this course with teaching experiences of Physiology and/or publication of original article in Physiology can earn points for accreditation. After evaluation, PSJ gives accreditation to those who fulfill the criteria. After the start of the program, the number of PSJ members has increased. Thus, the education program has attracted many Physiologists and may have potential to improve Physiology teaching quality. Another serious problem is a decline in young Physiologist, particularly medical school graduates. This may be because 2 years' internship has become obligatory, and because the time to study basic medicine has decreased under clinical-oriented curriculum. Through collaboration with Japan Society for Medical Education, Medical Societies in basic medicine including PSJ have proposed to government to support research-oriented medical students. The grant was approved and10 schools were selected. In such schools, the education curriculum has been modified so that students can also take PhD curriculum as a MD-PhD student. They can keep their PhD student position during internship. After obtaining PhD, their faculty position is guaranteed. Interestingly, many universities that could not obtain this grant had also started similar programs. Thus, this program may contribute to increase the number of MD basic researchers. No COI.

Teaching Physiology **SYMPOSIUM 3:**
Promoting inquiry in undergraduate biomedical science classes

TPS 3

Progressive development of scientific literacy through assessment in inquiry-based biomedical science curricula

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A key outcome of science education is the development of graduates' scientific literacy, defined as "an individual's scientific knowledge, and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions…" (OECD 2010, pg 137). To progressively develop such advanced skills within a broad major like biomedical science, it is essential to guide students along critical learning pathways. We have designed a series of inquiry-based classes to scaffold the development of these skills and vertically-integrated these across the curriculum (Zimbardi et al. 2013). To facilitate skills development within these classes, students undertake increasingly complex assessment tasks as they progress through each course, requiring them to draw on their developing content knowledge to propose and undertake experiments, and to make conclusions based on their findings and evidence from scientific literature. Longitudinal analysis of a variety of assessment tasks from students across four semesters demonstrates the developmental trajectory of these skills. Specifically, they demonstrate increases in their ability to formulate testable hypotheses with measurable outcomes, their appreciation of cutting-edge methodologies and deeper understanding of the contestable nature of increasingly complex areas of scientific knowledge. This presentation reports on the design and use of these assessment tasks within the series of inquiry-based curricula, and their impact on the progression of student learning. No COI.

TPS 3

A strategy for student engagement in peer student presentations- assessing critical thinking skills

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In 3nd year Physiology at the University of Adelaide, students work in small groups (n=2 to 4) in a research laboratory throughout the year, and present their results as a group (10 minutes talk, 5 minutes of questions) to an audience consisting of their peers. A large problem has been a lack of engagement of the student audience with the process. Following the dictum that "assessment drives learning", we therefore changed the format so that all students had to formulate questions to ask of the presenting group, and they were assessed on those questions. Each group presenting prepared a poster to illustrate their talk which was made available online a week before the presentations. Students (as groups) were assigned 3 of those posters to read and prepare questions. On the day of the presentations, they were assigned to ask questions to one of those 3. The marking rubric incorporated a section on "group asking questions": criteria for marking the questions asked, as well as "group presenting": the criteria for assessing the presentation poster. The presentation sessions are now much more interactive- the assessors now mostly only observe and assess, rather than having to initiate questions. Anecdotally, the students are engaging more in the critical appraisal of the work of their peers. In future to improve students' critical skills, we intend to give prior guidance on how to formulate questions- open ended vs closed questions, questions which show some insight vs "generic" questions. No COI.

TPS 3

Enhancing student engagement and critical thinking in learning physiological concepts: A guided inquiry approach

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Lectures develop students' physiology knowledge but not their communication, teamwork or critical thinking skills. The challenge is to modify lectures to develop these skills and to encourage student engagement and active learning. Using the theories of constructivism and peer learning we developed a guided inquiry (GI) approach to lectures. During GI lectures, relevant background is first presented by the lecturer, a GI worksheet in which students work in groups to interpret graphs, answer questions and solve problems follows. An interactive discussion about the GI concepts concludes the lecture. Our study consisted of two phases. In phase one, GI was trialled with radiography students (N=56). A survey was administered at the end of the lecture series (blood and respiration). Students indicated that the GI helped them to better understand the physiology concepts (100%) and that the discussion with their peers was an important part of their learning (86%) In the second phase of the study, GI was used in lectures to science students (N= 159) and diagnostic quizzes (pre and post-test) were used to evaluate student learning. The results showed a significant improvement in student performance between the pre and post-tests ($P < 0.05$). In a survey of student perceptions, students found that the GI lectures encouraged them to take notes during the lecture (55 responses, 82%) and to attend the lectures (75%). In conclusion, we found that a GI approach can be used to motivate active student learning, enhance student understanding of core physiology concepts and develop critical thinking skills. No COI.

TPS 4

Learning Physiology: The Students' Voice

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With an ongoing transformation of healthcare professional education, e.g. from a discipline-based to a competency-based curriculum, an explosion of knowledge and characteristics of the 21st century learner, teaching physiology has been transformed in many institutions in order to effectively facilitate students' learning. Various active learning formats such as an interactive lecture, a flipped classroom, a simulation-based learning, or an edutainment have been introduced to help students learn challenging physiological concepts. Regarding students' learning, well-written examination questions can evaluate learning as well as how effective and successful the learning activity was. Nevertheless, good physiology classes cultivate more than information and knowledge, including students' enthusiasm for physiology. In this session, students from various institutions across FAOPS member countries will be invited to share experiences, thoughts and impressions regarding their perceptions on physiology education including physiological knowledge, skills, and attitude toward teaching and learning physiology in the 21st century. No COI.