FAO/BMB Education Symposium
(IUBMB Sponsored) in conjuction with
26th FAO/BMB-ConBio2017 Conference
held at Kobe Portopia Hotel, Japan

Date/time: 6th December 2017, 9 am to 11:30 am
Theme: Biochemical Education – the 21st Century Approach
Venue: Diamond Room, Kobe Portopia Hotel, Japan
Session chairs: Siok Im Koh and Mayumi Nakanishi-Matsui

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Abstracts of the speakers

1. Team based learning and basic skills analysis in biochemical education

Professor Keiichiro Suzuki, Noriko Fujiwara, Hironobu Eguchi, Daisaku Yoshihara.
Department of Biochemistry, Hyogo College of Medicine.
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In Japan, students are admitted to medical schools immediately after graduating from high school. They are almost 18-20 years old and are referred to as digital natives. Because they are too premature to receive a classical higher education, we should give thought to education-related techniques and the curriculum that is used to teach these
students biochemistry in medical school. In addition, we should be interested in stimulating and supporting the development of a research spirit in these undergraduate students. Here we summarize our current information regarding team based learning (TBL), basic skills analysis and the MD researcher course.

We arrange the curriculum in a stepwise manner. Regarding first year students: Team based learning (TBL) is a well-defined active strategy for learning in which pre-class self-learning is combined with highly interactive small group interactions in the classroom. In the lecture course, students are provided with information related to biochemistry and metabolism after food intake and metabolism in fasting by themselves. They also have access to various educational resources that are available on the Web. They then are divided into small groups (about 6 students per group) where they discuss aspects of diet, such as carbohydrate-restricted diets. Each group has an iPad and bidirectional education is carried out using the internet (“Moodle”). After small group discussions, they give an appraisal of their performance each (peer review) also via Moodle. Finally they take a comprehensive examination.

Regarding second year students: After practical training in biochemistry, the students take an examination on basic laboratory skills, which involves as assay for lactate dehydrogenase activity. Numerous aspects of their performance are evaluated including the use of a pipette, a spectrophotometer, calculating enzyme activity, and so on.

Regarding third and fourth year students: Students who enroll in the MD researcher course are not required to complete most of the clinical medicine curriculum (3rd and 4th school year). Instead, they are exposed to laboratory research during the daytime. They have the opportunity to view recorded clinical medicine lectures on the Web.

We present data regarding these activities and the results of questionnaires given to the students.

2. **UPM’s Undergraduate Biochemistry Education: Gearing for the 21st Century**

Professor Marilou G. Nicolas, PhD

University of Philippines, Manila, College of Arts & Sciences

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When the undergraduate programme in Biochemistry was launched in 1996, the educational philosophy of student-centeredness in the Philippines was relatively new. Teaching was lecture-based and the approach was taxonomic, i.e. structure and function and transformation, including metabolism of the biomolecules were discussed individually. At the turn of the century, educational philosophy has shifted more towards students taking charge of their own learning. In the Philippines, the basic education curriculum has also changed from 10 years to 12 years with senior high schools already deciding on career paths. In addition, ASEAN integration is also putting pressure on higher education to produce graduates that are equipped with excellent knowledge and skills so that they can compete with peers in the region and in the world. Although the programme, over a span of 20 years, has produced more than 500 graduates pursuing various career tracks, these new challenges necessitated a review and revision of existing curriculum, learning outcomes and teaching strategies, including assessments for the undergraduate biochemistry programme.

After an analysis of the teaching strategies employed over the span of 20 years, we have identified key concepts that students find difficult to understand. This talk will therefore discuss these new teaching approaches that will focus on key or threshold concepts in the lectures (1, 2) and enquiry-based learning in the laboratories (3).

References:

Vision and role of the International Union of Biochemists and Molecular Biologists in Biochemistry and Molecular Biology in the 21st Century

Professor Janet Macaulay
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Email: janet.macaulay@monash.edu

The International Union of Biochemistry and Molecular Biology (IUBMB) has committed to supporting the improvement of education in biochemistry and molecular biology at all levels. A major effort of IUBMB, in collaboration with Federation of European Biochemical Societies (FEBS) and the Weizmann Institute of Science (Israel) is the organisation of The New Horizons in Biochemistry and Molecular Biology Education conference. The conference is designed to bring the international community of biochemistry and molecular biology educators together to discuss current practices in the way we teach and what we teach. I will discuss the outcomes of the conference - a series of recommendations to be shared with the educational community and the establishment of international collaborations and engage participants in a discussion of the needs of the FAOBMB region.

Reference

Engagement of students with lectures in biochemistry and pharmacology
Davis EA, Hodgson Y, Macaulay JO.

4. The development of innovative and engaging digital simulations for the laboratory based teaching of Biochemistry
Professor Maurizio Costabile
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Biochemistry is a subject that is well known to be challenging for undergraduate students. In particular, students find the learning of laboratory-based principles of Biochemistry especially challenging. While there are limitations associated with practical based teaching, it is imperative that teachers explore ways to overcome any impediments to learning. In response to these challenges, the author developed an interactive simulation for the teaching of enzyme kinetics. Such technology allows for
the provision of blended learning modalities. The simulation facilitated student engagement, from filling test tubes in a virtual lab, entering experimental data, to calculating results. There is a stepwise explanation of raw data collection, its manipulation, presentation and interpretation. To conclude the simulation, a multiple-choice review is undertaken by the students to test their knowledge and understanding. The simulation provides the student with question specific feedback and the opportunity to review the simulation multiple times prior to entering the real wet lab laboratory setting. Online learning in this manner provides a flexible and personalised learning experience that is also both scalable and sustainable allowing for the provision of a flexible individualised learning experience.

The impact of the simulation on student performance in the formal practical report was compared to prior cohorts where no simulation was available. There was a significant increase in mean student practical report scores following the implementation of the simulation. In addition, **ALL** students now achieved a minimum passing grade, when previously some students had failed the assessment. Data collected between 2014-2016, shows similar improvements; suggesting any variation in student performance is likely due to the impact of this new educational approach rather than the cohort. Since its introduction, there has been significantly **fewer** students in the lower quartile compared to previous cohorts. The simulation specifically helped **weaker** performing students who previously may have failed the written practical report due to their lack of understanding of central concepts. Additionally, the benefits after implementation indicate a **consistency** and **reproducibility** with each subsequent year. Consistently, student feedback is emphatically positive with the request for additional simulations in other practicals, and even other courses. Based on the data and student feedback, **ALL** Biochemistry practicals are now taught with an accompanying simulation to facilitate student learning. This presentation will also discuss the professional development and support required for the development of such simulations to engage students in Biochemistry education.

In this workshop session, attendees will have the opportunity to discuss current issues in laboratory-based teaching. There will also be an opportunity for attendees to interact with the simulation that will be available prior to attendance of the workshop. The workshop will also discuss the professional development and support required for the development of such simulations to engage students in Biochemistry education.
5. **Practical advice on developing and implementing inquiry-based laboratories**

Professor Masha Smallhorn  
Flinders University, Adelaide, Australia  
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Inquiry has been described as a teaching method which combines student-centred, hands-on activities with discovery. The educator acts as a facilitator of the learning activity, promoting student discussion and providing guidance rather than directing the activity (Herron, 2009; Wood, 2009). Based on the principles of the scientific method, in inquiry-based learning students observe a phenomenon, synthesise research questions, test these questions in a repeatable manner and finally analyse and communicate their findings. The learning is directed by students with the educator providing a supportive role. The level of input from the educator depends on the level of inquiry. In open-inquiry students independently formulate a question to research while in guided-inquiry the educator provides guidance with the construction of a question (Weaver, Russell, & Wink, 2008).

The laboratory is a critical part of an undergraduate science degree. In this learning space, students apply knowledge gained through the lecture series by participating in laboratory activities designed to test concepts. Traditionally the activities require the application of prescribed step-by-step protocols which often result in a predicted outcome. The nature of this traditional laboratory experience limits the opportunity for students to develop critical thinking and analysis skills both fundamental to research science. Inquiry-based laboratories have been shown to result in a deeper understanding of scientific content and improve students’ attitudes towards science (Brownell, Kloser, Fukami, & Shavelson, 2012; Myers & Burgess, 2003)

**Questions for discussion with workshop participants.**

1. How do we develop a curriculum which fosters a passion for inquiry in the 21st century learner?
2. What are the challenges in moving to inquiry-based learning? How can these be overcome?
3. What support do educators need to be able to implement change in teaching practice?
4. What is the role of the laboratory in 21st century science learning? Should first year science topics be offered without a laboratory component?
5. What is the minimum laboratory time required to achieve the best academic outcomes for students?

Innovative approach

To improve the engagement and learning outcomes of the large first year Molecular Basis of Life student cohort at Flinders University, the laboratories were redeveloped into guided-inquiry. The guided-inquiry laboratories were run weekly in large classes of a 100 students to increase student contact and facilitate teaching efficiency. Teams of students were guided by an educator to design and carry out an experiment. The impact of the move to inquiry-based learning on student satisfaction and learning outcomes was evaluated by surveying students and comparing exam data before and after the redevelopment. An analysis of the survey data following the redevelopment indicated high levels of student satisfaction. Students thought the laboratories improved the quality of their university experience, helped them to understand the major concepts of the topics, challenged them intellectually and helped to develop data analysis skills. Overall, there was a significant improvement in student answers to exam questions following the redevelopment. There was also a significant improvement in exam questions identified as content-related before the redevelopment and laboratory-related after the redevelopment. These findings suggest that inquiry-based learning can improve both the University experience and learning outcomes for a large student cohort (Smallhorn, Young, Hunter, & Burke da Silva, 2015).

Participants at the workshop will learn how to implement inquiry-based learning within their own topics through an interactive workshop experience. We will explore the key elements of inquiry-based learning and discuss how existing traditional laboratories can be developed into inquiry-based laboratories following some modifications. Practical advice will be given on overcoming the challenges associated with inquiry-based laboratories. Strategies for fostering success in the 21st century student cohort will also be explored.
References and further reading


Myers, M., & Burgess, A. (2003). Inquiry-based laboratory course improves students' ability to design experiments and interpret data. Advances in physiology education, 27(1), 26-33. doi:http://advan.physiology.org/content/27/1/26

