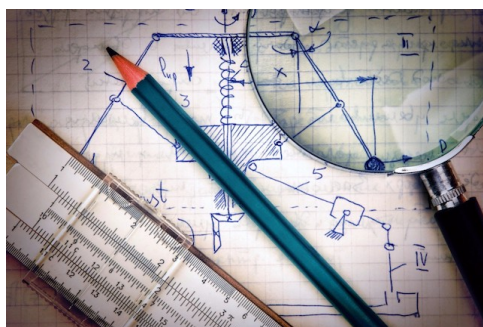


# Problem-Based Learning in Mathematics

**FYi**  
**Maths**



Thursday 9 February, 2017

University of Technology Sydney

*Sponsored by the Australian Council of Deans of Science*

 **Australian Council  
of Deans of Science**

## Venue

Grid Room, Level 5, Building 4 (CB04.05.430)  
University of Technology Sydney  
745 Harris Street  
Sydney



## Wifi information

If possible please use Eduroam. There will be a limited number of individual guest wifi accounts available.

## Organizing Committee

A/Prof Deborah King (University of Melbourne)  
Dr Anita Ponsaing (University of Melbourne)  
Prof John Rice (Australian Council of Deans of Science)

## Program

9:00	<i>Registration</i>
9:30	<i>Introduction &amp; Acknowledgement of Country</i>
9:45	Opening ( <b>Brian Yates</b> , President, ACDS)
10:00	<b>Jean-Roch Nader &amp; Christopher Chin</b> , AMC
11:00	<i>Morning Tea</i>
11:30	PBL Workshop ( <b>Les Kirkup</b> , UTS)
1:00	<i>Lunch</i>
2:00	<b>Adelle Howse</b>
3:00	<i>Afternoon Tea</i>
3:15	<b>Dann Mallet</b> , QUT
3:35	<b>Di Warren</b> , USyd
3:55	<i>Questions</i>
4:00	<b>Stephen Woodcock</b> , UTS
4:20	<b>Tristram Alexander</b> , UNSW Canberra
4:40	<i>Questions</i>
4:45	Discussion
5:15	<i>Close</i>

## PBL Workshop

*Fermi problems stimulate knowledge integration*

Fermi problems offer the potential to develop students' capacities to think independently and creatively, work collectively and collaboratively, apply what they know already and connect and utilize this knowledge in a broad range of contexts. So, what is a Fermi problem, and how can it do this? In this workshop participants will actively explore Fermi problems and examine their value to the undergraduate curriculum.

### Adj Prof Les Kirkup (UTS)

Les held academic positions in England and Scotland before joining UTS in 1990. He has published widely in peer-reviewed discipline and education-focused journals throughout his career and has written several textbooks. Many of Les' teaching and educational development activities have focused on enhancing the student experience in laboratories. His contributions to teaching and learning were recognised nationally in 2007 with the award of a Carrick Associate Fellowship and again in 2011 with the award of an ALTC National Teaching Fellowship. In 2014 he was awarded the Australian Institute of Physics Education medal for his national contributions to physics education.



# Keynote Talk

## *Industry perspectives on mathematical sciences graduates*

In this talk I will give some perspectives on what attributes the corporate sector finds attractive in mathematical sciences graduates. This will be based on my own direct experience as a graduate with mathematics degrees working in both electricity, construction and mining industries as well as additional insights gathered from participating in the AMSI initiated industry and Mathematical Sciences engagement taskforce. I hope this will provide some interesting thoughts for how educators and the corporate sector can collaborate to benefit both innovation and productivity in the workforce and interesting employment for mathematical sciences graduates.

### **Adelle Howse**

BSc (Hons), PhD (Mathematics), MBA,  
AAICD, FFIN

[www.adellehowse.com](http://www.adellehowse.com)



Adelle is a well-credentialed executive leader with a track record in the delivery of strategic business transformation, operational performance improvement, structured M&A and corporate finance solutions.

Adelle currently is her own personal business entity for consulting and contract engagements. Strategic consulting and execution with corporations and businesses on market position, mergers, acquisitions and divestments, business transformation and operational performance improvement. Current and recent assignments include the AMSI Industry Mathematical Sciences Task Force: development of a plan to build industry and education sector mathematics engagement, awareness and capability, working with blue-chip companies including Woodside, Commonwealth Bank, BHP, Google, PayPal and IBM.

Adelle has performed in various roles at the CIMIC Group (previously Leighton Holdings) from 2003 and her most recent role was Chief Strategy Officer until May 2016. Prior to that Adelle has held positions at Tarong Energy, Energex, the Pelerman Group and Unilever Australasia.

## Invited Talk

**Dr Jean-Roch Nader & Dr Chris Chin** (Australian Maritime College)

### *Problem-Based Learning at AMC in First Year Engineering*

Several reviews have shown the inadequacy between traditional Engineering Curriculum based on the old “chalk and talk” pedagogy in universities and the technical and personal skills requirement in industry. Mills (2003) showed that the introduction of problem based learning within the curriculum as a mixed approach to be the best way to satisfy industry. This learning methods are focused on developing direct applied engineering components. They are student driven and aim at developing design, communication and team work skills as well as providing more awareness of the social, environmental, economic and legal issues of modern engineering practices. These methods are based upon group work with a number of phases which include problem identification, research, student initiative, observational skills and reflection. These approaches have seen many applications in Engineering curriculum. However, they are usually developed in mid-to-late courses where early years are designed to teach engineering fundamentals and concepts. This does pose a problem where first year students can find it difficult to relate the theoretical concepts to real world engineering problems. This has the effect to drop motivation and increase detachment.

To address these issues, a strong effort was made at NCMEH to develop a series of projects and activities applying knowledge to engineering problems in first year. These include three problem-based projects within four different units as well as outdoor activities and industry visits. Feedback from students showed that these activities have a very positive impact on student experience at AMC.

## Contributed Talks

**Prof Dann Mallet** (Queensland University of Technology)

*Problem-based learning: A whole-of-degree perspective in a Bachelor of Mathematics*

In this talk I will discuss recent work around incorporating problem-based learning across the three years of a Bachelor of Mathematics curriculum. Motivating factors, including academic standards and university strategic goals, for the use of problem-based approaches will be presented and examples of how these approaches were implemented in the classroom will be described. Challenges and obstacles faced both in the classroom and in the design phases will be discussed and potential means of addressing these will also be described.

**Dr Diana Warren** (University of Sydney)

*Choose your own adventure: Motivating students in large FY Stats Courses using PBL*

While a FY Stats Course has the potential to be extremely interesting and relevant, students often report the exact opposite, especially in large compulsory service courses. In order to motivate students, we introduced a collaborative, self-directed assessment, in which students present a report on data of their own choice. This seems to result in better engagement by both students and tutors. We'll discuss the challenges, constraints, and lessons, with some exemplars.

**Dr Stephen Woodcock** (University of Technology Sydney)

*Beyond Rote: Enquiry-Oriented Learning through Problem Based Workshops*

Arguably the largest challenge facing undergraduate students majoring in quantitative disciplines is the large gulf between high school mathematics and those skills eventually required in the workplace. The differences are not just in the level and depth of the disciplinary knowledge required but, more challengingly, in the types of learning and problem-solving methods employed. Much has been

written about the rise of high school “coaching” services and the prioritising of rote learning procedures, often at the expense of developing mathematical enquiry and deeper understanding.

Here, I discuss recent developments in the curriculum at the University of Technology Sydney (UTS) for undergraduates majoring in the Mathematical Sciences. In particular, I focus on the implementation of mathematical modelling workshops for students from their very first semester. These workshops typically open with a real-world industry-inspired problem whose solution cannot be obtained by any calculation which students will have seen before. Students are then encouraged to think about the context and make reasoned approximations and assumptions to estimate which ranges of solutions might be plausible. The workshop leader can then present similar, but simplified cases of a closely related system and explain which mathematical procedures are required and, more importantly, why. Finally, students are then able to obtain a solution to the initial problem and reflect on why/whether their initial intuition was reasonable or accurate.

This structure is designed to build the confidence of students to attempt problems whose type they have perhaps not seen before, a skill often underdeveloped by heavily “coached” students.

**Dr Tristram Alexander** (University of New South Wales Canberra)

*Findings from four iterations of a first year problem solving course*

At UNSW Canberra we have been running a problem solving course for first year Engineering students for the last four years. Over the lifetime of this course we have made a number of changes, developing from a course built upon the McMaster Problem Solving program, with its explicit focus on skill development, through to a greater focus on the heuristic approach to problem solving, famously introduced in George Polya’s classic work. In this talk I will give a brief overview of some of the things we have tried, and discuss what worked and what didn’t. I will also identify some of the things we have learnt more generally about student problem solving approach, and the implications of student learning for the teacher. As we serviced Engineering students the course also had a specific programming component, and this brought its own challenges which I will briefly discuss.



## Participants

Tristram Alexander	University of New South Wales Canberra, ACT
Lyn Armstrong	Western Sydney University, NSW
Sy Chan	Concerige, NSW
Christopher Chin	Australian Maritime College, TAS
Emily Cook	Swinburne University of Technology, VIC
Wilhelmina Du Toit	UTS Insearch, NSW
Antony Edwards	Swinburne University of Technology, VIC
Rosei Espedido	UTS Insearch, NSW
Nikki Fozzard	Griffith University, QLD
Garo Gabrielian	Gmoney, NSW
David Gruenewald	University of Sydney, NSW
Dilshara Hill	Macquarie University, NSW
Adelle Howse	Strategy and Transformation Executive, NSW
Trish Jelbart	Victoria University, VIC
Carolyn Kennett	Macquarie University, NSW
Nazim Khan	University of Western Australia, WA
Les Kirkup	University of Technology Sydney, NSW
Amor Lynn Macalalad	University of Sydney, NSW
Dann Mallet	Queensland University of Technology, QLD
Margaret Marshman	University of the Sunshine Coast, QLD
Jean-Roch Nader	Australian Maritime College, TAS
John Nicholls	Western Sydney University, NSW
Dietmar Oelz	University of Queensland, QLD
Leon Poladian	University of Sydney, NSW
Anita Ponsaing	University of Melbourne, VIC
John Rice	Australian Council of Deans of Science
Malcolm Roberts	University of Newcastle, NSW
Jelena Schmalz	University of New England, NSW
Don Shearman	Western Sydney University, NSW
Elena Sinchenko	Swinburne University of Technology, VIC
Maree Skillen	UTS Insearch, NSW
Frank Valckenborgh	Macquarie University, NSW
Tim Walker	1Scope, NSW
Diana Warren	University of Sydney, NSW
Stephen Weissenhofer	Western Sydney University, NSW
Stephen Woodcock	University of Technology Sydney, NSW
Brian Yates	President, Australian Council of Deans of Science
Shona Yu	Western Sydney University, NSW