

STEM Education Futures Research Centre Newsletter Issue 1, July 2018

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Director's Message

Welcome to the inaugural newsletter of the STEM Education Futures Research Centre! The Centre was formed in 2017 and reflects a research strength within the Faculty of Arts and Social Sciences at the University of Technology Sydney. The members of the Centre are shown in the side box on the right. Associated with the Centre are also 16 higher degree students undertaking PhD research across STEM-related topics.

The formation of the STEM Education Futures Research Centre comes at a critical time where globally, there is increasing interest in STEM education and its research to address a number of issues relating to STEM education and career uptake. Our broad research question is *How can we best enhance STEM capacity and capability in Australia?* Our research embraces new and emerging technologies in STEM education, learning analytics to help teachers and students achieve better learning outcomes, mobile learning and STEM pedagogy, teacher education and professional learning, and the use of futures-oriented methodologies such as the Best-Worst Scaling and Discrete Choice Experiment. Aligned with the UTS inclusive model of social justice and diversity, our research also focuses on STEM education equity in gender, Indigenous education and students from disadvantaged background. Technology in many ways, such as personalising learning, is able to address issues of inclusiveness and diversity.

I would like to invite stakeholders with an interest in STEM education to reach out to us to discuss and form partnerships in researching the many challenges in STEM education. For more information on our Centre members and the externally funded projects that we are engaged in, please visit the STEM Education Futures Research Centre website at <https://www.uts.edu.au/research-and-teaching/our-research/stem-education-futures-research-centre/about-centre/about-stem>

A/Professor Wan Ng

Contact us: STEMEDFutures@uts.edu.au

Follow us: Twitter - https://twitter.com/STEMed_fUTureS

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STEM Education Futures Research Centre Members

A/Professor Wan Ng (Director, School of Education)
Professor Sandy Schuck (Co-director, School of Education)
Professor Peter Aubusson (Founding Director, School of Education)
Professor Lori Lockyer (Dean, Graduate Research School)
Professor Theo Van Leeuwen (Faculty of Arts & Social Sciences)
Professor Didar Zowghi (Faculty of Engineering & IT)
A/Professor Matthew Kearney (School of Education)
A/Professor John Buchanan (School of Education)
A/Professor Anne Prescott (School of Education)
Dr Mary Coupland (Faculty of Science)
Dr Keiko Yasukawa (School of Education)
Dr Damian Maher (School of Education)
Dr Jane Hunter (School of Education)
Dr Kimberley Pressick-Kilborn (School of Education)
Dr Kirsty Young (School of Education)
Dr Simon Knight (Faculty of Transdisciplinary Innovation)

Early Career Researchers/ & Associates

Dr Meera Varadharajan (Centre Manager, School of Education)
Dr Tracey-Ann Palmer (School of Education)

The STEM Education Futures Research Centre was formally launched on 23 February 2018. It was preceded by a symposium where 102 people registered and attended - these included academics/researchers from different Faculties and Units across UTS, industry partners from STEM related organisations such as the NSW Department of Education, CSIRO, Australian Academy of Science, Office of the Chief Scientist, Association of Independent Schools, EdQuire-FIC Educational Technology company, Australian Association of Mathematics Teachers, government and independent school teachers and students as well as researchers from QUT, Curtin University, Hull University UK and Eindhoven University of Technology Netherlands. The Dean of the Faculty of Arts & Social Science (FASS), Professor Mary Spongberg welcomed the guests and opened the symposium while Professor Alan McKee (FASS Associate Dean Research) and Professor Charles Rice (DVC Research) formally launched the Centre. Professor Kevin Burden (University of Hull, UK) and A/Professor Ruurd Taconis (Eindhoven University of Technology) were the two keynote speakers speaking on the topics of *Mobilising STEM Learning: Citizen Science or Citizen Inquiry?* and *STEM Teacher Education in Open Realistic STEM Projects* respectively.



Members of the debating teams

Many ideas were exchanged and concerns raised pertaining to STEM education at the symposium in the form of a debate on the topic of *STEM Education is More Than the Sum of its Parts* and a panel discussion on *What are the Compelling Questions for STEM Education in the Future?*. The debating team members were: Professor Joanne Mulligan (Macquarie University, NSW); Professor David Treagust (Curtin University, WA); A/Professor Ruurd Taconis (Eindhoven University of Technology, Netherlands); Christine del Gallo (NSW Secondary Principals Council executive member); Heidi Hammond (Head Teacher Science, Easthills Girls Technology High School) and Phillipa Millar (Education Consultant Curriculum K-12/STEM, AISNSW). The panel discussion brought together researchers and practitioners in STEM education to tease out some of the compelling questions facing STEM education. The panel presenters were: Professor Kevin Burden (Hull University, UK); Krisztian Baranyai (Office of Chief Scientist); Shelley Peers (Australian Academy of Science); Matthew McClosky (Past Independent School Principal; K-12 STEM specialist); Professor Les Kirkup (Science Faculty, UTS); Dr Michael Celjnar (FIC Technology Pty Ltd) and A/Professor Donna King (STEM researcher QUT).

The debates and presentations provided Centre members with a good understanding of how different stakeholders view STEM Education and the challenges they perceive. Some of the key issues raised are shown in the right panel on page 3 of this newsletter and broadly relate to the nature of STEM and how do we measure STEM outcomes, how best practice look like at school and tertiary levels, and the nature and role of teachers. The discussions and questions raised indicate the complexity involved in addressing some of the challenges and the need for a comprehensive and coherent approach involving the working



Keynote speakers Prof Kevin Burden and A/Prof Ruurd Taconis with some Centre members

together of key players. These challenges sit under our Centre's broad mission and research question on *How can we best enhance STEM capacity and capability in Australia?*

Read more at <https://www.uts.edu.au/research-and-teaching/our-research/stem-education-futures-research-centre/news/future-stem>

CENTRE LAUNCH



Participants at the Centre Symposium



L to R: Prof Charles Rice (DVS Research), Prof Alan McKee (FASS A/Dean Research), Prof Sandy Schuck (Centre co-director) & A/Prof Wan Ng (Centre Director)



Primary students show-casing STEM learning



STEM Education Futures Research Centre temperature sensitive mugs



A Snapshot of Members' Research: Learning Analytics

During 2017 a research project was undertaken exploring the use of the 360 degree camera in conjunction with an analytics platform. The project was undertaken with five universities including the University of Technology Sydney, Curtin University Queensland, Queensland University of Technology, RMIT University and the University of South Australia and was funded by a teaching and learning grant. Dr **Damian Maher and Dr Tracey-Ann Palmer** worked on this project. Based on that project a further project is now being undertaken in 2018 by Damian with a Sydney primary school's two senior classes. The focus of the project is to investigate how the camera can support student learning and how, through the use of the analytics platform, teacher assessment can be supported.

Dr Simon Knight is currently working with colleagues in the Connected Intelligence Centre on the ATN supported HETA (Higher Education Text Analytics) project. With Antonette Shibani and Sophie Abel (both PhD candidates) he is developing writing analytics approaches to support undergraduate and HDR academic writing. This work involves designing formative writing assessment tasks, understanding writing data, and supporting students to understand their own data and how to action feedback on their writing. This strand of work fits into Simon's broader interest in how students and educators use and evaluate data to support learning.

In the \$1.64 million multi-institutional *Smart Science Initiative* project funded by the Australian Government's Australian Science and Maths Partnership Program, **A/Professor Wan Ng** (lead research investigator), worked with scientists from UNSW (lead institution), UWA and Flinders University and IT experts/software developers of the award-winning Smart Sparrow educational technology company to research the design and development of intelligent courseware. Four inquiry-based learning STEM modules for Year 9 and 10 Student were developed on Smart Sparrow's adaptive platform that is able to personalise learning. Working with A/Professor Guandong Xu from the Advanced Analytics Institutes, the data captured for one of the modules was analysed to study the behaviour of students when interacting with online content. A paper titled 'Knowledge or gaming?: Cognitive modelling based on multiple-attempt response' is published in the *Proceedings of the 26th International Conference on World Wide Web*. In addition, Wan is examining the analytics of pre-service science teachers to understand the pathways they undertake to solve problems in the *Smart Science* online inquiry-based learning environments. A paper has been submitted for review based on this study.

Acting Co-Director

Professor Sandy Schuck is on Development Leave in semester 2, 2018 and A/Professor Matthew Kearney is Acting Co-Director in her absence.

Useful STEM Education Links

ACARA STEM Connections Project Report:

<https://www.australiancurriculum.edu.au/media/3220/stem-connections-report.pdf>

National STEM School Education Strategy: A Comprehensive Plan for Science, Technology, Engineering and Mathematics Education in Australia.

<http://www.educationcouncil.edu.au/site/DefaultSite/filesystem/documents/National%20STEM%20School%20Education%20Strategy.pdf>

STEM CHALLENGES

What exactly is STEM education?

What is the nature of STEM?

What is STEM literacy?

How do we help teachers to understand STEM?

What is STEM education in the primary school?

Are we clear what PCK in STEM is?

How do we ensure rigour and academically high levels in the M and E in STEM education? How do we ensure teacher quality in STEM?

How do we communicate the benefits of a STEM education to parents and students?

How do we raise awareness of careers in STEM?

What outcomes and impact do we want - what is the right evidence base?

Are we being realistic layering on M, T, E to science?

What is the role of industry in the school education system and how do we involve them?

What does best practice in partnerships between industry and schools look like?

How can we create meaningful STEM-school industry partnerships that contribute to invigorating STEM teaching and learning in schools?

STEM: what does it mean to academics/researchers in the disciplines of science, technology, engineering and mathematics?

Is it possible/desirable to offer all undergraduate students a STEM experience?

How does STEM manifest itself at university?

How do we preserve the integrity of the STEM subjects whilst also preparing students for a technology-rich future?

What evidence links computer use to outcomes?

How can we foreground the substantial and essential mathematics needed for effective STEM engagement?

How can we help teachers to feel confident across disciplines and pedagogy to successfully deliver the breadth and depth of STEM?

Researchers: **Dr Mary Coupland, A/Professor Anne Prescott**, Marco Angelini, **Professor Sandy Schuck**

The \$1.9 million Australian Government-funded *Maths Inside* project was officially launched on 12 June 2018 at UTS in a function attended by stakeholders from CSIRO, the Office of the Chief Scientist, the Australian Association of Maths Teachers and ABC, as well as school teachers and students involved in delivering its teaching resources. The *Maths Inside* project's aim is to address the disengagement of students in maths, particularly the higher levels of maths, by highlighting the importance of quality school experiences in maths and raising awareness of the relevance of maths to careers and personal development.

Teaching Resources: The main outputs of the project are 9 **short film** Case Studies on the contributions of CSIRO mathematical scientists, linked with 32 **classroom activities**, all prepared by professional scientific communicators as videos and illustrated text and rich teaching tasks. As part of the trialling and research study since 2015, project videos and class activities have been delivered by teachers in over 60 schools across Australia. Over 120 teachers and 1600 students have been involved in the project. The resources are linked explicitly to the Australian Curriculum and are authentic, pedagogically sound teaching/learning materials that are geared towards investigations rather than rote learning. Workshops are being held around the country to promote the materials developed, and they are also available on web platforms.



A/Professor Anne Prescott and Marco Angelini presenting Maths Inside Project at ASERA conference

Research outputs: A monograph proposal titled *Maths Inside. Enhancing mathematical engagement of secondary school students* is being prepared for Springer (RQF-ranked A publisher). The book will highlight key results and impact of the large scale national project on students' engagement and participation in maths. The book is anticipated to be completed by December 2019. A journal article titled *Engaging students in mathematics by showing them the maths 'inside'* has been submitted to the *International Journal of Science and Mathematics Education* (Springer) for peer review. The project has been presented at various educational conferences in the last two years, including MANSW, ASERA, MAV, MERGA and AAMT. A paper has been published in the proceedings of the MERGA 2017 conference, titled *Maths Inside: A Project to Raise Interest in Mathematics*.

Good News and Achievements

Professor Sandy Schuck and Professor Peter Aubusson: Publication of their co-authored book 'Uncertainty in Teacher Education Futures: Scenarios, Politics and STEM' by the ERA A-ranked publisher Springer (see image of book on side bar).

Dr Keiko Yasukawa: Publication of her co-edited book titled 'Numeracy as Social Practice' published by the ERA A-ranked publisher Routledge (see image of book on side bar).

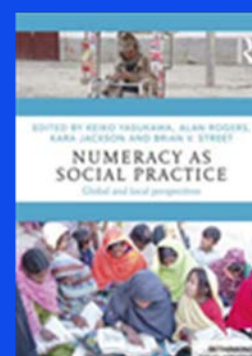
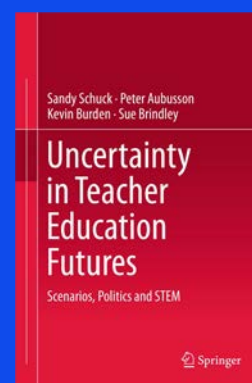
UPCOMING EVENTS

Aug 16, 2018: UTS National Science Week Day. Dr Mary Coupland and A/Professor Wan Ng will be running activities for about 100 secondary school girls.

Dec 2018: NSW Adult Literacy and Numeracy Council Conference.

Chair: Keiko Yasukawa.
Website <http://nswalnc.org.au/>

Jan 2019: MITE 2019.
Chair Damian Maher. Website <https://mite2019.uts.edu.au/>
<https://twitter.com/MITecconference?lang=en>



A/Professor Wan Ng: Lead researcher in the recent successful 250K WISE (Women in STEM and Entrepreneurship) project titled 'The STEAMPunk Girls Project' in collaboration with Andrew Connolly (Equity & Diversity Unit) and Maya Marcus and Monique Potts (Innovation & Entrepreneurship Unit). The project is funded by the Australian Government Business.

A/Professor Wan Ng: Invited speaker at the ACTA International Conference in Adelaide with theme 'English Language Learning in a Mobile World' in October 2018 - see website https://www.conveneit.com/secure/onsite/acta_2018/?pg=3

A/Professor Wan Ng: Invited to Chair and deliver a keynote at the 1st International Conference on Multidisciplinary Academic Research by the Asia-Pacific Institute of Advanced Research (see website <https://apiar.org.au/?conference=1st-international-conference-on-multidisciplinary-academic-research-icmar-2018-sydney-australia>). The talk will focus on STEM as a multidisciplinary entity and include the incorporation of Arts and Entrepreneurship from work in the WISE/STEAMPunk Girls project.

Dr Simon Knight: Released (with colleague Kirsty Kitto) a new UTS Open module "What Does Facebook Know About You" at <https://open.uts.edu.au/facebookknowyou.html>, a hands on approach to encourage people to engage with their data, how it can be used, and the privacy implications

Dr Jane Hunter: Opening keynote address on High Possibility Classrooms in Australian schools at the London Festival of Learning in June 2018. This learning festival brought together international scholarly communities of AI in education, the learning sciences and learning at scale. Jane's talk featured brief detail of the original research that developed the HPC framework (2013), validation studies (2014-15), the impact of the work in Australian schools in NSW, Victoria and the ACT as well as findings from the two NSW studies in STEM with 37 teachers, and 1000 students in 8 low SES primary schools (2016-17). Read more here: <http://www.highpossibilityclassrooms.com/blog/>

Dr Jane Hunter on High Possibility Classrooms (HPC) coaches for STEM in NSW public schools; 2017-18. Six primary schools and 25 middle level leaders are participating in an 18month study to develop their capacity as great teacher leaders using Stoll's (2018) notion of evidence informed, collaborative professional learning. Teachers report using a pedagogical framework like HPC has enabled them to develop confidence in preparing fully integrated units of work in all four of the STEM disciplines and a renewed sense of professional engagement. This research builds on two NSW studies conducted in 2016-17 in low SES public schools; the new study concludes in December 2018*.

*The five NESA accredited courses in High Possibility Classrooms (HPC) include STEM and STEAM with the humanities and arts are evidence informed teacher professional learning workshops supported by ongoing research in Australian Schools.



Stage 2 students constructing hydraulic pump. See video at <https://www.youtube.com/watch?v=S6jOloXrG2E&feature=youtu.be>

Dr Jane Hunter and HPC

Good News and Achievements (contd_2)

Professor Lori Lockyer: ARC project 'Designing Effective Learning Experiences' - Project team will be presenting a pre-conference workshop at Australian Council for Computers in Education (ACCE) Conference 2018 on October 2nd 2018.

Professor Peter Aubusson, A/Professor Wan Ng, Dr Kimberley Pressick-Kilborn and Dr Tracey-Ann Palmer: Successful completion of 'Science by Doing' and 'Primary Connections' projects, both funded by the Australian Academy of Science, totalling nearly 300K. Collaborators of the projects are A/Professor Paul Burke (Business School), Dr Andy Goodall (Public Policy and Governance), Jennifer Fergusson (School of Education) and Keith Skamp (adjunct professor, SCU).

Dr Damian Maher: Chair of the 2019 MITE - Mobile Technology in Teacher Education Conference (Jan 18th and Jan 19th 2019) – see conference link in the 'upcoming events' on the side bar on page 4 of this newsletter.

Dr Keiko Yasukawa: Convener for the NSW Adult Literacy and Numeracy Council conference (7 Dec 2018) – see conference link in the 'upcoming events' on the side bar on page 4 of this newsletter.

Dr Meera Varadharajan: Recipient of the 2018 Early Career Researcher grant from the Australian Teacher Education Association (ATEA) for conducting research on career change teachers from STEM backgrounds.

Visiting Scholars to the STEM Education Futures Research Centre:

In semester 1, 2018, we had several researchers visiting the Centre:

Professor Kevin Burden from the University of Hull, UK, was visited the Centre as a recipient of the DVC Distinguished Visiting Scholar Scheme. He presented a keynote at the Centre symposium and worked with various members of the Centre on several projects.

A/Professor Ruurd Taconis from the Eindhoven University of Technology, Netherlands, was invited to deliver a keynote at the Centre symposium and a research seminar in the School of Education as well as to work with Centre members on research projects.

Professor Susann Fegter from TU Berlin, School of Education SETUB, Institute of Education, visited the Centre in March of this year. A collaborative research project discussed is *Improving Quality of Gender and Diversity Approaches in STEM Higher Education* that includes looking at initiatives to increase the participation of women in STEM and integration of gender and diversity aspects into STEM Teacher Education Programs.

A/Professor Niels Bonderup Dohn from the Danish School of Education, Aarhus University, Denmark visited the Centre in July. Neils gave a research seminar on 'Students' interest in an advanced biotech citizen science program', hosted a fireside chat on Research Design for HDR students and discussed with members on research projects.

Forthcoming visit by international delegation, 14 September 2018

A delegation of Dean, Associate Dean and academics from the Faculty of Industrial Education and Technology at the King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand will be visiting our Centre on 14 September, 2018. They are interested in STEM Education and digital technologies to enhance learning. Discussion of a dual PhD research degree between their university and UTS is one of the topics of interest with KMITL

