43rd Annual ASERA Conference

PROMOTING SCIENCE EDUCATION AND SCIENCE EDUCATION RESEARCH IN ALL CONTEXTS AND AT ALL LEVELS OF EDUCATION

June 27th – June 30th 2012

University of the Sunshine Coast
Sippy Downs, Queensland, Australia

CONFERENCE PROGRAM

AND ABSTRACTS

ASERA 2012

The 43rd Annual ASERA Conference of the Australasian Science Education Research Association

www.asera.org.au

June 27th - June 30th 2012

University of the Sunshine Coast
Sippy Downs, Queensland, Australia

Hosted by:

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Welcome and Introduction

Welcome to the Sunshine Coast

The University of the Sunshine Coast acknowledges the Gubbi Gubbi people as the traditional custodians of the land on which the campus stands, and recognises the strength, resilience and capacity of Aboriginal and Torres Strait Islander people in this land.

The University of the Sunshine Coast is regionally relevant and recognised, nationally and internationally, for excellence in teaching, research and engagement.

Sippy Downs began as a northern campus of the Brisbane College of Advanced Education in 1994, but became an independent entity in 1996, renamed The Sunshine Coast University College , with its first student intake that year. Full university status was granted to the new institution in 1998 when it became the University of the Sunshine Coast.

Located in one of the country's fastest growing regions, the University of the Sunshine Coast campus at Sippy Downs currently accommodates more than 7,000 enrolees.

From its establishment the University has been primarily focused on community engagement, campus development, innovative programs and a personalised approach to learning.

The University of the Sunshine Coast Campus

The University is 10 kilometres south-west of Maroochydore, so is conveniently close to all that the beautiful Sunshine Coast has to offer and is just 100 kilometres north of Brisbane ,Queensland's capital city, which is only, an hour's drive away.

As you explore USC's award-winning 100-hectare campus at Sippy Downs, you will enjoy the spacious and natural setting and be impressed by the stylish modern buildings fully-equipped with the latest technology. To ensure students live a balanced lifestyle, academic facilities - including a large library, open air study areas and dedicated student services - are complemented by modern sport and health amenities. Staff and students relax at onsite cafes and enjoy recreational activities in the wider Sunshine Coast area which is home to a number of exceptional natural and man-made attractions.

The University is part of the education precinct at Sippy Downs, being co-located with private and public schools. The surrounding area will expand further in coming years, with the population set to double in the next decade. Sippy Downs will have a new town centre with retail and commercial space, parks, squares, community and recreational facilities including a tavern and cinemas. It will provide for 4000 new jobs and accommodate another 4500 people in 2500 dwellings, adding vitality to the area beyond business hours. Strategic job creation will focus on "smart industries" to diversify the Coast's economic reliance on tourism, retail and construction. The State Government's SEQ Regional Plan 2009-2031 identifies Sippy Downs and the university as an "employment opportunities area" in technology and education. The university is currently the third biggest employer on the Sunshine Coast and nearly 30 knowledge-based businesses already operate from the university's Innovation Centre.

The ASERA 2012 committee would like to thank all of the people who have contributed to this conference. Associate Professor Deborah Heck, Head of Education, USC, has kindly provided support from the School of Science, Education and Engineering, including support staff and Administrative assistance to help organise the conference.

Our particular thanks go to:

- Margaret Marshman, Beverly Lowe, John Hunt, Tim Strohfeldt, School of Science, Education & Engineering
- Harry Kanasa and David Geelan, Griffith University
- Gillian Kidman and Jim Watters, Queensland University of Technology
- Ken Appleton
- Peter Fensham, Queensland University of Technology
- Sue Westbrook, Samantha Bray and Alison McCallum, School of Science, Education and Engineering professional staff
- Ben Gay, Brianna Clancy, Adam Duus, Kayla Monk, Sean Gibson, Kylie Barrington and Mark Jenkins – Student Volunteers Studying Education

We hope you have an enjoyable and stimulating experience at this conference

Deborah Heck

2012 ASERA Conference Convenor, School of Science, Education and Engineering,
University of the Sunshine Coast

The History of ASERA Conferences

In 1970 Peter Fensham (Monash University), the first Professor of Science Education in Australasia, initiated the first conference of what was then the Australian Science Education Research Association. The list of researchers, their institutional affiliations and research interests of those who attended this conference can be located at http://www.asera.org.au//images/stories/SR-Archives%20(e).pdf That beginning for ASERA (now the Australasian Science Education Research Association) makes it the second oldest science education research body in the world, after the National Association for Research in Science Teaching in the USA. It should be noted that this was also several months before the first conference of the then newly formed Australian Association for Research in Education (AARE). It is thus likely that ASERA was the first professional body in educational research in Australia.

The New Zealand dimension of ASERA began with the attendance of the late Roger Osborne at the 1977 conference, but was not formalized in the name change to "Australasian" until 1990, 7 years after ASERA first met in New Zealand.

The general belief at the first conference was that every second meeting would need to be organized by Monash, a reflection of the fact that in 1970 Monash was the only substantial centre for science education research in Australia. The notion that Monash would be responsible for every second ASERA was part of the 'gentle coercing' that had the Macquarie organizers agree to host the second conference, and is why the third conference was held at a very different form of venue - a secondary science curriculum project headquarters in Melbourne. Such was the very rapid growth of Australian science education research and a strong association that this perspective only lasted until ASERA 5.

Venue	**Conference Convener(s)**
ASERA 1 -1970, Melbourne	Peter Fensham, Lindsay Mackay & Dick White (Monash University)
ASERA 2- 1971, Sydney	David Cohen & Neil Baumgart (Macquarie University)
ASERA 3 -1972, Melbourne	Probably Les Dale (ASEP) & Peter Fensham (Monash) (Australian Science Education Project headquarters, Toorak, Melb) It has not been possible to establish with certainty who organized the conference.
ASERA 4 -1973, Brisbane	Colin Power & Dick Tisher (University of Queensland)
ASERA 5 -1974, Melbourne	Russell Linke & Leo West (Monash University)
ASERA 6 -1975, Adelaide	Arthur Lucas (Flinders University)
ASERA 7 -1976, Newcastle	Max Maddock (University of Newcastle)
ASERA 8 -1977, Wagga Wagga	Tony Blake (Riverina CAE) (now a campus of Charles Sturt University)
ASERA 9 -1978, Brisbane	Cam McRobbie (Mt Gravatt CAE) (now a campus of Griffith University)
ASERA 10 -1979, Perth	Dennis Goodrum (Churchlands CAE) (now a campus of Edith Cowan University)
ASERA 11- 1980, Melbourne	David Symington (State College of Vic, Toorak) (now a campus of Deakin University)
ASERA 12 -1981, Hobart	Paddy Lynch & Andrew Davies (University of Tasmania)

ASERA 13 -1982, Sydney	Bill Butts (Macquarie University)
ASERA 14 -1983, Hamilton (NZ)	Roger Osborne (University of Waikato)
ASERA 15 -1984, Melbourne	Dick Gunstone & Jeff Northfield (Monash University)
ASERA 16 -1985, Rockhampton	Ken Appleton (Capricornia Institute of Advanced Ed) (now a campus of UCQ)
ASERA 17 -1986, Adelaide	Chris Dawson, Mike Sullivan and Effie Best (University of Adelaide)
ASERA 18 -1987, Wagga Wagga	Doug Hill (Riverina CAE) (now a campus of Charles Sturt University)
ASERA 19 -1988, Sydney	Colin Gauld & Barry Newman (University of New South Wales)
ASERA 20 -1989, Melbourne	Dick Trembath (Chisholm Inst Technology, Frankston campus) (now a campus of Monash University)
ASERA 21 -1990, Perth	David Treagust (Curtin University of Technology)
ASERA 22 -1991, Surfers Paradise	Cam McRobbie (Queensland University of Technology)
ASERA 23 -1992, Hamilton (NZ)	Malcolm Carr (University of Waikato)
ASERA 24 -1993, Lismore	Keith Skamp (University New England, Northern Rivers campus) (now Southern Cross University)
ASERA 25 -1994, Hobart	Brian Jones & Max Walsh (University of Tas)
ASERA 26 -1995, Bendigo	Peter Searle & Brian Hand (LaTrobe University, Bendigo campus)
ASERA 27 -1996, Canberra	Tim Hardy & Marilyn Fleer (University of Canberra)
ASERA 28 -1997, Adelaide	Yvonne Zeegers & Paul Strube (University of SA)
ASERA 29 -1998, Darwin	Bill Palmer (Northern Territory University) (now Charles Darwin University)
ASERA 30 -1999, Rotorua (NZ)	Bev France & Mavis Haigh (Auckland College of Education), (now Auckland University)
ASERA 31 -2000, Fremantle	Léonie Rennie (Curtin University of Technology)
ASERA 32 -2001, Sydney	Peter Aubusson (University of Western Sydney)
ASERA 33 -2002, Townsville	Steve Ritchie (James Cook University)
ASERA 34 -2003, Melbourne	Rod Fawns & Christine Redman (University of Melbourne)
ASERA 35 -2004, Armidale	Debra Panizzon (University of New England)
ASERA 36 -2005, Hamilton (NZ)	Judy Moreland (University of Waikato)
ASERA 37 -2006, Canberra	Jim Woolnough & Leah Moore (University of Canberra)
ASERA 38 -2007, Fremantle	Grady Venville (University of Western Australia), Vaille Dawson & Rachel Sheffield (Edith Cowan University)
ASERA 39 -2008, Brisbane	Gillian Kidman, Donna King, Steve Ritchie (Queensland University of Technology)

ASERA 40 -2009, Geelong	Coral Campbell (Deakin University)
ASERA 41 -2010, Newcastle	Dave Palmer, Vicki Parkes, Mitch O'Toole (University of Newcastle)
ASERA 42 -2011, Adelaide	Yvonne Zeegers, Kathy Paige (University of South Australia)
ASERA 43 -2012, Sunshine Coast	Deborah Heck, Margaret Marshman, Beverly Lowe, John Hunt, Tim Strohfeldt (University of the Sunshine Coast)

ASERA Executive Board

The members of the ASERA Executive Board are:

- Professor Alister Jones - Managing Director
- Dr Coral Campbell
- Associate Professor Deborah Corrigan
- Associate Professor Bronwen Cowie
- Associate Professor Debra Panizzon
- Professor Stephen Richie
- Professor David Treagust

Sponsorship Acknowledgement

Major sponsors:

- University of the Sunshine Coast – School of Science, Education and Engineering

Other Sponsors:

- Springer Publications
- Pearson Australia
- Routledge Publications
- Cengage Learning
- Cambridge University Press

ASERA 2012 Program Overview

Wednesday 27th June

8.30-3.30pm	Early Career Researchers Conference – Pre-Conference Workshop – Room HG.45
4.00-5.00pm	Registration desk open – The Brasserie – (Building BR)
5.00-6.00pm	Welcome Reception – The Brasserie

Thursday 28th June

8.00-8.55am	Registration – The Brasserie
9.00-9.25am	Official Welcome – Lecture Theatre 7 (Ground Floor, C Block)
9.30-10.10am	Session 1 - Presentation of Papers
10.10-10.35am	Morning Tea – The Brasserie
10.35-11.10am	Session 2 - Presentation of Papers
11.15-12.00pm	Session 3 – Presentation of Papers
12.00-1.00pm	Lunch – The Brasserie
1.00-1.40pm	Session 4 - Presentation of Papers
1.45-2.25pm	Session 5 - Presentation of Papers
2.30-3.00pm	Session 6 - Poster Presentation 1
2.45-3.15pm	Afternoon Tea - The Brasserie
3.20-4.00pm	Session 7 - Presentation of Papers
4.05-4.45pm	Session 8 - Presentation of Papers

Friday 29th June

8.45-9.25am	Session 1 - Presentation of Papers
9.30-10.10am	Session 2 - Presentation of Papers
10.10-10.35am	Morning Tea – The Brasserie
10.35-11.15am	Session 3 - Presentation of Papers
11.20-12.00pm	Session 4 – Presentation of Papers
12.00-12.45pm	Lunch – The Brasserie
12.45-1.25pm	Session 5 - Presentation of Papers
1.30-2.10pm	Session 6 - Presentation of Papers
2.15-2.45pm	Session 7 - Poster Presentation 2
2.35-3.15pm	Afternoon Tea – The Brasserie
3.20-4.00pm	Session 8 - Presentation of Papers
4.05-4.45pm	Session 9 - Presentation of Papers
5.00-6.30pm	AGM for ASERA – Lecture Theatre 7 (Ground Floor, C Block)
7.00-11.00pm	Conference Dinner (4th Floor Restaurant, Mooloolaba)

Saturday 30th June

9.00-9.40am	Session 1 - Presentation of Papers
9.45-10.25am	Session 2 - Presentation of Papers
10.30-11.00am	Morning Tea – The Brasserie
11.00-12.15pm	Session 3 - ACARA Forum – Lecture Theatre 7 (Ground Floor, C Block)
12.15–1.00pm	Light lunch (before departure) – The Brasserie

Sippy Downs Campus –Conference Rooms

Map 1: USC Campus Map Details

C Block Rooms	H Block Rooms	BR – Brasserie
Ground Floor – Lecture Theatre 7 C1.39, C1.40, C1.41, C1.48, C1.49, C1.50	H1.45, H1.51, H1.52	Reception and Welcome Reception Morning tea, lunch and afternoon tea served here

General Conference Information

Conference Arrival

The registration desk will open at 4pm on Wednesday 27th June and at 8am each morning of the conference. When delegates first arrive at the conference, they should register at the registration desk, which is located in The Brasserie, Building BR (location identified on Map 1).

Welcome Reception

The Welcome Reception will be held from 5.00 – 6.00pm on Wednesday evening in the Brasserie, Building BR (location identified on Map 1). There will be drinks and canapés provided and the registration desk will remain open at this time.

Official Welcome

The Official Welcome will be held from 9.00 – 9.25am on Thursday morning in Lecture Theatre 7, Ground floor of C Block (location identified on Map 1), please be seated by 8.55am. The conference will commence with a Welcome to Country on behalf of the traditional custodians on the land on which we will be meeting. This will be followed by a welcome to the University and the conference.

Annual General Meeting

The ASERA Annual General Meeting will be held Friday 29th June from 5.00-6.30pm in Lecture Theatre 7 (location identified on Map 1). All members are welcome to attend.

Chairing Sessions

If you are presenting a paper, then you have probably been assigned to chair a session for someone else. Please check the program of presentations. If you are not presenting any paper then you have not been assigned to chair a session.

Each session lasts 40 minutes. This allows 20 minutes for paper presentation and 20 minutes for questions. The Chairperson should introduce the speaker, monitor the time for the speaker and assist in managing any questions.

If you are unable to chair a session for which you have been assigned, please arrange to swap with someone else

Poster Information

On the day of your presentation, your poster needs to be taken to the Brasserie (identified on Map 1) before the sessions begin and placed on one of the available panels. Each panel is labelled with numbers. These numbers correspond to the numbers for each poster session listed in the conference program. Please hang your poster in the correct space with the materials provided. At the time allocated for poster presentations, you will have the opportunity to speak to conference participants as they visit the posters on display. At the end of the days' sessions, please remove your poster. Thank you for participating in the poster presentation.

Internet Access: Eduroam Wireless Network

Eduroam is a wireless network provided across most Universities in Australia, and many others around the world, that will allow students and staff of member institutions to connect using their home institution's username and password.

For Visiting Students and Staff of other participating Universities, this will allow you to connect to the wireless Eduroam network provided on the USC campus using your home institutions credentials.

For details of this service and to see a list of member institutions visit http://www.eduroam.edu.au/

Some additional wireless access services will be made available for international participants and those from institutions that do not participate in the Eduroam. A username and password will be issued at registration.

Meals

Lunches, and morning and afternoon teas will be served in the Brasserie, Building BR (location identified on Map 1). Tea and coffee will also be available all day in this area.

Conference Dinner

The 2012 conference dinner will be held at the 4th Floor Restaurant, Level 4, 77 The Esplanade, Mooloolaba (marked by the knife & fork on Map 2) on Friday 29th June from 7.00pm. This is within walking distance of Mooloolaba accommodation.

The dinner will include a 3-course meal, some drinks and music. Please present your dinner ticket at the restaurant upon arrival.

TRANSPORT

AIRPORT SHUTTLE BUSES

- **Sunshine Coast/Maroochydore Airport:**
-
    - Sun Air – Shuttle Bus Service - Sun-air meets every jet service and provides door to door shuttle transfers to holiday accommodation and private residences south of the Sunshine Coast Airport *(Must be Pre-Booked* 1800 804 340 Toll Free*.)*
    - o
- **Brisbane Airport:**
    - **Sun Air – Shuttle Bus Service** departs Brisbane Airport every hour. Door to door and transit stop service available. General Enquiries: Ph:+61 7 5477 0888. General Enquiries Toll Free within Australia: 1800 804 340 www.sunair.com.au
    - **Col's Airshuttle** departs Brisbane Airport every 45 minutes. Door to door and transit stop service available. Bookings essential: Ph:+61 7 5450 5933 in Office hours Mon - Fri: 0700 – 2100, Sat & Sun: 0700 – 1700 www.airshuttle.com.au
    - o

Bookings are recommended for all shuttle services

TAXIS

Suncoast Cabs: Phone 131 008. Fares from the Sunshine Coast/Maroochydore airport to:

- Maroochydore approximately $24.00
- Alexandra Headland approximately $34.00
- Mooloolaba approximately $35.00

To signal a taxi driver on the street, raise your hand in the air or phone the taxi company (131 008) in order to request a taxi pick-up from a specific location. Tell the driver your destination, or if you are phoning, tell the dispatcher your name, location and destination. Expect to wait longer for a taxi during rush hours, bad weather or in school holiday periods.

If you plan to catch a train or plane, please book your taxi one day in advance.

All taxis must have a meter and the rates are fixed by law. When paying, ask for a receipt and remember that tips for taxi drivers are not typical in Australia.

LOCAL TRAIN AND BUS

- Translink provide train services from Brisbane to the Sunshine Coast to Landsborough station with bus connection to Maroochydore – Route 615 or Nambour station with bus connection to Maroochydore – Route 602. For further information visit: http://translink.com.au/

- There are regular bus services to and from the University from most Sunshine Coast suburbs. For further information on Bus Services and Bus timetables for the Sunshine Coast, please refer to http://translink.com.au/

PARKING ON CAMPUS

Parking is available on campus, please refer to the map in your satchel for parking locations.

Conference Bus

A bus marked "ASERA" will operate to and from Mooloolaba to the University at the times listed below:
(Map 2 shows the location of the bus stop in a loading zone opposite First Avenue on Brisbane Road along with the suggested hotel accommodation. The bus stop is identified with a red star: ★)

MOOLOOLABA TO THE UNIVERSITY - BOARD BUS AT LOADING ZONE IN FRONT OF PENINSULAR HOTEL IN BRISBANE ROAD, OPPOSITE FIRST AVENUE & INFORMATION KIOSK. UNIVERSITY TO MOOLOOLABA – BOARD BUS AT TRANSIT STATION, LOADING BAY 3					
Wednesday 27 June	**Outward journeys**	**Pick-up**	**Mooloolaba**	**at**	**3.40pm**
		Drop-off	**University**	**at**	**4.00pm**
		Pick-up	**Mooloolaba**	**at**	**4.20pm**
		Drop-off	**University**	**at**	**4.40pm**
	Return journeys	**Pick-up**	**University**	**at**	**5.45pm**
		Drop-off	**Mooloolaba**	**at**	**6.05pm**
		Pick-up	**University**	**at**	**6.15pm**
		Drop-off	**Mooloolaba**	**at**	**6.35pm**
Thursday 28 June	**Outward journeys**	**Pick-up**	**Mooloolaba**	**at**	**7.50am**
		Drop-off	**University**	**at**	**8.10am**
		Pick-up	**Mooloolaba**	**at**	**8.10am**
		Drop-off	**University**	**at**	**8.30am**
	Return journeys	**Pick-up**	**University**	**at**	**5.00pm**
		Drop-off	**Mooloolaba**	**at**	**5.20pm**
		Pick-up	**University**	**at**	**5.15pm**
		Drop-off	**Mooloolaba**	**at**	**5.35pm**
Friday 29 June	**Outward journeys**	**Pick-up**	**Mooloolaba**	**at**	**7.55am**
		Drop-off	**University**	**at**	**8.15am**
		Pick-up	**Mooloolaba**	**at**	**8.10am**
		Drop-off	**University**	**at**	**8.30am**
	Return journeys	**Pick-up**	**University**	**at**	**5.00pm**
		Drop-off	**Mooloolaba**	**at**	**5.20pm**
		Pick-up	**University**	**at**	**6.40pm**
		Drop-off	**Mooloolaba**	**at**	**7.00pm**
Saturday 30 June	**Outward journey**	**Pick-up**	**Mooloolaba**	**at**	**7.55am**
		Drop-off	**University**	**at**	**8.15am**
	Return journey	**Pick-up**	**University**	**at**	**1.00pm**
		Drop-off	**Mooloolaba**	**at**	**1.20pm**

IMPORTANT CONTACTS:

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In Australia, for extreme emergencies, you can dial 000 from any phone for free.

- Dialling this number will have police, fire *and* ambulance sent to your location immediately.
- Please only call this number in case of a serious emergency.
- If the situation is deemed not to be a serious emergency by authorities, the person who called will be fined.

Mooloolaba Police Non-Emergency: + 6 1 7 5444 1276

Caribbean Resort
www.caribbeanresort.com.au
17/19 Brisbane Road, Mooloolaba QLD 4557
+61 7 5444 7311

Cilento Mooloolaba
www.cilentomooloolaba.com.au
19 First Avenue, Mooloolaba Queensland 4557
+61 7 5457 9100

Coco Mooloolaba
www.cocomooloolaba.com.au
81 First Avenue, Mooloolaba QLD 4557
+61 7 5315 5166

Mantra Zanzibar
www.mantrazanzibar.com.au
47 - 51 The Esplanade, Mooloolaba QLD 4557
+61 7 5444 5633
MantraConferenceRates.pdf

Mooloolaba Beach Backpackers
www.mooloolababackpackers.com
75 Brisbane Road
Sunshine Coast - Mooloolaba QLD 4557
+61 7 5444 3399

ASERA Bus Stop

Newport Mooloolaba Apartments
www.newportmooloolaba.com.au
Parkyn Parade, Mooloolaba QLD 4557
+61 7 5444 4833

Pacific Beach Resort
www.pacificbeach.com.au
95 Mooloolaba Esplanade, Mooloolaba Beach QLD 4557
+61 7 5444 4733

Pandanus Mooloolaba
www.resort.pandanusmooloolaba.com.au
15 Smith Street, Mooloolaba QLD 4557
+61 7 5457 8989

Raffles Mooloolaba
www.rafflesmooloolaba.com.au
65 - 69 First Avenue, Mooloolaba QLD 4557
+61 7 5444 0077

Sandcastles on the Beach
www.sandcastlesonthebeach.com.au
11 River Esplanade, Mooloolaba
+61 7 5478 0666

Fourth Floor: Conference Dinner Venue

Map 2: Conference Accommodation Venues, Conference Dinner and Bus Stop

Program of Presentations

THURSDAY 28TH JUNE									
8.00-8.55am	**Registration -University of the Sunshine Coast - The Brasserie, Building BR**								
9.00-9.25am	**Official Welcome -Lecture Theatre 7**								
THURSDAY 28TH JUNE (Sessions before Morning Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
9.30-10.10am **Session 1**		**Laura Barraza, Edgar Caballero & Grace Wong** *Children's drawings to understand the concept of climate change and wild animals* **Chair: Carole Haeusler**	**Lyn Carter, Melitta Jones & Carolina Castano-Rodriguez** *Transformative learning in science: progressing our sociocultural agenda* **Chair: Rebecca Cooper**	**Angela Stott & Jenni Case** *South African physical science teachers' understanding of force concepts* **Chair: Jeong-yoon Jang**	**Nasser Mansour, Ahmad Qablan, Saeed Alshamrani & Abdulwali Aldahmash** *Ensuring Effective Impact of Continuing Professional Development: Science Teachers' Perspectives* **Chair: Brendan Briggs**	**Jonte Taylor & Mary Grace Villanueva** *Using Argument-based Inquiry to Improve Achievement & Critical Thinking Outcomes for Traditionally Low-Achieving Students* **Chair: Sangeeta Varma**	**Gillian Kidman & Stephen Keast** *Learning via Slowmation: What is possible?* **Chair: Alberto Bellocchi**	**Deborah Corrigan, Alister Jones & Cathy Buntting** *Rethinking The Place Of Context In Science Education* **Chair: Coral Campbell**	**Peter Fensham** *The Rise of Anti-Science in Australian Society: How have we gone wrong in school science education?* **Chair: Kathrin Otrel-Cass**
10.10-10.35am	**Morning Tea -The Brasserie- Sponsored by Cambridge University Press**								

THURSDAY 28TH JUNE (Sessions between Morning Tea and Lunch)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
10.35-11.10am Session 2		**Marlizayati Binti Johari, Nor'Arifahwati Binti Haji Abbas & Ak Modh Rahiman Bin Pg Aliudin** *Correlation between reasoning abilities and academic achievements amongst Physics 'A' level Brunei students* **Chair: Laura Barraza**	**Jisun Park, Hunkoog Jho & Jinwoong Song** *A review and analysis of the studies focused on ethical aspect regarding socio-scientific issues* **Chair: Lyn Carter**	**Jenny Arnold & David Clark** *A framework for supporting the development of student agency in science classrooms* **Chair: Angela Stott**	**Vaille Dawson & Katherine Carson** *Science Teachers' Understanding of Climate Change: Does it Matter?* **Chair: Nasser Mansour**	**Zuway-R Hong, Huann-shyang Lin, Hsiang-Ting Chen, Hsin-Hui Wang, Chia Jung Lin & Tien-chi Yu** *Enhancing Elementary School Students' Active Learning, Positive Thinking and Decreasing Their Anxiety in Learning Science* **Chair: Mary Grace Villanueva**	**(A)George Aranda & Peter Hubber** *Cross-cultural Science Education Research: An objective lens?* **Chair: Gillian Kidman**	**Jennifer Oakley** *Using cogenerative dialogue to transform the emotional climate of science classrooms* **Chair: Deborah Corrigan**	**Jacolyn Weller** *How to detect if change is being taken to heart by the science teacher* **Chair: Peter Fensham**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
11.15-12.00pm Session 3		**Cheryl Jakab** *Three children explore scientific ideas of matter using 21st century interactives* **Chair: Marlizayati Binti Johari**	**Mihye Won & David Treagust** *Students' Use of Diagrams to Make Sense of Biological Evolution* **Chair: Jisun Park**	**Melissa Glackin** *Teaching science outside the classroom: the role of teachers' beliefs and teacher efficacy* **Chair: Jenny Arnold**	**Kathryn Paige, Yvonne Zeegers, David Lloyd & Philip Roetman** *Teacher and academic Professional Learning What was achieved, what was learned* **Chair: Vaille Dawson**	**Susan Millar** *The Response of Science Teachers to Professional Development as a Result of Individual, Faculty and School Decisions* **Chair: Zuway-R Hong**	**(B)Chao-Ti Hsiung, Russell Tytler, Joerg Ramseger, Sharon Chen, Gisela Romain & Ines Freitag-Antmann** *Reasoning through representation: Contrasting cases of learning sequences in Taiwan and Germany* **Chair: George Aranda**	**Tim Strohfeldt & Deborah Heck** *Facilitating Preservice Teachers' Proficiency in ICT Pedagogy* **Chair: Jennifer Oakley**	**James Watters & Carmel Diezmann** *Overqualified to be teaching? Challenges confronting science professionals becoming teachers* **Chair: Jacolyn Weller**
12.00-1.00pm	**Lunch - The Brasserie**								

THURSDAY 28TH JUNE (Sessions between Lunch and Afternoon Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
1.00-1.40pm Session 4		**Katherine Doyle & Michael Dezuanni** *Culturally diverse children's representations of science procedures through digital video production: Overcoming barriers to participation* **Chair: Cheryl Jakab**	**Mary Oliver & Jim Woolnough** *I'm a Science Teacher: Why do I Need to Know about the Brain?* **Chair: Mihye Won**	**Anne Hume & Chris Eames** *The impact of expert input into CoRe design on the PCK of early career* **Chair: Melissa Glackin**	**Rebecca Cooper** *Critical Experiences to Build Understanding of Science Teacher Educators' Pedagogical Knowledge* **Chair: Yvonne Zeegers**	**Marissa Rollnick & Elizabeth Mavhunga** *PCK of experienced teachers and pre-service teachers for teaching chemical equilibrium: qualitative and quantitative perspectives* **Chair: Susan Millar**	**(C)Khadeeja Ibrahim-Didi, Mark Hackling & Karen Murcia** *Justification of reasoning: The challenge from a multi-modal perspective* **Chair: Russell Tytler**	**Tomokazu Yamamoto, Miki Sakamoto, Junko Nishigaki, Keita Maratsu & Shinichi Kamiyama** *A study of classroom lessons in Japan designed to nurture argument skills: 5th-grade science module on pendulum movement case* **Chair: Timothy Strohfeldt**	**M. Shaheed Hartley** *Successes, challenges and limitations of a professional development course to upgrade fifty rural science teachers in South Africa* **Chair: James Watters**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
1.45-2.25pm Session 5		**Donna Satterthwait** *Teaching the Demonstration Lesson Online* **Chair: Katherine Doyle**	**Beverley France** *Bringing Communities together: connecting learners with scientists* **Chair: Mary Oliver**	**Huann-shyang Lin, Frances Lawrenz & Zuway-R Hong** *Promoting and scaffolding argumentation through reflective asynchronous discussions* **Chair: Anne Hume**	**Christina Krumbacher** *Analyses of Learning process Sequences - a Video Study in Primary School Science Classes* **Chair: Mark Hackling**	**Pam Mulhall** *Developing the pedagogical content knowledge of preservice physics teachers* **Chair: Marissa Rollnick**	**Lawrence Bencze, G Michael Bowen, Shaun Chen & Allison Ritchie** *Youth as Socio-scientific Activists: Visions for School Science from Informal Contexts* **Chair: Khadeeja Ibrahim-Didi**	**Christine Preston** *Implications for teachers of primary children's free interpretation of science diagrams* **Chair: Tomokazu Yamamoto**	**Olivier Morin, Laurence Simonneaux, Jean Simonneaux & Laura Barraza** *Exploring Socio-Scientific Issues through Digital Technology: the Impact of Context and Culture* **Chair: M. Shaheed Hartley**

THURSDAY 28TH JUNE (Sessions between Lunch and Afternoon Tea)									
	POSTER 1 **The Brasserie**	**POSTER 2** **The Brasserie**	**POSTER 3** **The Brasserie**	**POSTER 4** **The Brasserie**	**POSTER 5** **The Brasserie**	**POSTER 6** **The Brasserie**	**POSTER 7** **The Brasserie**	**POSTER 8** **The Brasserie**	**POSTER 9** **The Brasserie**
2.30-3.00pm **Session 6**	**Shiho Miyake** *Which social aspects of science do Japanese science teachers and education researchers focus on more?*	**Kuan-Li Chen, Shiang-Yao Liu & Po-His Chen** *Development of a test for assessing energy literacy*	**Chin-Tsu Chen, Cheng-Cai Wang & Chun-Fu Chen** *A Study on Higher Education Brand Image, School Satisfaction and Behavioural Intentions*	**Yi-Jung Lin, Shu-Fen Cheng, Jer-Ming Hu, Meichun Lydia Wen & Yu-The Kirk Lin** *Developing loan boxes of university museum materials and teaching lesson plans*	**Lih-Lian Hwang** *Changes in Undergraduate Students' Cancer Awareness*	**Beverly Lowe** *Moving Teachers to New Horizons*	**Keita Muratsu, Shigenori Inagaki,** *Developing Argumentation Skills in Japanese Elementary Schools: A Case Study of 6th-grade Elementary School Students (11-12 years old) in Science Lessons on 'Static Electricity'*		
	Chair 1: Leonie Rennie **Chair 2: Peter Fensham**								
2.45-3.15pm	**Afternoon Tea -The Brasserie - Sponsored by Routledge Publishing**								

THURSDAY 28TH JUNE (Sessions after Afternoon Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
3.20-4.00pm **Session 7**		**Andrew Gilbert** *Using the notion of wonder to develop science content understanding with preservice science teachers* **Chair: Donna Satterthwait**	**Valerie Wing-yan Yip, Benny Hin-wai Yung & Ching Lai** *Learning to Teach Nature of Science: A Focus on Working with Students' Ideas* **Chair: Beverley France**	**Mpunki Nakedi** *Planned Actions, Reflective Practice and the Shifting Knowledge Insights from Physical Science Teachers' Case Studies* **Chair: Huann-shyang Lin**	**Retselisitsoe Mosoloane, Martie Sanders & Tony Lelliott** *Analysis of diagrams illustrating phases of the Moon in South African textbooks* **Chair: Susan Millar**	**Katherine Stewart** *Mobilising student learning in senior secondary school science* **Chair: Pam Mulhall**	**Rekha Koul & Vaille Dawson** *Diverse Classrooms: Promoting Inquiry based Science Teaching Methods in India* **Chair: Lawrence Bencze**	**Wendy Nielsen, Garry Hoban & Rachael Moll** *Social Interaction during Animation Construction: A Discourse Analysis of Discussion During the Making of a "Slowmation"* **Chair: Christine Preston**	**Gregory Thomas, Al Meldrum & John Beamish** *Conceptualization and Development of an Instrument for Investigating Undergraduate Physics Laboratory Learning Environments: The UPLLES* **Chair: Olivier Morin**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
4.05-4.45pm **Session 8**		**Carole Haeusler** *Evaluating a team-based approach in a science education course for pre-service primary teachers* **Chair: Andrew Gilbert**	**Greg Lancaster & Rebecca Cooper** *Team Teaching: Evaluating Benefits and Challenges for Teachers in a Senior College* **Chair: Valerie Wing-yan Yip**	**Jeong-yoon Jang & Brian Hand** *Modeling the Impact of Structured Reading Framework on Student Performance* **Chair: Mpunki Nakedi**	**Brendan Briggs** *Science as life, language and progress: A cross national comparison of the rationale for compulsory years' science education in Australia, New Zealand and South Africa* **Chair: Retselisitsoe Mosoloane**	**Sangeeta Varma** *The Dilemmas of Junior School Science Teaching: Societal Expectations, School Structures, Student Experiences, Teacher Accounts - a persistent issue in Science Education Research* **Chair: Katherine Stewart**	**Alberto Bellocchi, Donna King, Stephen Ritchie, Kenneth Tobin, Senka Henderson, Maryam Sandhu & Satwant Sandhu** *Eventful Learning in Pre-Service Science Education Classes: Reconciling Emotional Climate and Value of Experience* **Chair: Rekha Koul**	**Coral Campbell & Gail Chittleborough** *Investing in teacher professional development in science education to develop capacity to teach and promote student learning in science in primary schools* **Chair: Wendy Nielsen**	**Kathrin Otrel-Cass, Lars Domino Ostergaard, Per Johnsen & Jakob Krogh** *Tracing learning about astronomy during an ICT supported inquiry* **Chair: Gregory Thomas**

FRIDAY 29TH JUNE (Sessions before Morning Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
8.45-9.25am Session 1		**Elaine Khoo, John Williams, Kathrin Otrel-Cass, Darron Cutler, Michelle Ballard & Jim Critchley** *Observing, recording, and reviewing: Using mobile phones in support of science inquiry* **Chair: Marilyn Fleer**	**Hye-Gyoung Yoon, Mijung Kim, Yong Jae Joung, Young-Shin Park & Byung Sug Kim** *Pre-service Teachers' Understanding and Responses to Teacher Educators' Feedbacks on Inquiry Teaching Practice* **Chair: John Hunt**	**Robyn Gregson & Paul Rooney** *Realigning specialised pedagogical practices: science as the centre of science education* **Chair: Sibyl Wong**	**Phihlo Pitjeng & Marissa Rollnick** *Development and validation of a tool for measuring Topic Specific Pedagogical Content Knowledge (TSPCK) of the particulate nature of matter* **Chair: Jennifer Yeo**	**Denis Lajium & Richard K Coll** *Students' Mental Model of Chemical Reactions* **Chair: William Palmer**	**Junjun Chen, Bronwen Cowie & Angela Schipper** *Integrating Science with citizenship in a primary classroom: Being a citizen scientist* **Chair: Pam Farrelly**	**Marianne Logan** *Science as a Human Endeavour: Teachers' understanding relating to the implementation of this element into primary and secondary classrooms* **Chair: Christina Siry**	**Mahbub Sarkar & Debbie Corrigan** *Promotion of scientific literacy in Bangladesh: Teachers' perspective, practices and challenges* **Chair: Michael Michie**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
9.30-10.10am Session 2		**Judith Gomes & Marilyn Fleer** *A cultural-historical reading of scientific concept formation in families: Views from parents and teachers* **Chair: Elaine Khoo**	**Karen Marangio** *Learning progressions in psychology within the curricula policy documents* **Chair: Hye-Gyoung Yoon**	**Mary Oliver & Philip Adey** *Thinking Science Australia: professional development, an effective intervention and student gains with an effect size* **Chair: Robyn Gregson**	**Linda Hobbs** *Teaching 'out-of-field' as a boundary-crossing event: An agenda for examining identity issues for teachers of mathematics and science* **Chair: Phihlo Pitjeng**	**Youngsik Shin & Youngseok Jhun** ***Analysis of** Effectiveness of the Group Discussion on Science Writing Ability of Elementary School Student* **Chair: Denis Lajium**	**Christine McDonald & Deborah Heck** *"How do we teach argumentation in the new Australian Curriculum?" Secondary Science Teachers' Experiences in an Argumentation-based Professional Development Program* **Chair: Junjun Chen**	**Kenneth Tobin, Konstantinos Alexakos, Magorzata Powietrzynska, Natasha Dachos, Parvathy Nair, Glauco do Santos Ferreira da Silva & Victor Hugo Rodriguez** *Do learning environments afford wellness? A central conundrum in an emerging science of teaching and learning science* **Chair: Marianne Logan**	**Carolina Castano-Rodriguez** *The Australian National Curriculum: Science and the values on animals and nature it encourages* **Chair: Mahbub Sarkar**
10.10-10.35am	**Morning Tea -The Brasserie - Sponsored by Allen & Unwin Publishing**								

FRIDAY 29th JUNE (Sessions between Morning Tea and Lunch)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
10.35-11.15am **Session 3**			**Lawrence Bencze & Lyn Carter** *School Science For/Against Consumerist Societies* **Chair: Karen Marangio**	**Shinyoung Lee & Heui-Baik Kim** *Exploring the Model construction of Blood Circulation in Cognitive Collaboration between Small Group Members* **Chair: Mary Oliver**	**Bette Davidowitz & Nonkanyiso Vokwana** *Developing an instrument to assess grade 12 teachers' topic specific PCK in organic chemistry* **Chair: Linda Hobbs**	**Joseph Ferguson & Barbara Karmenia** *A Cultural Model of the Religious Student of Science - Is Learning Science Enough?* **Chair: Youngsik Shin**	**Russell Tytler & Vaughan Prain** *Informal reasoning and representation construction in school science* **Chair: Christine McDonald**	**Rekha Koul, Arpana Dhar & Rached Rafie** *Influence of Teacher Teaching Beliefs on Student Outcomes: A Case Study* **Chair: Kenneth Tobin**	**Coral Campbell & Gaye Williams** *The intentional teaching of science in early childhood settings* **Chair: Carolina Castano-Rodriguez**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
11.20-12.00pm **Session 4**			**Wendy Jobling** *Model Solar Vehicles provide an authentic context for learning is science* **Chair: Lawrence Bencze**	**Miki Sakamoto, Etsuji Yamaguchi, Junko Nishigaki & Tomokazu Yamamoto** *Argument Skill Acquisition among Grade 5 and Grade 6 Elementary School Students* **Chair: Shinyoung Lee**	**Rene Toerien** *Let's talk teaching in the township: Operationalising pedagogical content knowledge (PCK) in the context of two South African science classrooms* **Chair: Bette Davidowitz**	**Dalal Alhendal** *Kuwaiti Science Teacher Beliefs Regarding the Use of Inquiry-Based Instruction* **Chair: Joseph Ferguson**	**Anne Forbes & Keith Skamp** *Knowing and learning about science in primary school 'communities of science practice': The views of participating students in the MyScience initiative* **Chair: Russell Tytler**	**Yvonne Zeegers & Ian Clark** *Education for and about sustainability: an imbalanced juggling act?* **Chair: Rekha Koul**	**Heojeong Yoon, Mihye Won & David Treagust** *Teaching with a model for better scientific understanding: How do students actually interpret the bell-jar model for breathing mechanism?* **Chair: Gaye Williams**
12.00-12.45pm	**Lunch -The Brasserie**								

FRIDAY 29TH JUNE (Sessions between Lunch and Afternoon Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
12.45-1.25pm Session 5			**Dorothy Smith, Richard Gunstone & Christina E Hart** *The social location of scientists and their work: a study in progress* **Chair: Wendy Jobling**	**Bruce Waldrip, Vaughan Prain & Peter Sellings** *Improving reasoning and personalizing learning process through assessment* **Chair: Rene Toerien**		**Jiyeon Na & Jinwoon Song** *How do primary school students' everyday experiences affect their scientific argumentation* **Chair: Dalal Alhendal**	**Mary Grace Villanueva, Brian Hand & Jaime Sabel** *Developing Scientific Ideas using Writing-to-Learn Activities: The effects of* **Chair: Kathy Paige**	**(A)Mark Hackling & Karen Murcia** *Orchestration of Semiotic Resources to Support Co-construction of Explanation and Student Reasoning in Primary Science: An Australian case study* **Chair: Yvonne Zeegers**	**Garry Hoban & Wendy Nielsen** *The Affordances of Representations when Creating a "Slowmation": Preservice Teachers as Creators of Multimodal Digital Animations* **Chair: Heongjong Yoon**
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
1.30-2.10pm Session 6			**Marilyn Fleer** *Affective imagination in science education: Determining the emotional nature of scientific and technological learning of young children* **Chair: Dorothy Smith**	**Sakiko Nakashin, Etsuji Yamaguchi & Shigenori Inagaki** *Fostering Pre-service Teachers' Argument Skills Through Making Sense of Tradeoffs in Genetically Modified Food* **Chair: Bruce Waldrip**		**Grady Venville, Colin Hanbury & Nancy Longnecker** *"Choosing science comes more from the heart than from the brain (or the pocket)": A retrospective study of why scientists chose to study science* **Chair: Jiyeon Na**	**Leonie Rennie** *Scientists in Schools: Five Years On* **Chair: Mary Grace Villanueva**	**(B)Peter Hubber, Gail Chittleborough & George Aranda** *Connecting teaching and learning: Examining the strategies used to promote reasoning through rich discourse in an inquiry approach to teaching primary science* **Chair: Mark Hackling**	**Gillian Kidman, Tom Cooper & David Nutchey** *Get Into Vocational Education (GIVE): Motivating underperforming students* **Chair: Garry Hoban**

FRIDAY 29th JUNE(Session between Lunch and Afternoon Tea) continued									
	POSTER 1 The Brasserie	**POSTER 2 The Brasserie**	**POSTER 3 The Brasserie**	**POSTER 4 The Brasserie**	**POSTER 5 The Brasserie**	**POSTER 6 The Brasserie**	**POSTER 7 The Brasserie**	**POSTER 8 The Brasserie**	**POSTER 9 The Brasserie**
2.15-2.45pm **Session 7**	**Marlina Ali** *Physics problem solving differences between "more successful" problem solvers and "less successful" problem solvers in "lift problem" from a metacognitive perspective*	**Adam Bertram** *Exploring pedagogical content knowledge (PCK) with pre-service physics teachers*	**Hayashi Nakayama, Yuji Saruta, Eri Yammamoto & Norio Nomura** *Types of questioning terms in the Japanese Lower Secondary School Science Textbooks*	**Tzu-Ling Wang** *Hemispheric Preferences Related to Cognitive and Affective Learning Outcomes of Taiwanese Elementary School Students*	**Ming-Ling Lee & Meichun Lydia Wen** *The metacognitive knowledge analysis of Taiwanese junior high science textbooks pictures: A preliminary study*	**Jenny Donovan & Grady Venville** *Primary students' perceptions of the sources of their information about genes and DNA.*			
	Chair 1: Marilyn Fleer **Chair 2: Mark Hackling**								
2.35-3.15pm	**Afternoon Tea -The Brasserie-Sponsored by Cengage Learning**								

FRIDAY 29th JUNE (Sessions after Afternoon Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
3.20-4.00pm **Session 8**				**Xinxin Fan & David Geelan** *Effectiveness of an Active Instruction with Simulation on Misconceptions in Senior Secondary Physics Classroom in Mainland China* **Chair:** **Sakiko Nakashin**	**Angela Stott** *Adaptive technology as an agent of conceptual change* **Chair:** **Rene Toerien**	**Sally Birdsall** *Teaching Sustainability with a Science Programme: Effects on Young Children's Learning* **Chair:** **Grady Venville**	**Jim Scott** *How has ESSA testing of Y8 students in NSW government schools impacted science teaching and learning?* **Chair:** **Leonie Rennie**	**Jill Robbins & Robyn Babaeff** *'More than computers and digital technologies': Perspectives on early childhood technology in Singapore and Australia* **Chair:** **Peter Hubber**	**Rachel Moll, Wendy Nielsen & Cedric Linder** *Learning and Teaching in the 21st Century: Realities and Possibilities of Social Media* **Chair:** **Gillian Kidman**
4.05-4.45pm **Session 9**				**Sibyl Wong** *A case study of investigating possible factors affecting Chemistry teachers teaching Triplet Relationship in different settings* **Chair:** **Xinxin Fan**	**Jennifer Yeo, Hye-Eun Chu & Charles Chew** *Developing Students' Metavisual Capability in Electromagnetic Induction through a Visualization-based Instructional Package* **Chair:** **Angela Stott**	**William Palmer** *Professor John White Webster, science educator and convicted murderer* **Chair:** **Sally Birdsall**	**Pam Farrelly** *Middle School Students' Perceptions of Science: Aesthetics, Affordance and Agency* **Chair:** **Jim Scott**	**Christina Siry** *The collective construction of science curricula in a Kindergarten class* **Chair:** **Jill Robbins**	**Michael Michie** *Implementing both-ways science education teaching in an indigenous tertiary institution* **Chair:** **Rachel Moll**
5.00-6.30pm	**AGM FOR ASERA -Lecture Theatre 7**								
7.00-11.00pm	**CONFERENCE DINNER -4th Floor Restaurant, Mooloolaba**								

SATURDAY 30th JUNE (Sessions before Morning Tea)									
	Room 1 C1.39	**Room 2 C1.40**	**Room 3 C1.41**	**Room 4 C1.48**	**Room 5 C1.49**	**Room 6 C1.50**	**Room 7 HG.45**	**Room 8 HG.51**	**Room 9 HG.52**
9.00-9.40am Session 1					**Joel Rioux** *Teaching from Country: Queensland Aboriginal narratives and teaching of the Linnaean taxonomy in an indigenous classroom* **Chair: Brian Lewthwaite**	**Ally Bull** *Working together: Schools and the Science Community* **Chair: Beverly Lowe**	**Denis Goodrum** *The Status and Quality of Year 11 and 12 Science in Australian Schools* **Chair: Christine Howitt**	**Keith Skamp & Shelley Peers** *Implementation of science based on the 5E Learning Model: Insights from teacher feedback on trial Primary Connections units* **Chair: Leah Moore**	**Margaret Marshman** *Working with middle years student to design a local skate park* **Chair: Peter Aubusson**
9.45-10.25am Session 2					**Brian Lewthwaite & Kimberley Wilson** *Citizenship Science Education? Responding to the Voices of Aboriginal Communities* **Chair: Joel Rioux**		**Christine Howitt, Fiona Mayne & Leonie Rennie** *Learning science in playgroups through incursions: Methodological mastery or mayhem* **Chair: Denis Goodrum**	**Wilhelmina Van Rooy & Leah Moore** *Learning and teaching about the 2011 Japanese earthquake, tsunami and nuclear events from a socio-scientific literacy perspective: scaffolding for success* **Chair: Keith Skamp**	**Peter Aubusson** *Our national science curriculum - states of change and future scenarios* **Chair: Margaret Marshman**
10.30-11.00am	**Morning Tea -The Brasserie**								

SATURDAY 30th JUNE (Sessions between Morning Tea and Lunch)	
11.00-12.15pm **Session 3**	**ACARA** **LECTURE THEATRE 7** **Melanie Isaacs & Deborah Corrigan** **"this forum is about providing some detail on the development of the Australian Senior Secondary Science Curriculum and providing an opportunity for discussion"**
12.15-1.00pm	**Light Lunch - The Brasserie**

Kuwaiti Science Teacher Beliefs Regarding the Use of Inquiry-Based Instruction

Friday, 11.20am – Room 6

Dalal Alhendal
Griffith University

The current science education reform movement highlights inquiry-based instruction as a key idea in school science teaching. However, researchers have showed that implementing this form of pedagogical reform is difficult. Therefore, understanding factors influencing science teacher's implementation of reform is one of the most challenging issues in education research. Teachers' beliefs/ attitudes about curriculum and instruction may play a significant role in the implementation of reforms, so in this study the influence of Kuwaiti science teachers' beliefs and attitudes on their teaching behaviour was examined in order to understand the psychosocial factors affecting their use of inquiry-based instruction. To achieve this, the psychosocial theory known as the theory of planned behaviour (TPB) (Ajzen, 1985), was used alongside an adapted model of TPB known here as the Science Adoption Model (SAM).

Data were collected through a mail questionnaire with a sample of 496 teachers from all government primary schools in Kuwaiti. A key finding was that teachers' attitudes toward using inquiry-based instruction significantly influenced their capacity to create and deliver lessons that were based on that pedagogical approach. The Kuwaiti teachers in this study were less concerned about internal or external constraints (e.g. teaching resources, professional development opportunities, parent and administrators support, etc) and even less concerned about what others think of this practice. Teachers in this study also held positive attitudes toward the implementations of inquiry-based instruction. This optimism and confidence may be as a result of their cultural perspective. From the results, it is recommended that school administrators work closely with teachers to address their beliefs and concerns about their classroom practice and provide them with the required support for the successful implementation of inquiry-based instruction.

Physics problem solving differences between "more successful" problem solver and "less successful" problem solver in "lift problem" from metacognitive perspective

Friday, 2.15pm – Poster 1, Brasserie

Marlina Ali
Monash University

This paper is part of a PhD study, its purpose is to differentiate the physics problem solving processes used by "more successful" and "less successful" problem solvers working on a problem intended to be unfamiliar in type for the problem solvers. The problem involves calculation of the acceleration of a lift from changes in the readings of a set of bathroom scales that a lift passenger is standing on as the motion changes. The focus of the study was to see if the more successful problem solvers were more metacognitive in their approaches and, if so, what did these differences look like. The problem was given to 21 students, all Physics majors enrolled in a Bachelor of Science degree within the Faculty of Education at Universiti Teknologi Malaysia and data from the most successful 5 and least successful 5 were used for analysis. The chosen instruments for the study were participant observation and interview. Participants were instructed to "think aloud" as they went about solving the problem; they were then immediately interviewed about what they had said and drawn, with the goal of further exploring their problem-solving strategies. Data was transcribed and then analysed manually using NVivo.

The data showed that more successful" and less successful problem solvers did show clear differences in how they went about solving the problem. The more successful problem solvers set clear goals, needed to reread the question less in order to understand each part of the task set, drew diagrams that reflected deeper levels of thinking and spent more time thinking qualitatively analysis before and during the problem solving process. They used scientific representation to represent the variables operating in the task, they progressively monitored their thinking, when they changed approach it was because they identified a deficiency, and they evaluated their answers before finalising their response.

On the other hand, less successful problem solvers, set less clear goals than the more successful problem solvers and were less effective in achieving these because they prematurely leapt into substituting data into equations spending less time on qualitative analysis, frequently rereading the question. They also used naïve representation to represent the variables, when they changed approach it was to select a different equation and they did not evaluate their answers before finalising their response.

Cross-cultural Science Education Research: An objective lens?

Thursday, 10.35am – Room 7

George Aranda and Peter Hubber
Deakin University

This paper examines the methodology used in the ARC-funded 'Equalprime' study, which compares teacher's practice and their support of quality learning in primary science classrooms in Taiwan, Germany and Australia. Research groups in each country recorded video-data of teacher and student interactions of Year 4 primary science lessons for a science topic. A shared repertoire was used as a common mode of analysis to examine the cultural similarities and differences of teaching practice between teachers from each of the participating countries. Our research group examined three teachers in Victoria and an analysis was conducted using video-coding software which highlighted the similarities and differences between the teachers in terms of their teaching styles, pedagogic emphases, use of technology and class-activity time. The analysis highlighted the complexity of the video-data and that appreciable differences in teacher practice exist within different Australian cities, let alone international differences. While an analysis with a cultural lens was useful in highlighting cross- cultural differences between teacher practice in different countries, the results indicate that some differences in teacher practice can be accounted for by non-cultural reasons.

A framework for supporting the development of student agency in science classrooms

Thursday, 10.35am – Room 4

Jenny Arnold and David Clark
University of Melbourne

Student agency has been described as the driving force of student engagement and learning, yet there have been very few studies of student agency in science classrooms. The paper reports findings and implications of a research project operationalising student agency as a discursive practice. The purpose of the project was to provide insight into addressing the balance of agency in science education to improve knowledge of science teaching and learning practices as transformative education. A middle year's science classroom was filmed for an entire unit of work

and, drawing upon these records, classroom observation and post-lesson video-stimulated interviews with participating students, an instrumental case was constructed.
The findings highlighted the science classroom practices from the ontological perspective of three high achieving girls. The main implications were that the girls' small group operated like a sub-community of practice within their science classroom, and that designing for learning to enhance the positioning of students as personally and collectively agentic, and designing for student-initiated inquiry, are complimentary practices. A framework developed from the research for supporting student agency in the social constructive process of leaning in science is provided

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Our national science curriculum - states of change and future scenarios

Saturday, 9.45am – Room 9

Peter Aubusson
University of Technology Sydney

The way science curriculum can develop is interesting. Every now and then we create a crisis in science education. People write reports. These recommend change, including curriculum change, and point out the ways in which current patterns of school science education fail. The implication often is that we can fix this by thinking differently about school science, what is taught, how it is taught and what it ought to mean to learn school science. Every now and then this upheaval gives rise to the development of a science curriculum: a bright new document outlining science learning and teaching for the next generation. These have been launched with much fan fare in the past, but with varying levels of impact on the science experiences of teachers and students. The question arises: How might our latest attempt at a science curriculum fare? This paper explores the possibilities through the eyes of science education leaders from different parts of Australia. It reports analyses of conversations with these leaders to consider curriculum emphases; strengths and weaknesses; missed and realised opportunities. This leads to the development of potential scenarios for our future science education. These take into account possible alternative implementation strategies that might be adopted.

Children's drawings of climate change and animals

Thursday, 9.30am – Room 2

Laura Barraza, Edgar Caballero & Grace Wong
Deakin University, Australia and University of Heredia, Costa Rica

This paper provided some key information on how Mexican children from primary schools represent their understanding of the concept of climate change and its impact on animals by using drawings. A scientific concept is not simply an idea embedded in curricular documents and textbooks, but consists of a set of interlinked representations and practices Hubber (2010). Representations play a fundamental role in the teaching and learning of science. We use different representations in science, both in terms of what we use to teach, but also in terms of what we understand. They are the means by which we understand and communicate our science understandings. A total of 91drawings from children aged 11 and 12 were collected from 4 primary schools in the State of Michoacán, Mexico. We used qualitative data analysis software (Atlas-ti) with an inductive process to codify the drawings.

Preliminary results showed that children relate the concept of climate change to weather conditions without showing a clear understanding of the cycles involved in the process. Children showed few links and or connections with other issues related to climate change and some of them are concerned to what may happen to animals and humans as a consequence of this phenomenon.

Eventful Learning in Pre-Service Science Education Classes: Reconciling Emotional Climate and Value of Experience

Thursday, 4.05pm – Room 7

Alberto Bellocchi, Donna King, Stephen Ritchie, Kenneth Tobin, Senka Henderson, Maryam Sandhu and Satwant Sandhu
Queensland University of Technology

The role of emotion in educational encounters in higher education is an under-researched and under-theorized area. We explore the emotional climates of a pre-service science education class in this case study to inform practice for producing and reproducing quality experiences for pre-service science teachers. We use such methods as student perceptions of the emotional climate of their class, conversation analysis, and cogenerative dialogue from multiple compatible theoretical perspectives related to the sociology of emotions. The major outcome from our analyses is that even though students identified discrepant events demonstrations and role-play activities positively, they also recognized such practices as running commentary of demonstration lessons as valuable learning experiences for teaching. We reconcile emotional climate data and student comments in cogenerative dialogue to inform our understanding of quality experiences in teacher education.

School Science For/Against Consumerist Societies

Friday, 10.35am – Room 3

Lawrence Bencze & Lyn Carter
University of Toronto, Australian Catholic University

In many places in the world, school science and fields of professional science and technology/engineering appear to be enmeshed in a global economic system that prioritizes enrichment of relatively few holders of capital, largely at the expense of the wellbeing of many individuals, societies and environments. A major feature of this system — particularly in so-called 'knowledge economies/societies' — is an emphasis on creation of flexible consumer desires for idealized abstractions that may repeatedly occlude profitable compromises to products and services. Utopian visions mask dystopian realities. Pretty containers and promises of health and happiness may, for instance, distract consumers from low nutrient and high artificial ingredient content in manufactured foods. Such a consumerist ethos seems to be facilitated, in part, by school science in many jurisdictions. Fields of science are, for example, portrayed in school science as overly systematic, unbiased and unproblematic for individuals, societies and environments while, often, their professional practices may be compromised through capitalist partnerships. Drawing on McLaren's concepts associated with *revolutionary* pedagogy and actor network theory, a theoretical framework — with practical examples — for countering tendencies towards consumerism through school science are discussed.

Youth as Socio-scientific Activists: Visions for School Science from Informal Contexts

Thursday, 1.45pm – Room7

Lawrence Bencze, G Michael Bowen, Shaun Chen & Allison Ritchie
University of Toronto

Given the potential seriousness of possible problems associated with socioscientific issues, such as climate change, many jurisdictions urge educators to engage students in decision making regarding such issues. Scholars and others argue, however, that students also need to take sociopolitical *actions* — such as lobbying of power-brokers — to address issues. Experience indicates, however, that attempting this in formal schooling often meets structural barriers. School science systems tend, for complex reasons, to orient instruction towards students' passive acceptance of conclusions of fields of science and technology. Such an orientation appears not conducive to challenges to the authority of professional science and technology or their financiers. In the study reported here, we found that teenagers' research-informed activism in the context of an after-school club seemed, generally, relatively slow and somewhat 'timid' — in the sense of being limited to local and/or anonymous (at a distance) situations. In our analyses, it appeared that our choice to use a reflexive apprenticeship and students' sense of place in larger actor networks seemed to influence their outcomes. Implications of these conclusions for science education in formal contexts are considered.

Exploring pedagogical content knowledge (PCK) with pre-service physics teachers

Friday, 2.15pm – Poster 2, Brasserie

Adam Bertram
Monash University

It is well established in the research literature that the academic construct of PCK offers science teachers a valuable means of marrying their content knowledge with their pedagogical knowledge that can powerfully transform their teaching so that student learning is maximised. It therefore could be argued that it is imperative that science teacher education courses expose pre-service teachers to the concept and make a move toward developing these teachers' own PCK. This presentation offers the findings from a small study which explored how pre-service physics teachers (n = 5) might explicitly engage with the idea of PCK while on their teaching practicum. The pre-service teachers used content representations (CoRes) in preparing their lessons and were interviewed post-practicum to see how their understanding of PCK might have developed. The findings revealed that CoRes were useful in developing an informed understanding of PCK, even though sometimes the CoRe was difficult to fully complete because of their limited teaching experiences. All participants, however, felt that PCK was an important construct in shaping their understanding of teaching and learning, and they all agreed that embedding CoRes and PCK in this way in their pre-service course was particularly beneficial to their developing professional knowledge.

Teaching Sustainability with a Science Programme: Effects on Young Children's Learning

Friday, 3.20pm – Room 6

Sally Birdsall
University of Auckland

There is declining interest in science amongst students worldwide. To overcome this problem, educators like Derek Hodson recommend that science learning be set in contexts relevant to learners. The aim of this research was to explore children's learning that resulted from science programmes set in relevant contexts. One programme was taught in a class of 5-6 year olds and focused on their class garden and the other taught to 7-8 year olds and focused on bees. These programmes were underpinned by the concept of sustainability, one of *The New Zealand Curriculum*'s future-focused principles. Teacher professional development about sustainability was undertaken prior to teaching. An interpretivist methodology was employed and two cases constructed. Data were gathered from classroom teachers (n=2) and their children (n=18) through individual interviews, an assessment task and teachers' planning.
Children's data were analysed using a definition of sustainability developed by the researcher and teachers' data analysed thematically. The results showed that these children developed understanding of scientific concepts such as interrelationships between plants, animals and people and consequences of plant and butterfly life-cycles being interrupted. Some children were able to express an understanding of sustainability but this understanding was not what the teachers had planned to teach. Possible reasons for this discrepancy will be discussed.

Science as life, language and progress: A cross national comparison of the rationale for compulsory years' science education in Australia, New Zealand and South Africa

Thursday, 4.05pm – Room 5

Brendan Briggs
University of Canberra

As practiced and visionary texts, science curricula are important symbolic statements about the relationship between science and society. Curriculum informs not only whose and what scientific content is taught to students, but, why. This paper compares and contrasts the rationale for teaching and learning science in national curriculum statements for compulsory science education in Australia, New Zealand and South Africa. Drawing from *Curriculum Theory* and *Science and Technology Studies (STS)*, this paper utilises critical literature review and critical discourse analysis (CDA) to examine central themes across all three countries' rationales for science education. The assumptions made about the nature of science in each country are also discussed. Research findings suggest that each country's unique political and economic backgrounds have shaped not only their rationale for teaching and learning science, but, also, the way scientific knowledge is represented within their curriculum. Furthermore, across all three countries, three central curriculum themes are identified: science as 'life', science as 'language', and science as 'progress'. The paper concludes by suggesting concepts Australia could both learn from and contribute to, in the science curriculum statements of its international counterparts.

Working together: Schools and the Science Community

Saturday, 9.00am – Room 6

Ally Bull
New Zealand Council for Educational Research

Recently, in New Zealand, we have seen an increasing acknowledgement, at government level, of the importance of science and innovation to New Zealand's economic and social future. Strengthening our science education system to ensure success for *all* students is a complex issue. Addressing this challenge requires change in a number of areas – new teaching and assessment practices, and better linkages between science and education, for example.
The New Zealand Council for Educational Research is conducting research for New Zealand's Ministry of Education to provide information about the range of current science community and school initiatives aimed at supporting science education. This project aims to find out how various science community and school partnerships are established and sustained, how their successes are measured and the challenges or issues facing different kinds of initiatives. We are also hoping to identify other ideas and opportunities for supporting science learning success through science community engagement with schools. In this presentation we will share our emerging findings and draw on the expertise of the audience to identify similarities and differences between New Zealand and Australia in relation to the science community engagement with schools.

Investing in teacher professional development in science education to develop capacity to teach and promote student learning in science in primary

Thursday, 4.05pm – Room 8

Coral Campbell & Gail Chittleborough
Deakin University

Science has not been a priority in many primary Victorian schools, and national trends of falling interest in science has prompted the government to create new positions of science specialists in selected Victorian primary schools. This paper reports on the professional development experience of 42 teachers who have recently been appointed as science specialists in Victorian primary schools as part of this government initiative. This paper will describe the science specialist professional learning program and how this is translated into practice at the school. Interviews with the teachers, surveys about their professional development experiences and presentations of their unique situations were collected over the initial three month period of their training. These data are analysed with respect to defining the role of science specialists and the effectiveness of the professional development program. The findings identify the multiplicity of contexts, support, and role of diversity. It is argued that by investing in science specialists, the subject of science can be promoted, resources better managed, and teachers who are not confident in science mentored. In this way the benefits of the program extend from the science specialists to other teachers, students, the school and wider community by promoting and improving the teaching of science.

The intentional teaching of science in early childhood settings

Friday, 10.35am – Room 9

Coral Campbell & Gaye Williams
Deakin University

The introduction of the new "Early Years Learning Framework" (DEEWR, 2009) has shifted the focus in Early Childhood Centres (ECC) from incidental learning through play, to planning curriculum with play as the vehicle to achieve learning in science. Using student research, we identified instances of educator practice that fitted with the new framework, and videoed practitioners' sessions to select vignettes to use as part of an Early Childhood Science Education Unit. This presentation will discuss the varied practitioners' approaches we saw and students' and teachers' interpretations of forms of 'intentional teaching, with particular reference to science. We formulated an 'Intentional Teaching Spectrum' for the purpose of locating along it early childhood educator practice that differed in the opportunities that practice provided for creative and innovative children's activity. As this work is not yet complete, full analysis of the video material is yet to be completed, so descriptive aspects only will be discussed

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Transformative learning in science: progressing our sociocultural agenda

Thursday, 9.30am – Room 3

Lyn Carter, Melitta Jones & Carolina Castano-Rodriguez
Australian Catholic University

Significance: Sociocultural approaches to science education that aim towards scientific literacy for active citizenship have been increasing in recent years and are now firmly entrenched. Areas of interest are broad and include calls to socio-political action like those from Hodson (2003). Hodson argues that if contemporary social and environmental problems are to be solved, we need to orient science education strongly towards action. Included in much of this literature, either explicitly or implicitly, is the notion of a *transformation* in attitudes, behaviours, values, beliefs, and actions. While more often than not used colloquially, transformation is also a *term d'art* within the nascent field of transformative learning (TL). TL in not well known within science education, and we believe it may offer new insights into ways of progressing some of our sociocultural agendas.
Aim and Method: This paper describes proposed research to be conducted in Semester 2, 2012 that will use the key precepts and processes of TL including holism (intellectual, spiritual, value, moral, and emotional dimensions), disorientating dilemmas and critical reflexivity to enable science learners to critically identify and revise assumptions that are part of transformation. We ask what real TL may look like in a science classroom and what challenges and issues accompany its implementation.
Results: Results will be reported at future ASERA meetings

The Australian National Curriculum: Science and the values on animals and nature it encourages

Friday, 9.30am – Room 9

Carolina Castano-Rodriguez
Australian Catholic University

In the past decades there has been an increasing awareness of the human impact on the environment and on other species. Authors such as Andrzejewski, Pederson, and Wicklund (2009)

and Bekoff (2008), agreed that most education promotes a view of non-human animals as 'others' and does not incorporate the learning of aspects of animal lives and emotions which could challenge these views. This anthropocentric view could have significant impact in our attitudes towards nature and other animals and in the well-being of both humans and non-human animals.
Despite this, it is still unclear to whether the newly designed Australian Curriculum: science can (and want to) educate new generations of children that act more responsibly and ethically with other species and the environment. In this paper I examine the values that the Australian national curriculum: Science will promote regarding other species and nature. For this I carry a qualitative and quantitative analysis of the entire Australian curriculum: Science document. Results show that The Australian Curriculum: Science presents non-human animals as 'living things' often for the purpose of study and that ethical discussions regarding our attitudes to other species and the environment are absent from most years.

Integrating Science with citizenship in a primary classroom: Being a citizen scientist Activities

Friday, 8.45am – Room 7

Junjun Chen, Bronwen Cowie & Angela Schipper
University of Waikato

There is a call for building partnerships between schools and scientists in New Zealand to enlarge the opportunities students have to access science in authentic contexts. While it is not realistic for scientists to visit science classrooms as a regular event web-based videos hold out the possibility that students can engage with scientists in their own classrooms.
This paper reports on how New Zealand teachers used videos of New Zealand scientists talking about themselves and their research. The videos were sourced on the Science Learning Hub. Two researchers observed lessons in eight different classrooms for 21 uses of videos with students from Years 1 to 12 (age 5 to 16 years). Student and teacher interviews and teacher focus group discussions were conducted to explore the use of video in classrooms.
The five strategies were identified for video use including; bringing scientists into classrooms; connecting science with relevant local contexts; introducing a concept/phenomenon; promoting discussion; and linking to hands-on activities. The teacher's role in introducing the videos, interacting with their content and making explicit connections with the scientists in the videos is discussed.

Development of a test for assessing energy literacy

Thursday, 2.30pm – Poster 2, Brasserie

Kuan-Li Chen, Shiang-Yao Liu & Po-His Chen
National Taiwan University

Energy use is one of the critical environmental issues in recent years. Education for sustainable use of energy has become an agenda for school curriculum in Taiwan and elsewhere. This paper reports the development process of a test for assessing students' energy literacy. The framework for energy education was established through literature analysis and collation of expert opinions in our previous study. It comprises four dimensions: energy concepts, reasoning of energy issues, low-carbon lifestyle, and civic responsibility for a sustainable society. Referring to the design of PISA assessment, we compiled multiple-choice items and questions in groups within contexts that reflect to real-life situations requiring students to construct responses and make judgments. The test has been used for field study with a sample of 200 junior high school students. According to the results of item response analyses, 35 items were retained.

All participant students had above average performance on the energy concepts, reasoning of energy issues, and civic responsibility for a sustainable society. A national survey will be conducted using this test to evaluate high school students' energy literacy and accordingly provide a reference for promotion of energy education.

Critical Experiences to Build Understanding of Science Teacher Educators' Pedagogical Knowledge

Thursday, 1.00pm – Room 5

Rebecca Cooper
Monash University

The research looked to build understanding of science teacher educators' (STE) development of pedagogical knowledge (PK) using critical experiences (CE's) and investigate:

- The role of CE's in developing PK for STE's.
- Way/s STE's notions of PK develop/change over their career?
- Precursors to developing an understanding of PK for science teacher education?

Eight STEs from six Australian universities identified CE's from their career (all worked as secondary school science teachers prior to becoming STEs) during an interview. Interview transcripts were combined with notes from participant's to form cases, which were analysed to identify categories of CE's and theme/s for each participant. Morine-Dershimer and Kent's 1999 model of PK was used to help explain shifts and changes in thinking and teaching practice that participant's CE's revealed. The research indicates;

- CE's provide an exemplar, with a personal connection, to consider how a person's thinking and/or teaching practice has shifted with respect to the facets of PK.
- Keeping a focus on science plays a role in developing PK as an STE.
- Continual reflection and risk taking with teaching practice assists to challenge the notions of PK held as science teacher and shift them to accommodate the complexities of science teacher education.

Rethinking the Place of Context in Science Education

Thursday, 9.30am – Room 8

Deborah Corrigan, Alister Jones & Cathy Buntting
Monash University

This paper sets out to develop a conceptual framework for rethinking the role and place of context in policy, curriculum, teaching, learning and assessment in school science. Although much has been written about contexts in relation to science education, the theoretical basis for using context-based approaches is usually implicit rather than explicit, with emphasis on a general notion of relevance rather than specific articulation of relevance about what and to whom. There has also been an implicit view that the introduction of contexts will provide meaningful anchors that will assist students in making cognitive connections. We consider notions of fluency, disposition, discernment and competence in relation to contextual approaches in science education. The framework represents ways of knowing (which includes thinking and acting) in relation to contexts and has two continua: individual concepts to big ideas and simple applications to complex contexts. It will not only act as an analytical tool for examining existing contextual based teaching and learning but also can be used to consider appropriate ways in which contexts and the different types of contexts can be introduced and played out in classroom settings.

Developing an instrument to assess grade 12 teachers' topic specific PCK in organic chemistry science

Friday, 10.35am – Room 5

Bette Davidowitz & Nonkanyiso Vokwana
Cape Town University

In South Africa, a demanding senior secondary physical science curriculum has been introduced resulting in teachers having to master new material while simultaneously changing their conceptualisation of content and the way it is taught and assessed. A large proportion of grade 12 teachers have only studied their discipline to first year university level. A project has been established to investigate how teachers' knowledge of their subject matter affects the way they teach across several different contexts. One of the objectives is to develop instruments for assessing pedagogical content knowledge, PCK, of teachers in selected topics in chemistry and physics. An instrument based on the Big Ideas of the current curriculum for grade 12 organic chemistry has been designed. After piloting the instrument with selected expert teachers it is currently being used to collect data on subject matter knowledge and PCK from a diverse group of teachers. An existing rubric will be used to analyse the data to produce peer-validated raw scores. Rasch analysis will provide reliability estimates for the test items and the teachers. The instrument has the potential to provide baseline data for a large cohort of teachers as well as to evaluate any targeted interventions on teachers' PCK.

Science Teachers' Understanding of Climate Change: Does it Matter?

Thursday, 10.35am – Room 5

Vaille Dawson & Katherine Carson
Curtin University

It is undeniable that climate change is occurring and we are experiencing its effects. In Australia, in the last year alone, there have been devastating droughts, bushfires, cyclones and floods. It is increasingly important for students to understand the mechanisms and consequences of climate change. If students are to develop a sophisticated understanding then science teachers need to be well-informed about climate change science. In this pilot study, 29 teachers and 323 Year 9/10 students from 13 Western Australian schools were surveyed about their views of the importance of climate change science. Teachers and students also responded to questions to ascertain their understanding of climate change science, the challenges and consequences of climate change. Preliminary findings indicate that these teachers have a sound understanding of climate change science, recognising the importance of the greenhouse effect for life and the relationship between greenhouse effect and temperature. However a proportion of teachers do not teach any climate change science. In this presentation, the findings from the teachers are reported along with implications for preservice and inservice teacher education and curriculum development.

Primary students' perceptions of the sources of their information about genes and DNA

Friday, 2.15 – Poster 6, Brasserie

Jenny Donovan & Grady Venville
University of Western Australia

Prior research has established that students aged 10 and older have some knowledge about DNA and genes, and are already developing misconceptions about these concepts. Genetics is not part of the primary curriculum for any Australian state, and is to be taught to 15 year olds in the Australian curriculum. This raises questions about the source(s) of young students' conceptions and misconceptions. The mass media, particularly television shows such as *CSI: Crime Scene Investigation,* have been considered likely sources; however, no previous research has established whether this is the case. The purpose of this research was to investigate students' perceptions of their sources of information about genes and DNA. The sample was 141 students aged 10 to 12 in three Australian states. All students participated in a survey and a smaller sample (*n*=62) participated in an in-depth interview. Data were analysed quantitatively and qualitatively. The findings indicated that the majority of students perceived that television was their major source of information about genes and DNA. Of less importance were the internet and their parents. Information about the importance of specific television programs as well as the implications for curriculum and for the teaching of genetics is provided in the poster

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Culturally diverse children's representations of science procedures through digital video production: Overcoming barriers to participation myth

Thursday, 1.00pm – Room 2

Katherine Doyle & Michael Dezuanni
Queensland University of Technology

School science is an unpopular subject choice for students according to a number of eminent reports and reviews from the last decade such as PISA (2006) and Re-imagining Science Education (Tytler, 2007). Students with low literacy levels are particularly at risk of disengagement from science due to reliance on traditional print literacies. Media and 'science as popular culture' such as television programs are, however, popular with students and the multimodalities associated with video production allow new ways of participating in science learning. We investigated the impact of media arts implemented during explicit and implicit teaching practices, as a means of representing science, on Year Four students' science learning. The study was part of a larger, longitudinal project focussing on digital and print literacies in a low socio-economic, culturally-diverse public school. Results demonstrated that students actively participated in science processes and were able to explain and reason about science content. These results imply that media arts is a viable way of communicating science knowledge and processes. Therefore, media-arts as science teaching practice can potentially provide a more accessible modality to learning science processes and content.

Effectiveness of an Active Instruction with Simulation on Misconceptions in Senior Secondary Physics Classroom in Mainland China

Friday, 3.20pm – Room 4

Xinxin Fan & David Geelan
University of Queensland

This study is to develop an active instruction with simulation approach to help senior secondary students in Beijing, Mainland China to move away from their misconceptions and come to a deeper understanding of conceptions about force and motion. Working from the constructivist perspective, the concepts of misconception, inquiring learning and discourse sharing are examined. Empirical studies are extensively reviewed. A quasi-experimental mixed method design will be used; the Force Concept Inventory (FCI) will be used to measure students' misconceptions and correct understandings; semi-structured-interview, classroom observations and Frustration Test also will be used for data collection. The data will be analyzed using *t* test and Hake gain method. The results will compare (1) the effects of active instruction using interactive simulation with (2) active instruction without interactive simulation and (3) traditional instruction. The goal is to determine the most effective means of reducing the number of misconceptions students hold about force and motion. This study will provide evidence about the effectiveness of particular approaches for physics teachers to effectively deal with students' difficulties in physics. It is also intended to provide a methodological approach for researchers in education to evaluate the effectiveness of technological tools coupled with particular pedagogical approaches.

Middle School Students' Perceptions of Science: Aesthetics, Affordance and Agency

Friday, 4.05pm – Room 7

Pam Farrelly

The decline in rates of student participation in science in post-compulsory years at both secondary and tertiary level has resulted in an increased focus on research that promises to uncover the factors responsible for students' disenfranchisement with science. Despite the volume of research in this field, a small fraction of this literature concerns itself directly with the role played by the environment of the classroom; where 'environment' is taken as the ontological site of learning that includes what is afforded by the social and material world inhabited by students and teachers as agents.

This paper presents the preliminary results of a qualitative study of middle school students' perceptions of science and the level of socio-cultural significance they ascribe to it. Students' responses through interviews, the construction of Personal Meaning Maps (PMMs) and their aspirational accounts of what they see as possible ways of 'placing' themselves in science education; serve as the source material for this research. Student perceptions were drawn from these accounts using a theoretical framework that brings to the fore the aesthetic, moral and agentive aspects of students' experiences of the science classroom.

The Rise of Anti-Science in Australian Society: How have we gone wrong in school science education?

Thursday, 9.30am – Room 9

Peter Fensham
Queensland University of Technology/Monash University

This paper sets out to contrast the manner in which science and the contributions of scientists are now being presented in the public arena in Australia with the content and nature of science as it has, and still is, largely taught in schools and universities. Science in the arena of public life has become 'a contact sport" not a metaphor that the science curriculum uses. Since the beginning of the 21st Century there has been a decline in student interest in science in schools and universities, a decline in political, social and personal confidence in the authority of science, and increasing political stalemates over urgent issues involving science and technology. When these symptoms are used to re-examine what we have understand as school science, a number of its features are found wanting. Its abstractness, generalizability, established character, and the role given to empiricism, have provided much of its strength as knowledge. These features have now become seriously limiting if students are to be equipped for the public debates about science and these S&T issues. Some suggestions for the features of science that need now to be included in school science will be made and their implications for science teaching will be opened for discussion.

A Cultural Model of the Religious Student of Science - Is Learning Science Enough?

Friday, 10.35am – Room 6

Joseph Ferguson & Barbara Karmenia
Deakin University

This paper investigates the religious student of science's cognitive experience of studying evolutionary biology in a Victorian State secondary school. Four year 10 religious students studying science at a Melbourne, State secondary school, who were identified using the Religious Background and Behaviour Questionnaire, participated. Students were interviewed, responding to questions about their cognitive experience of studying evolutionary biology. Students' responses were analysed, using "cultural analysis of discourse," to construct a cultural model of the religious student of science. This cultural model suggests that these students employ a *human schema* and a *non-human schema*, which assert that humans are fundamentally different from non-humans in terms of origins and that humans have a transcendental purpose in life. For these students, these concepts seem to be threatened by evolutionary biology. The model suggests that because the existential foundation of these students is threatened, they employ a *believing schema* to classify their religious explanations and a *learning schema* to classify evolutionary biology. Importantly, these students are thus able to maintain their existential foundation while fulfilling the requirements of school science. However, critically, the quality of this *learning* is questionable.

Affective imagination in science education: Determining the emotional nature of scientific and technological learning of young children

Friday, 1.30pm – Room3

Marilyn Fleer
Monash University

Vygotsky (1986) draws our attention to the interrelationship between thought and language and other aspects of mind. Although not widely acknowledged, Vygotsky (1991; 1999) also drew our attention to the search for the relations between intellect and affect. This presentation discusses the preliminary findings of a study which examined the unity of affect and intellect (Vygotsky, 1999) in imaginary scientific situations within the early years. The central research questions examined: What is the emotional nature of scientific learning? and How does affective imagination support early childhood science learning? The findings of this under researched area (e.g. Roth, et al., 2008) make a contribution to understanding how affective imagination can work in science education.

Knowing and learning about science in primary school 'communities of science practice': The views of participating students in the MyScience initiative

Friday, 11.20am – Room 7

Anne Forbes[1] & Keith Skamp[2]
[1]Australian Catholic University, [2]Southern Cross University

MyScience is a primary science education initiative in which being in a community of practice is integral to the learning process. In this initiative, three key stakeholder groups - primary teachers, primary students and scientist mentors - interact around the 'domain' of investigating scientifically. This paper builds on two earlier publications and reports findings from researching nine Year 5/6 students' views of their involvement as first-timer participants in *MyScience*. The study aimed to provide insights into students' perceptions of their involvement in *MyScience* and how being in a 'community of practice' around 'investigating scientifically' influenced their views about science, science learning and science teaching. Perceptions of students' interactions with their peers, teacher and mentors were revealed mainly through students' interview responses and were analysed using attributes associated with both 'communities of practice' and the 'nature of science'. Findings reveal that students' perceptions of what it means to be 'doing science' were transformed through their participation and students were able to identify some of the contributing factors. Where appropriate, students' views were compared with the published views of their participating scientist mentors. Implications for science teaching and learning in primary school community of practice settings are discussed focusing on learning as participation (not acquisition).

Bringing Communities together: connecting learners with scientists

Thursday, 1.45pm – Room 3

Beverley France
University of Auckland

In the quest for improving conditions for learning there is a strong drive to make learning experiences more 'connected'. This research aims to identify the significant factors that improve connectivity when science communities and students meet. Twelve illustrative examples of connections-in-action have been analysed from case studies to provide empirical evidence of the

factors that enhance learning for students. Five key principles have been identified: the world views and epistemic beliefs of all participants should be identified; the purpose must be stated and linked to measurable outcomes; all participants must be aware of the purpose of/and their role in the project; that planning for learning is closely linked to the purposes of the connection and an awareness that students experience identity issues when transitioning into the science community. These findings provide research-informed directions for people developing future connective initiatives between learners and the science community.

Using the notion of wonder to develop science content understanding with preservice science teachers.

Thursday, 3.20pm – Room 2

Andrew Gilbert
RMIT

The question, at the heart of this study, was concerned with how to inspire interest in science with teacher candidates that have expressed a lifetime of negative associations with school science? Thus, this case study investigated if the notion of wonder could be utilized with preservice teachers as vehicle to develop science content understanding. Preservice teachers demonstrated meaningful content growth as a result of these experiences within the science methods course (pre and post testing via content standards). They also articulated more nuanced views for the Nature of Science in ways that demonstrated science understanding as tentative and dependent upon evidence. Initial interview analyses demonstrated a desire to learn more about the science content that they often claimed to detest before engaging in the experiences related to the study. In all, the results of utilizing a wonder framework with adult students offered promising results. This study further argues that we may need to conceptualize science as not just a way to understand the world but also to clearly demonstrate that it is a field of inquiry that is sustained by mystery, beauty and wonder.

Teaching science outside the classroom: the role of teachers' beliefs and teacher efficacy

Thursday, 11.15 – Room 4

Melissa Glackin
King's College, London

Researchers have shown that science teachers resist taking students outside for reasons that include a lack of confidence and expertise. However little is currently understood about how teachers' beliefs and teacher efficacy influence pedagogical practice outside the classroom. Findings from the study will inform suggestions for improvements to outdoor science professional development programme design. The aim was to explore the relationship between science teachers' beliefs and teacher efficacy on practice during a two-year outdoor science programme of professional development.
The study produced six case studies of teachers who had completed the professional development programme. Data consisted of: post-professional development session evaluations, lesson observations, post-lesson interviews and a STEBI questionnaire.
The study's methodology was situated within a qualitative interpretative/social constructive paradigm.

Analytical frameworks were developed from the research literature for science teachers' beliefs and teacher efficacy.
Four key findings emerged:
1. Teachers' beliefs concerning how children learn influenced the majority of other teaching related beliefs and pedagogical decisions;
2. Beliefs concerning subject discipline had limited influence on teachers' belief about teaching science outside;
3. Teacher efficacy relating to managing student behaviour influenced all teachers' pedagogical choices; and
4. Teachers with *high* rather than *very high* teacher efficacy were more likely to implement new practices.

A cultural-historical reading of scientific concept formation in families: Views from parents and teachers

Friday, 9.30am – Room 2

Judith Gomes & Marilyn Fleer
Monash University

Whilst there is a growing number of studies that have examined concept formation in the early years, little research has been directed to how families and teachers conceptualise how young children learn science at home and in other informal settings. What do families think is science? How do they believe children learn science within everyday life? What are parents' and preschool teachers' beliefs about the relations between play and science learning? The study reported in this session examined the everyday practices of children at home and in the early childhood centre that they attended, with the view to mapping how in everyday life science learning is enacted. The study also sought to gain the perspectives of families and teachers about young children's scientific learning through a guided interview and informal survey procedure. In drawing upon cultural-historical theory, an extract from the findings are presented and discussed. Recently, a cultural-historical perspective is recognized as more appropriate for describing children's scientific learning because this theorisation of child development goes beyond age as the criterion for determining content. A cultural-historical perspective seeks to examine scientific learning in relation to how everyday situations create scientific encounters that are realized through adult-child mediated actions at home and in the preschool

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The Status and Quality of Year 11 and 12 Science in Australian Schools

Saturday, 9.00am – Room 7

Denis Goodrum
Australian Academy of Science

The purpose of the study was to develop a clear understanding of Year 11 and 12 science in Australian schools and the potential issues involved. The research approach develops two pictures. The first picture captures the best of what we want for our science students; the ideal. The other picture is a clear appraisal of what is actually happening in Year 11 and 12 science classrooms at the present time throughout Australia.
The study employs a mixed-method design that measures overlapping but different aspects by which richer descriptions of the ideal and actual pictures are developed. Data sources include:

- a systematic review and analysis of state, national and international reports, science education literature and curriculum documents

- student survey of Year 11 and 12 science and non-science students in New South Wales, South Australian and the Australian Capital Territory in schools chosen by a stratified random sampling procedure
- telephone survey of senior science teachers in New South Wales, South Australia and the Australian Capital Territory in schools also chosen by a stratified random sampling process focus group meetings with students, teachers, scientists and community members.

Realigning specialised pedagogical practices: science as the centre of science education

Friday, 8.45am – Room 4

Robyn Gregson & Paul Rooney
University of Western Sydney

Numerous studies concerning the level of student dissatisfaction with current curriculums in secondary sciences raise issues of engagement and relevance. This paper asserts there has been a shift away from the signature pedagogies of science within secondary science curriculum development and that education policy advocating a focus on numeracy and literacy has led to homogeneity of pedagogy at the expense of the specialised scientific practices that make science a unique field of study. Issues are raised about the role of the training of scientists and science teachers in higher education institutions in developing student dissatisfaction. A qualitative single case study of higher education science and teacher training courses was used to determine the level of inclusion and value of specialised scientific practices. The study also investigates the understanding of specialised scientific practices as perceived by emerging professional scientists and pre-service science teachers. The findings reveal the need to realign signature pedagogical practices within higher education to assist in the engagement of secondary science students through the science education cycle from teachers to students and into the workforce.

Orchestration of Semiotic Resources to Support Co-construction of Explanation and Student Reasoning in Primary Science: An Australian case study

Friday, 12.45pm – Room 8

Mark Hackling & Karen Murcia
Edith Cowan University

There is an increasing recognition of the importance of multimodal resources that are used to support the construction of meaning in primary science classrooms. This study, framed from a socio-cultural and social semiotic perspective, investigated how one teacher provided rich opportunities for quality learning - by implementing a learning sequence in which a range of semiotic resources were orchestrated - to support the co-construction of an explanation of how the spinning of the Earth creates day and night. The manipulation of objects, gestures and other embodied representations, images and discourse were skilfully introduced to support the development of an explanation. These semiotic resources were used in particular combinations to maximise their affordances in supporting learning. This paper draws on data from the ARC Discovery 'Equalprime' study which is comparing the ways in which teachers support quality learning and reasoning in Australia, Taiwan and Germany.

Evaluating a team-based approach in a science education course for pre-service primary teachers

Thursday, 4.05pm – Room 2

Carole Haeusler
University of Southern Queensland

Many pre-service elementary teachers lack science content knowledge and the self-confidence to teach the mandatory science content required by the Australian Science Curriculum. This has prompted the Faculty of Education at USQ to investigate ways to improve student outcomes in both science content and science pedagogical content knowledge in a compulsory science education course. A collaborative science curriculum project designed to model the practice of effective teacher learning communities was chosen as a pedagogical strategy because team-based project work has been shown in the literature to increase long-term memory retention, critical thinking and teamwork skills. A research survey consisting of validated measures of team efficacy beliefs, team characteristics (conflict, trust, task interdependence, reflexivity) and student perceptions of science learning was completed by 136 pre-service science education students. Descriptive statistical analysis of the data revealed high positive ratings for team characteristics and science learning outcomes, with no significant difference between the responses of face-to-face and online teams. The results of this research will inform the delivery methodology of on-campus and online pre-service science education courses.

Successes, challenges and limitations of a professional development course to upgrade fifty rural science teachers in South Africa

Thursday 1.00pm – Room 9

M. Shaheed Hartley
University of Western Cape

Science and mathematics education has been identified as a national priority in education in South Africa. Over the past years a number of professional development initiatives were launched in an attempt to address the crisis. This paper reports on the successes, challenges and limitations of a professional development course conducted for 50 science educators in the Eastern Cape Province in South Africa. The objective of the course was to upgrade and upskill rural science teachers through a series of training modules specifically designed to address (1) content knowledge, (2) teaching strategies and (3) practical and experimental skills in the physical sciences. The teacher development programme included a strong element of learner support that involved various science-related projects and science activities for learners. Data were collected from student records, examination records of performance in different modules, teacher portfolios as well as group interviews. By looking at the success rates of teachers we explore whether the programme has been successful in developing teachers in each of the three selected areas. This paper has implications for teacher training regionally and nationally and will serve to provide baseline data for further research.

The Affordances of Representations when Creating a "Slowmation": Preservice Teachers as Creators of Multimodal Digital Animations

Friday, 12.45pm – Room 9

Garry Hoban & Wendy Nielsen
University of Wollongong

A growing body of research has identified the value of learners creating their own representations of science concepts (Prain, 2006; Tytler & Prain, 2010). Most studies have involved them generating monomodal representations such as writing or sketches but increasingly technology is being used to enable learners to create multimodal digital representations such as animations, movies and PowerPoint presentations (Hoban & Nielsen, 2010).
The aim of this paper is to analyse the nature of affordances in the five representations that are usually involved when preservice teachers design and make a slowmation to explain a science concept. A slowmation is a simplified way for students to learn science by making a stop-motion animation, which is a multimodal digital representation. Case studies of preservice teachers, who were video and audio taped as they created a slowmation, showed that they create a sequence of five representations, each being a semiotic system with particular affordances that link as a *semiotic progression* (Hoban, Loughran & Nielsen, 2011). This presentation will discuss the affordances of each representation and its influences on students' thinking and learning.

Teaching 'out-of-field' as a boundary-crossing event: An agenda for examining identity issues for teachers of mathematics and science

Friday, 9.30am – Room 5

Linda Hobbs
Deakin University

Teacher supply and demand are significant policy issues both nationally and internationally. Quality education requires an adequate supply of teachers; however, shortages of qualified teachers, particularly in secondary mathematics and science, and particularly in rural and regional Australia, have led to an increase in the number of teachers teaching outside their subject area, a practice called teaching 'out-of-field'. The issues around this increasingly common practice are not widely researched and are under-theorised. A qualitative pilot study (funded by SiMERR) using teacher interviews in three rural schools examined meanings, support mechanisms and teacher identities associated with out-of-field teaching. A thematic analysis isolated factors influencing whether, and why, teachers self-assessed their practice and identities as out-of-field. The 'Boundary Between Fields' Model was developed to provide a framework using the boundary-crossings literature for examining the factors that influenced the nature of teachers' negotiation of subject boundaries and its impact on professional identity. One of the recommendations of the pilot study is that greater focus is needed in teacher education on the skills, knowledge and attitudes that increase teachers' adaptability when faced with teaching outside their discipline. The model generated by this study underpins our new agenda to follow early career teachers from university into schools to examine relationships between approaches to disciplinary methods in secondary education programs, and early career teachers' coping strategies in their first years of teaching, particularly when faced with the additional challenge of teaching out-of-field. This line of inquiry aims to clarify the complexity behind teaching out-of-field by investigating relationships between teacher confidence, subject commitment, and identity, and by investigating factors that lead to teachers' differing pedagogical and personal responses.

Enhancing Elementary School Students' Active Learning, Positive Thinking and Decreasing Their Anxiety in Learning Science

Thursday, 10.35 – Room 6

Zuway-R Hong, Huann-shyang Lin, Hsiang-Ting Chen, Hsin-Hui Wang, Chia Jung Lin & Tien-chi Yu
National Sun Yat-sen University

The purpose of the study was to investigate the effects of improving elementary school students' active learning and positive thinking and decreasing their anxiety in learning science through integrating aesthetics in science teaching. A total of 135 4^{th} graders (68 boys and 65 girls) participated in the study. Thirty-six students volunteered to participate in a 12-week intervention and formed the experimental group; 97 4^{th} graders volunteered as the comparison group. In addition, 4 target students with the highest scores and 4 target students with the lowest scores on the pretest of Science Learning Scales or Positive Thinking Scale were recruited to be observed and interviewed. All participants completed a 131-item investigator-developed instrument which assessed students' Science Learning, Positive Thinking, and Anxiety in Learning Science. Confirmatory Factor Analyses were conducted to evaluate reliability and validity of instruments; analyses of covariance (ANCOVAs) measured the significant differences between the two groups. The initial findings revealed that the experimental group on the scales of *Optimism*, *Appreciation, Learning Goal Orientation* and *Attitude to Subject.* Meanwhile their anxiety in learning science was significantly lower than the comparison counterparts. Implication and recommendation are discussed.

Learning science in playgroups through incursions: Methodological mastery or mayhem

Saturday, 9.45am – Room 7

Christine Howitt, Fiona Mayne & Leonie Rennie
University of Western Australia

Playgroups present a unique and untapped context for introducing science to young children. This presentation will introduce the new *Small Steps in Science* project that aims to develop knowledge about how best to structure incursions into the playgroup setting to promote science understanding. The emphasis of the research is to promote opportunities for young children and their parents to develop a greater understanding of science, and to increase the interaction between young children and their parents within the incursion. Additionally, the research will investigate how the program can be extended beyond the incursion and into the home in order to maintain engagement in science. The repeated case study research design planned to utilise multiple methods of data collection including observation, questionnaires, semi-structured interviews, home journals, focus group interviews and conversations with children. However, the pragmatics of collecting data from very young children and parents of young children highlighted the necessity of a flexible and emergent approach. Results from the pilot trial will be interpreted in light of methodological and ethical issues that became evident in conducting this research and how these were successfully overcome.

Reasoning through representation: Contrasting cases of learning sequences in Taiwan and Germany

Thursday, 11.15am – Room 7

Chao-Ti Hsiung[1], Russell Tytler[2], Joerg Ramseger[3], Sharon Chen[4], Gisela Romain[3] & Ines Freitag-Antmann[3]
[1]Taipei University of Education, [2]Deakin University, [3]Free University of Berlin, [4]Taiwan Normal University

Reasoning is increasingly recognized as an essential feature of quality learning, in science and generally. This paper draws on data from the ARC funded 'Equalprime' study which is comparing teacher support of quality learning in primary science classrooms in Taiwan, Germany and Australia. The paper will only analyze two lesson sequences –on 'the moon' in Taiwan, and on 'levers' in Germany. These sequences were chosen because they both exhibit richness in how multiple representations were coordinated over the learning sequence, yet the meta discursive rules operating in the classroom, in terms of who gets to speak about what, and how representations are introduced, are starkly contrasting. Data collection consisted of video capture of all lessons, teacher and student interviews, and collection of student artifacts. The Taiwanese sequence was characterized by strong teacher guidance, good at using multi-teaching resources, and whole class as well as group focused questioning. The German sequence followed a dialogic model where student ideas were given prominence and science ideas emerged through guided tasks and extended class discussion. The paper will discuss the different ways reasoning may be thought of in these classrooms, and the cultural determinants underlying these different quality practices.

Connecting teaching and learning: Examining the strategies used to promote reasoning through rich discourse in an inquiry approach to teaching primary science

Friday, 1.30pm – Room 8

Peter Hubber, Gail Chittleborough & George Aranda
Deakin University

This paper examines the teaching approaches used by an experienced Australian primary science specialist teacher to engage and challenge children and promote reasoning through an inquiry approach to teaching science. The paper draws on data from the ARC funded 'Equalprime' study which is comparing teacher support of quality learning in primary science classrooms in Taiwan, Germany and Australia. Video data from Grade 4 science lessons and interviews with the teacher and students provides evidence of this teacher's priorities of making science enjoyable and engaging; having students take responsibility for their learning; allowing time to learn, listening and getting feedback from the children and revisiting ideas. The analysis examines the pedagogical, technical and practical choices that this teacher makes to achieve his objectives, and analyses the teacher led discourse that challenges children's ideas, poses questions and encourages students to identify and articulate reasons (or backing) to explain science phenomena. The results demonstrate the significant role of the teacher in guiding individual students as they learn to think and reason various relationships in scientific concepts. This research is significant because it provides insight into pedagogical practice that promotes reasoning and highlights how this teacher's practice accurately exemplifies his philosophy and pedagogy.

The impact of expert input into CoRe design on the PCK of early career

Thursday, 1.00pm – Room 4

Anne Hume & Chris Eames
University of Waikato

This paper builds on research that shows Content Representation (CoRe) design is a viable means of developing the pedagogical content knowledge (PCK) of science teachers. To explore further uses of CoRe design, the key area of early career teacher education was chosen as the focus for the investigation and the scope was broadened to include science and the learning area of technology. The first phase of the study sought to determine how input into CoRe design from a unique partnership of expert classroom teachers, content experts, early career teachers and researchers might impact on the design process and the resultant CoRe. Follow up phases revealed how the early career teachers then used these CoRes in their planning and delivery of related classroom programmes and the nature of their students' learning. This presentation covers the research design, including an analysis of the CoRe development, followed by its implementation into classroom practice and the effect that had on the early career teachers' PCK and student learning

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Changes in Undergraduate Students' Cancer Awareness

Thursday, 2.30pm – Poster 5

Lih-Lian Hwang
Ming Chuan University

Cancer has been the leading cause of death for previous three decades and is also the third leading cause of death for the 15 to 24 year old population in Taiwan. The ability of educational intervention to improve students' cancer awareness was investigated. Undergraduate students enrolled in three different classes of the same 'Medicine and Health' course taught by the same teacher were invited to participate (N=211). Class A (n=71) and class B (n=70), the two experimental groups were given the cancer educational program separately. Class C (n=70), the control group, was given a stroke educational program. The mean total scores of awareness of cancer risk factors and warning signs of class A, class B and class C were 11.8, 11.7 and 11.8 at pretest, 16.7, 15.7 and 13.0 at post-test and 16.6, 16.4 and 13.5 at retention test respectively. With pretest score as a covariate, an ANCOVA revealed that the mean scores of posttest and retention test for the two experimental groups were all significantly higher than those of the control group. This research highlights the need to improve undergraduates' cancer awareness, the effectiveness of the educational intervention and its sustained impact on awareness after nine weeks.

Justification of reasoning: The challenge from a multi-modal perspective

Thursday, 1.00pm – Room 7

Khadeeja Ibrahim-Didi, Mark Hackling & Karen Murcia
Edith Cowan University

The current focus on students' reasoning within the science education literature recognises that reasoning if often multi-modal. This paper explores the relationship between the generative elements of reasoning and their evaluation from a multi-modal perspective. It presents data from a study embedded within an ARC-funded study (Equalprime) to explore quality teaching and learning in primary science across Germany, Taiwan and Australia. Selected data from an Australian primary

science, nine-lesson unit on “Spinning in Space” will be used to illustrate how evaluative coherence is achieved when students employ different forms of reasoning to make sense of how day and night are caused . Video and audio data of both whole-class and small-group settings, as well as data from student and teacher interviews were collected along with student work samples and teacher notes. The paper shows how student understanding is sensitive to temporally emergent understandings within the group as a result of manipulative, gestural and verbal representation-based interactions. The results suggest that when more informal modes of interaction (manipulative, or gestural) are at play alongside the more conventional forms of reasoning, the generative and the evaluative components of reasoning are much more integrated than in conventional discourse-based reasoning

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Three children explore scientific ideas of matter using 21st century interactive

Thursday, 11.15am – Room 2

Cheryl Jakab
University of Melbourne

Today a wide range of readily available interactive resources designed for 6-11 year old learners' direct these 'digital natives' towards and progress scientific thinking. Many ideas that were once difficult for scientists and adults to envisage are now easily explained visually in kid friendly interactives and simulations: the particulate nature of matter being a prime example.
This paper reports on the 'sayings and doings' of three children as they interact with one such 'particles' visualisation resource. A fine grained analysis of their 'sayings and doings' is presented, using affordances (Gibson, 1978), positioning theory (Harré, 1999), discursive psychology and distributed cognition (Salomon, 1993). The analysis provides insight into how visualisations can create cultural contexts and cognitive tools (Gauvain, 2001) for exploration of scientific ideas and enhance learner progress towards more sophisticated scientific thinking.
The three subjects of this paper vary in their everyday knowledge of molecules (Jakab, 2011). Each child progresses with their scientific understanding while playing on the same interactive website. Using ICT can clearly support successful learning (Reimann and Goodyear, 2004; Ng, 2011). Noss goes further, describing available visualisations and simulation tools as affording new 'learnabilities' and 'teachabilites' for scientists, adults and children (2011).

Modeling the Impact of Structured Reading Framework on Student Performance

Thursday, 4.05pm – Room 4

Jeong-yoon Jang & Brian Hand
University of Iowa

The main purpose of this study was to examine the structural relationship between two different writing-to-learn activities within an argument based inquiry approach, which are a Structured Reading Framework (SRF) and a Summary Writing Task (SWT). Data were collected from 170 middle school students through students' writings. Structural equation modeling was used to test hypothesized relationships among variables of the SRF and SWT. The results suggested that the hypothesized model fits satisfactorily to the data (RMSEA = 0.028). Also, as expected, SRF was related positively and significantly to SWT (standardized coefficient = 0.74), and all parameters estimated were statistically significant. The Implications of these findings for future research are discussed.

Model Solar Vehicles provide an authentic context for learning is science

Friday, 11.20am – Room 3

Wendy Jobling
Deakin University

The Department of Education and Early Childhood Development (DEECD) in Victoria has recently provided a professional learning program to develop science specialists in Victorian primary schools. Deakin University staff was responsible for implementing some sections of the program. As part of this, one of the school clusters has followed up with a plan to introduce their upper primary students to designing and making model solar boats. This paper will report on the substantial science learning to be gained through such an activity, particularly in terms of its integration with *Design, Creativity and Technology,* which is how the science is applied. The importance of professional learning is a key to the success of such a program where hands-on workshops are provided to primary students and their teachers. The culmination of this process is a competition held in the latter part of the year, which not only involves the production of a boat, but also a poster detailing the design and making process including testing . (Although this reports on a Victorian case the competition does allow state winners to compete at a national level.)

Correlation between reasoning abilities and academic achievements amongst Physics 'A' level Brunei students

Thursday, 10.35am – Room 2

Marlizayati Binti Johari, Nor'Arifahwati Binti Haji Abbas & Ak Modh Rahiman Bin Pg Aliudin
Universiti Brunei Darussalam

The development of students' science reasoning abilities is one of the main goals in science education. The current indicator for Brunei students to be able to take science subjects at 'A' level is based on their 'O' level science academic achievement. The assumption made is that the students are equipped with the required cognitive and reasoning abilities to cope with 'A' level science subjects. Thus the aim of the study is to investigate the correlation between physics students' reasoning abilities and their academic achievement. Three sets of reasoning abilities tests were administered to 391 year 12 physics students from the form 6 centres in Brunei Muara district. Using one way MANOVA analysis, there was a statistically significant difference between students' academic achievement on their reasoning abilities test scores. Further analysis showed that there is a significant difference in the abstract reasoning score between A grade students and B grade students ($p = .003$), and between A grade students and C grade students ($p < .0005$) but not between B grade students and C grade students ($p = .399$). However, there is no statistically significant difference between academic achievement and verbal reasoning abilities, and between academic achievement and spatial reasoning abilities.

Learning via Slowmation: What is possible?

Thursday, 9.30am – Room 7

Gillian Kidman[1] & Stephen Keast[2]

[1]Queensland University of Technology, [2]Monash University

Based on their research with primary preservice science teachers, Hoban and Neilsen (2010) proposed the Five Rs model (5Rs) for understanding how learners engage with slowmation when learning about science concepts. In this paper an alternative model that builds on the 5Rs model is offered which, emerged from the authors work with secondary preservice science teachers in two different tertiary institutions in Australia. For the secondary context, the authors propose an extension of Hoban and Neilsen's (2010) 5Rs model to reflect the Semiotic Mediation that takes place within group learning. Reviewing the 5Rs model, the authors identified four key stages for their preservice teachers in working with slowmation; background knowledge, animation and editing, presentation and explanation and reflection. These four stages have been combined to form the Learning MMAEPER model which suggests that learning occurs when background knowledge is socially linked allowing individual's to "make meaning" that can be displayed in the form of a slowmation.

Get Into Vocational Education (GIVE): Motivating underperforming students

Friday, 1.30pm – Room 9

Gillian Kidman, Tom Cooper & David Nutchey

Queensland University of Technology

This study explores the effects of a vocational education-based program on academic motivation and engagement of primary school aged children. The *Get Into Vocational Education* (GIVE) program integrated 'construction' and the mathematics, English and science lessons of a Year 4 primary classroom. This paper focuses on investigating the components of the GIVE program that led to student changes in scientific academic motivation and engagement. The components proposed to have contributed to effectiveness of the GIVE program are: teacher and trainer expectations, task mastery and classroom relationships. These findings may be useful to researchers and educators who are interested in enhancing students' scientific academic motivation.

Influence of Teacher Teaching Beliefs on Student Outcomes: A Case Study

Friday, 10.35am – Room 8

Rekha Koul[1], Arpana Dhar[1] & [2]Rached Rafie

[1]Curtin University, [2]Rosmoyne Senior High School

In this paper a case study is presented to highlight the impact of epistemological beliefs of a science teacher on science teaching to lower secondary science class. This case study was part of a longitudinal study aimed at assessing the effectiveness of co-teaching and co-generative dialogue on student perceptions and understanding. The study reflects on the teaching strategies designed and administered by the science teacher within the limits of curriculum to improve student understanding of selected science topics. Providing a variety of interactive learning opportunities enhanced student motivation, interest and enthusiasm to participate in the learning process leading to deep conceptual understanding. It also strengthened the concept that teachers holding constructivist belief and applying that in their teaching strategies resulted in better student learning outcomes than teachers holding empiricist beliefs (Hashweh, 1996).

Diverse Classrooms: Promoting Inquiry based Science Teaching Methods in India

Thursday, 3.20pm – Room 7

Rekha Koul & Vaille Dawson
Curtin University

Given the diverse socio-cultural nature of the student population of Indian classrooms it is imperative that science teachers be prepared to critically examine, reflect on and respond to practices for learners with diverse needs and from diverse backgrounds. Language development, students' contextual understanding, world-views, quantitative and visiospatial reasoning skills and social skills, all contribute to preparing students to become productive scientists. While these aspects are found in varying degrees across students in classrooms in any part of the world, addressing them poses a challenge in the face of greater socio-cultural diversity, e.g., diversity in ethnicity, religion, region, habitat, language, and gender. This paper reports the findings of a project, where three day professional development workshops were conducted for Indian science teachers to enrich their teaching practices in diverse classrooms. Indian science teachers were introduced to and then engaged in inquiry based teaching methods based on the Australian Academy of Science, 'Science by Doing' materials. The professional development workshops provided opportunities for teachers to ask questions and work collaboratively with their peers to generate novel solutions using their science content knowledge. Most teachers enjoyed the workshop and found the contents useful. A challenge many of the teachers faced was how to implement the strategies within large classes in resource deficient classrooms

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Analyses of Learning process Sequences - a Video Study in Primary School Science Classes

Thursday, 1.45am – Room 5

Christina Krumbacher
University of Duisburg-Essen

Recent studies show a lack of structure in German primary school science lessons, which is unsatisfying because lesson structure is seen as a good predictor for students' knowledge acquisition. To support successful learning processes, it is assumed that lessons should follow key teaching goals that are described e.g. by Oser and Baeriswyl (2001) in detail. Three of fourteen learning processes have been found to be most important for science teaching: learning through experience, problem solving and concept building (Reyer, 2004).
To explore how to apply these learning processes in a lesson, an intervention study was conducted, based on Oser's theory to evaluate the effects of a learning-process-oriented teaching style. A teaching unit implementing all three processes was taught in five classes (Grade 4). The implementation of the different steps relating to one process will be evaluated using video analysis. Learning achievement, first measured with a pre-post test, was highly significant ($p < .001$) with a medium to large effect size ($d = .77$). The presentation will cover the model of learning processes used, the design and the performance of the study and first results of the video analysis.

Students' Mental Model of Chemical Reactions

Friday, 8.45am – Room 6

Denis Lajium & Richard K Coll
University of Waikato

This study investigated students' mental models of chemical reactions at different educational levels. Previous research on topics such as atomic structure and chemical bonding indicates that students' mental models are typically inconsistent with the scientific model, which seems to impede learning of advanced concepts. International research suggests that model-based teaching and learning in science education show promise in overcoming student misconceptions but research about modelling for chemical reactions is sparse. In this work, interviews were used to probe students' mental models of chemical reaction for various chemical phenomena. A thematic analysis on the students' discourse and sketches of their mental models revealed different types of mental models.
Some students' alternative conceptions remained despite advanced educational level, and collision theory is preferable to more sophisticated chemical bonding/energy-based considerations. Students who draw upon chemical bonding in their mental model are more likely to understand the relationship between chemical reaction and energy transfer.
Overall, it seems that lack of understanding about the nature of energy and its function in chemical reaction is the main issue. This study suggests that students should be confronted with more chaotic nature of science for a better understanding of the nature of scientific models.

Team Teaching Evaluating Benefits and Challenges for Teachers in a Senior College

Thursday, 4.05pm – Room 3

Greg Lancaster & Rebecca Cooper
Monash University

The practice of Team Teaching (Buckley, 2000) is widely implemented in schools and acknowledged for its benefits to whole school planning and administration. Alternatively, the adoption of team taught classes has seen only limited use, being largely restricted to combined classes of 'middle years' students in open plan classrooms. At present, team taught classes appear to be rarely implemented across schools in senior classes.
This paper reports on findings of a joint research project undertaken between a senior specialist school and members from the Monash Science Education Research Group focused on the school's adoption of team teaching and team taught classes as a fundamental pedagogical approach across the school.

An analysis of the findings indicate that while the teachers may struggle to build a shared understanding of what Team Teaching may mean they do agree on common requirements that contribute to effective team taught classes in which each teacher feels equal freedom to both contribute to and direct the lesson. Teacher reflections on their use of learning spaces supported by classroom observations, confirm that the school's flexible open learning spaces can be used in ways that specifically enhance the practice of team teaching leading to greater lesson flexibility.

The metacognitive knowledge analysis of Taiwanese junior high science textbooks pictures: A preliminary study

Friday, 2.15pm – Poster 5

Ming-Ling Lee & Meichun Lydia Wen
National Changhua University of Education

In the past, the use of content analysis to explore science textbook presents the depth and breadth of scientific knowledge, and also reveals the abstract/concrete and micro/macro dimensions of scientific knowledge related to research explores the reasons for learning difficultly. This study attempted to analyze the characteristics of the content of junior high school science textbook pictures through, somewhat different pathways of previous textbook research methods, three aspects of metacognitive knowledge including declarative knowledge, procedural knowledge and conditional knowledge. The results showed that there were differences in the distributions of the three kinds of metacognitive knowledge among Biology, Chemistry, Earth Science, and Physics subjects. Additionally, there were more declarative knowledge in Biology, more procedural knowledge in Chemistry, and more conditional knowledge in Physics separately. The result also showed that science textbook pictures contained more declarative knowledge, followed by procedural knowledge, and then followed by conditional knowledge.

Exploring the Model construction of Blood Circulation in Cognitive Collaboration between Small Group Members

Friday, 10.35am – Room 4

Shinyoung Lee & Heui-Baik Kim
Seoul National University

The purpose of this study was to investigate the quality of group models and students' understanding of blood circulation according to the social interaction pattern**.** Nine groups of three or four students in 8th grade participated in the modeling activity; group discussions were fostered through trigger questions. The analysis of the group discourse revealed three social interaction patterns varying as the cognitive collaboration among peers and participation in discourses: collaborative-collective, collaborative-multiple, non-collaborative-multiple. The group models developed in a collaborative-collective group as well as two collaborative-multiple groups and a non-collaborative-multiple group reached at certain standard of a target model. While models were developed by cognitive support between peers in collaborative interaction, the models built in non-collaborative interaction were strongly influenced by the leader's self-reflection. On the other hand, it is found that students' participation in group discourse allows them to internalize the model. In collective interaction, all group members showed confidence in understanding after the end of the science class but in multiple interaction, students who didn't participate in cognitive collaboration showed low levels of understanding about the group models of blood circulation.

Citizenship Science Education? Responding to the Voices of Aboriginal Communities

Saturday, 9.45am – Room 5

Brian Lewthwaite & Kimberley Wilson
James Cook University

A tension evident in science education conversations today from the classroom to the policy-making level across Canada, New Zealand and Australia is questioning the purpose of science education (for example, Australian Academy of Science, 2010; New Zealand Centre for Education Research, 2011). These conversations seek resolution to the question: what is the purpose of science education in schools and which of these purposes matters most? At the centre of these concerns is questioning a long held belief that science education experience should continue to primarily serve national interest for economic prosperity by preparing a small number of future scientists at the expense of engaging all young people in Citizenship Science. A question that needs to arise in this ongoing conversation is what is meant by a Citizenship Science education and, more importantly, whose interests does Citizenship Science education serve? Is Citizenship Science education just another attempt to serve a nations' interests?
Nel Noddings asserts that the obligation of schools is to be responsive: to listen attentively and respond as positively as possible to the legitimate expressed concerns of communities (2005).
In this presentation, we draw upon our research and development work with Indigenous communities in Canada, New Zealand and Australia to critically examine the premise of Citizenship Science in light of what Indigenous communities advocate for, and the means by which we assist teachers in being responsive to Indigenous community aspirations.

Promoting and scaffolding argumentation through reflective asynchronous discussions

Thursday, 1.45pm – Room 4

Huann-shyang Lin[1], Frances Lawrenz[2] & Zuway-R Hong[1]
[1]National Sun-Yatsen University, [2]University of Minnesota

Abstract: The purpose of this quasi-experimental study was to explore the impact of asynchronous discussion on the quality and complexity of college students' arguments. Three different cohorts of students registered in a physical science course in 2009 Fall, 2010 Spring, and 2010 Fall semesters were briefly supported with scaffolding in class and then involved in argumentation about socio-scientific issues as take-home assignments. Each cohort was divided into an asynchronous online communication group and a paper-pencil group. The findings showed that very few students' arguments from either group were rated in low in quality levels of 1 or 2 on a five-point scale. Additional comparisons revealed that the asynchronous online communication group students slightly outperformed their counterparts in terms of mean quality level of arguments (effect sizes ranged from 0.25 to 0.35) and the frequency of rebuttals. The significance of the findings are that given only one hour of scaffolding followed by the opportunity for practicing argumentation at home, students' argumentation skills can be better developed through reflective asynchronous discussions about socio-scientific issues. The results of this study shed additional light on the slightly positive effect of asynchronous online communication.

Developing loan boxes of university museum and the teaching lesson plans

Thursday, 2.30pm – Poster 4

Yi-Jung Lin[1], Shu-Fen Cheng[1], Jer-Ming Hu[1], Meichun Lydia Wen[2] & Yu-The Kirk Lin[1]
[1]National University of Taiwan, [2]National Changhua University of Education

Two kinds of loan boxes were set up for the fifth- to seventh-grade students, based on materials sourced from two museums at the National Taiwan University. (1)"The Bones Stories" comprises four sections covering eight topics incorporating the concepts of vertebrate classification, and the functionality of bones, teeth and beaks. (2)"Understanding breadfruit (Artocarpus Altilis Park Fosberg)" comprises five sections covering six topics demonstrating concepts of plant morphology and classification, using breadfruit as a starting point. Teaching guidelines, games and other activities are prepared, with the aim of promoting students' observation skills and integration of biological concepts. Much of the materials chosen were products of student experiments or activities conducted during the courses we offered.

We can therefore ensure the supply of replacement materials. This project includes two stages of evaluation, for both professional and in-class practices. These two loan boxes were first evaluated by three professors in the education field and ten junior high school teachers. We are planning to have seventh-grade students use these boxes in their classes and evaluate what they have learned after demonstration in the second stage. The loan boxes will be improved in response to their comments. The completed loan boxes will be available to school teachers free of charge, particularly for those from remote regions.

Science as a Human Endeavour: Teachers' understanding relating to the implementation of this element into primary and secondary classrooms

Friday, 8.45am – Room 8

Marianne Logan
Southern Cross University

Many Australian students, particularly secondary students, perceive school science to lack relevance (Goodrum & Rennie, 2007). Science is often trivialised in schools where it is reduced to a 'set of procedures' rather than introducing students to the more human aspects of science such as 'emotions and imagination' (Jenkins, 2000, p.213). The Science as a Human Endeavour (SHE) strand of the Draft Australian Science Curriculum attempts to address the relevance of science by encouraging students' understanding of the human elements, such as: the "unique nature of science", ethical and social implications, the contributions of people over time, and "how science can be used to inform decisions and actions" (ACARA, 2011, p 5). The aim of this research study was to examine teachers' responses to the SHE strand and how this strand interrelates with the 'science understanding' and 'science inquiry skills' strands of the Draft Australian Science Curriculum. This paper reports on a small-scale study involving 'in depth' interviews with four teachers (2 primary school teachers; 2 secondary school teachers). The findings revealed some innovative approaches for integrating SHE elements into science lessons but also teachers' concerns about addressing these elements. These concerns related to lack of familiarity with the strand, assessment of SHE elements, and the perceived inability of the primary and junior secondary students to be able to understand the sophisticated ideas surrounding SHE. These teachers believed that support would be required to assist them to address the SHE strand and to be able to break down these aspects in order to promote primary and junior secondary science students' understanding of these elements.

Moving Teachers to New Horizons

Thursday, 2.30pm – Poster 6

Beverly Lowe
University of the Sunshine Coast

Many primary teachers lack the knowledge and confidence to teach science effectively. Providing professional learning and professional development can have a powerful effect on the knowledge and skills of pre-service teachers and practicing primary teachers. A scholarship was created for a preservice teacher in a Bachelor of Education program and two practicing teachers to attend the US Space and Rocket Center's Educator Camp and learn appropriate science knowledge and teaching skills. A student and two practicing teachers attended the camp and learnt with peers about the earth and space sciences. The participants returned with greater knowledge and confidence to teach their own students and also to share with their peers. Professional learning activities have advanced their personal content knowledge and ability to teach with appropriate pedagogy.

Ensuring Effective Impact of Continuing Professional Development: Science Teachers Perspectives

Thursday, 9.30am – Room 5

Nasser Mansour[1], Ahmad Qablan[2], Saeed Alshamrani[3] & Abdulwali Aldahmash[3]
[1]King Saud University/Exeter University, [2]King Saud University/The Hachemite University, [3]King Saud University

This research looked specifically at Saudi science teachers' views and experiences about the continuing professional development (CPD) opportunities that they received. The overarching goals of the research were to highlight science teachers' views of the provision of the CPD and its impact on their teaching practices and to explore the variables that contribute to the success or failure of the CPD on their classroom practices. Data were collected from Saudi science teachers by means of a closed-ended questionnaire (n=620), an open-ended questionnaire (n=293) and interviews (n=9). The findings indicated that Saudi science teachers participating in the CPD programs faced several challenges in implementing what they learned. Further analysis of the data revealed the following themes; perceptions of participating in CPD; features of distinguished CPD programs; perceptions of ways to improve CPD; facilitating the successful implementation of training in the classroom; the impact of CPD on teacher's classroom teaching; and barriers to implement what teachers' learned from the CPD). The arguments presented emphasised that teachers should voice their perceptions about CPD and practices, and researchers should consider the socio-cultural-political contexts when interpreting or understanding teachers' voices.

Learning progressions in psychology within the curricula policy documents

Friday, 9.30am – Room 3

Karen Marangio
Monash University

Psychology is an extremely popular senior school subject in Victoria. More Victorian schools are offering psychology in the younger years than ever before, usually within science curricula or as an optional study, despite psychology not being explicitly mentioned in the VELS (and AusVELS) curriculum. As students enter VCE Psychology in future years, 'where will the prior learning of psychology come from within the new AusVELS curriculum policy document?' While acknowledging that a curriculum policy document is only a starting point and can never capture the totality of a student's experience, and that hypothetical learning progressions must be grounded on research into student learning, a central question asked here is 'what does progression towards a psychologically literate citizen look like within the Victorian curricula policy documents'? This seemingly simple question was in reality an incredibly complex and problematic one to answer. In the end, a systems approach was taken, one that interweaves the progression of psychological big ideas with the scientific practices, to engage students towards a greater understanding of psychology as a way of knowing, doing and thinking.

Working with middle years student to design a local skate park

Saturday, 9.00am – Room 9

Margaret Marshman
University of the Sunshine Coast

It is a continual challenge to engage and extend middle years students in science. One of the two sub-strands within the Science as a Human Endeavour strand of the *Australian Curriculum: Science* is to "explore how science knowledge and application affects people's lives … and how science … can be used to inform decisions and actions" (ACARA, 2011). This paper will explore how some students 'do' science in a community based project context; designing a local skate and recreational park, and the role that science plays in their decision making and problem solving. This project is underpinned by the theoretical framework of Knowledge Producing Schools (KPS) (Bigum & Rowan, 2009). This framework uses learning opportunities where students produce work on an authentic task that is important to their local community. Experts are drawn from the community to support the students as they work through their project

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"How do we teach argumentation in the new Australian Curriculum?" Secondary Science Teachers' Experiences in an Argumentation-based Professional Development Program

Friday, 9.30am – Room 7

Christine McDonald[1] & Deborah Heck[2]
[1]Griffith University, [2]University of the Sunshine Coast

The implementation of the Australian Curriculum: Science across the compulsory years of schooling (F-10) in the majority of Australian states this year requires science teachers to address the teaching of scientific argumentation in their classrooms. To attend to this challenge, we conducted an argumentation professional development program with practicing secondary science teachers, who possessed a range of teaching experience. Examples of the pedagogical activities implemented in the program will be outlined in this presentation, in addition to a discussion of five teachers' experiences of the program sourced from pre- and post-intervention interviews. Shifts in participants' views of argumentation, participants' perceived implementation of argumentation, and barriers to the successful implementation of argumentation will also be discussed.

Implementing both-ways science education teaching in an indigenous tertiary institution

Friday, 4.05pm – Room 9

Michael Michie
Batchelor Institute of Indigenous Tertiary Education

This paper examines the both-ways nature of science education courses in the undergraduate education program presented at the Batchelor Institute in 2010. Both-ways education refers to a philosophy and practice of education which merges Indigenous Australian and Western academic disciplinary traditions of knowledge. The underlying both-ways philosophy of the Institute is examined and how it was implemented in two preparatory courses (a science education course and a science content course) for primary and middle school teaching is described. The role of the author as a non-indigenous lecturer in implementing both-ways philosophy in these courses is examined using examples from his teaching and assessment.

Two alternative conceptions of both-ways are identified. Firstly it is conceived as a practice related to the steps of the teaching and learning process. Secondly, it can be seen through a sociocultural lens as involving the cultural identities of the students. For the lecturer, the identity learning model of Geijsel and Meijers (2005) enables the theorising of meaning-giving and sense-making over time, leading to effective both-ways teaching and learning.

The Response of Science Teachers to Professional Development as a Result of Individual, Faculty and School Decisions

Thursday, 11,15am – Room 6

Susan Millar
University of Western Australia

Using a mixed method approach, this study aims to investigate the individual response of teachers to professional development, based on the National Standards, in five case-study schools. The investigation also considers the impact of decisions made at the level of both the faculty and the school. Teachers, departmental heads and relevant members of the school executive were interviewed. In addition, classroom observations, Science Reasoning Tasks and analyses of student work were undertaken and field notes from professional development were made. Analyses of these data analysis provide insight into the response of teachers to professional development and how this is linked to decisions made by individuals, departments and schools. According to research literature the success of professional development depends on the decision of individuals to participate in addition to other factors, such as the active support of the school executive, long term support for teachers, the provision of learning resources to assist teachers as they acquire new skills, the development of collegiality and teachers' awareness of improved student outcomes as new pedagogical skills are used. The analyses from this investigation tend to support findings recorded in the research literature.

Which social aspects of science do Japanese science teachers and education researchers focus on more?

Thursday, 2.30pm – Poster 1

Shiho Miyake
Kobe University

School science curricula in Japan promote a focus on the links between science and society, achieved through outcomes such as 'Connection Between the Outcomes of Learning and Everyday Life (COLEL)', 'Partnership and Cooperation with Museums and Centers (PCMC)', and 'Familiarization with Contribution to the Natural Environment (FCNE) '. This study aimed to identify which of these three outcomes is now of more interest to Japanese teachers and researchers involved with science teaching? The author reviewed articles with a title related to COLEL, PCMC and FCNE in issues of *Science Education Monthly* (SEM) and the *Journal of Research in Science Education* (JRSE) published in Japan between 2000 and 2011. As a result, 291 articles related to COLEL, PCMC and FCNE were found. COLEL is the most popular of the three concepts in SEM, while it is very rare in RJST. On the other hand, FCNE is the highest proportion in RJST. For PCMC, the number of articles in RJST was notably larger than that for COLEL but only one-third compared with FCNE.

Learning and Teaching in the 21st Century: Realities and Possibilities of Social Media

Friday, 3.20pm – Room 9

Rachel Moll[1], Wendy Nielsen[2] & Cedric Linder[3]
[1]Vancouver Island University, [2]University of Wollongong, [3]Uppsala University

The objectives of this international collaboration are to: a) study students' and teachers' use of social media for learning science across age groups and contexts, b) develop a model for understanding science learning through social media, and c) make recommendations for the use of social media as new and innovative tools for instructional practice in secondary and post-secondary science. Research has shown that learners rarely take advantage of the collaborative and creative potential of Web 2.0 technologies (Bennett, Maton, & Kervin, 2008). Currently students are learning about technology from experience, not from education (Boyd, 2010).
A complexity thinking perspective (Davis & Sumara, 2006) was used to interpret student focus group data for the extent to which students embrace the interactive potential of social media to provide "unprecedented opportunities and affordances for emergent learning" (Williams, Karousou, & Mackness, 2011, Knowledge Ecologies, para. 4). Results indicated that students and teachers used social media but not in ways that significantly improved the in-school and out-of-school learning environments. A survey of science student social media use was designed based on results from focus group data. Future work will examine student learning in case study contexts of social media use in science classrooms.

Exploring Socio-Scientific Issues through Digital Technology: the Impact of Context and Culture

Thursday, 1.45pm – Room 9

Olivier Morin[1], Laurence Simonneaux[2], Jean Simonneaux[2] & Laura Barraza[3]
[1]Université LYON, [2]ENFA, [3]Deakin University

In response to increased public questioning of scientific expertise, the teaching of Socially Acute Questions (SAQ) needs to focus on epistemological clarification for the exercise of informed, critical and active citizenship. Our research is concerned with "collective expertise": How does dealing with an Environmental SAQ collectively facilitate the development of socio-scientific reasoning (SSR)?

We focus on the evolution of SSR of French and Australian university students collaborating on a digital platform (using wikis and forums). Groups dealt with one of two issues : the construction of a desalination plant near Melbourne to produce fresh water, or the changes in global meat consumption in 2050 linked to demographic projections.

In analyzing the student exchanges we defined indicators to characterize SSR, with six dimensions (Problematization, Governance, Scale, Values, Uncertainties and Knowledge), and we developed a framework showing to what extent the individual arguments can become part of the collective reasoning. By comparative analysis, we observed the effects of socio-cognitive disturbances: the interplay of different subjectivities is more apparent in the discussions taking place on an international level, when the participants more explicitly display their cultural identity. Such confrontations of arguments from disparate viewpoints provide a wider understanding of the complexity, and features of depth of collective reasoning.

Analysis of diagrams illustrating phases of the Moon in South African textbooks

Thursday, 3.20pm – Room 5

Retselisitsoe Mosoloane, Martie Sanders & Tony Lelliott
University of Witswatersrand

Several scholars have conducted research involving textbook diagrams (e.g. Lewalter, 2003), but very few have focused on the nature of diagrams illustrating moon phases (e.g. Trundle, Troland & Prichard, 2008). Only one of these studies investigated issues that might hinder interpretation of these diagrams (i.e. semantic issues), while none investigated issues associated with perception of information in these diagrams (syntactic issues) and suitability of the diagrams to context of intended viewers (pragmatic issues). This paper presents findings of a study which investigated syntactic, semantic and pragmatic issues in diagrams illustrating moon phases in 24 South African textbooks designed for use in Grades 4 to 9. Results show that diagrams from three books had syntactic problems (e.g. lack of visual cues); diagrams from 22 books had semantic problems (e.g. incorrect use of symbols), while diagrams from 18 books had pragmatic problems (e.g. illustrating moon phases as seen from the opposite hemisphere). These results can help education officials to recommend textbooks whose diagrams have fewer design problems. In addition, the officials can work with publishers to ensure fewer design problems in textbook diagrams. Furthermore, the officials can work with teachers to help them minimize impact of these problems on learning.

Developing the pedagogical content knowledge of preservice physics teachers

Thursday, 1.45pm – Room 6

Pam Mulhall
University of Melbourne

Good physics teaching requires pedagogical content knowledge (PCK) - knowledge about tailoring the teaching of specific physics topics to student learning. PCK develops with teaching experience, making it difficult to achieve in most physics teacher preparation programs.

The study explored the use of a teaching tool called a 'CoRe' (Content Representation) for 'fast-tracking' PCK development in pre-service physics teachers. A CoRe is a matrix that lays out the big ideas for teaching a particular physics topic as well as aspects of teaching each big idea. Pre-service teachers were given an assignment that required them to develop a CoRe for a physics topic, seek feedback about their CoRe from an experienced physics teacher, and write a reflective piece on the value of these tasks in terms of their development as teachers.

The purpose of the study was to understand how, in the context of the CoRe assignment, pre-service teachers developed PCK for teaching particular physics topics, and how their content understanding, and beliefs about teaching and learning physics impacted on this development. The approach was qualitative and used mainly interview data.

The research suggested that developing a CoRe enhanced the pre-service teachers' content understanding, helped them differentiate the content to be taught and recognise the big ideas, reinforced a conceptual view of physics, and stimulated changes to more student-centred lesson planning.

Developing Argumentation Skills in Japanese Elementary Schools: A Case Study of 6th-grade Elementary School Students (11-12 years old) in Science Lessons on 'Static Electricity'

Thursday, 2.30pm – Poster 7

Keita Muratsu, Shigenori Inagaki
Kobe University

This research explored whether the design principles which we formulated contributed to developing students' argumentation skills. We focused on the skills to use rebuttals in particular, formulating design principles for developing students' skills to use rebuttals based on previous studies. Design principle (1) was that students engage in argumentation, teacher forms small groups of students supporting different theories. Design principle (2) was that teacher emphasizes the importance of rebuttals and describes required conditions for clear rebuttals. We then conducted science lessons based on these design principles, targeting 6th-grade elementary school students (aged 11-12 years). We analysed students' discourse data that were recorded three times during the lessons. Results showed that there was improvement of students' skills to use rebuttals between the first and second argumentation, but no improvement between the second and third. At this point, we found the issue to be addressed that we should elicit a method for teaching rebuttals from previous studies and improve design principle (2).

How do primary school students' everyday experiences affect their scientific argumentation

Friday, 12.45pm – Room 6

Jiyeon Na & Jinwoon Song
Seoul National University

Many studies in science education have found that students use everyday experience in their scientific practices. Many researchers have regarded everyday experience as a principal source of learning difficulty or a barrier to scientific concept learning and argumentation. The purpose of this study was to examine how primary school students employ their everyday experience in argumentation. A group of six fourth-graders was observed in argumentation where they talked about ideas related to thermal concepts. The data was also collected through interviews and questionnaires. The analysis of the data showed that the students used their experiences to refute or accept other's claims, and to assert their own ideas, especially as backing or rebuttal for themselves or for others, in argumentation. Students composed a more complex process of argumentation and used its more diverse elements when they used their own experiences than when they did not. According to an assessment framework by Osborne *et al.* (2004), this result implies that the level of argumentation is higher when experience is evoked. Everyday experience should be considered as a stepping stone in order that students who are unfamiliar with and have difficulty in scientific argumentation can become better familiarized with argumentation, and not as its obstacle.

Fostering Pre-service Teachers' Argument Skills Through Making Sense of Tradeoffs in Genetically Modified Food

Friday, 1.30pm – Room 4

Sakiko Nakashin, Etsuji Yamaguchi & Shigenori Inagaki
Kobe University

There are many potential benefits in student engagement in and practice of argument. To nurture the argument skills of students, teachers themselves need to have high-level argument skills, since they will otherwise find it very difficult to teach such skills to students. This study focused on the low level of teacher argument skills. This paper presents the results of a two-year study to provide pre-service teachers with a curriculum to gain high-level argument skills addressing socio-scientific issues The curriculum revision implemented for the second year of the study was allowed the teacher educator sharing the argument assessment criteria with the pre-service teachers

The arguments produced by pre-service teachers in the first year and the second year show that pre-service teachers taking the second-year curriculum produced higher-quality arguments in terms of explaining the reasons that evidence challenges a claim, using evidence to counter evidence against their position, and making sense of trade-offs between conflicting evidence.

Types of questioning terms in the Japanese Lower Secondary School Science Textbooks

Friday, 2.15pm – Poster 3

Hayashi Nakayama[1], Yuji Saruta[2], Eri Yammamoto[1] & Norio Nomura[1]
[1]University of Miyazaki, [2]National Institute for Educational Policy Research

According to the course of study in Japan, developing students' abilities in problem solving or investigation is one of the important objectives of school science. However, the course of study does not obviously develop students' ability to choose the appropriate scientific terminology in order to pose scientifically framed questions. However, there are many questions already posed in school science textbooks which can be used as the starting point of any investigative activity. Those questions will guide students during the process of scientific inquiry. The aim of this study is to find out the types of questions contained in the Japanese lower secondary school science textbooks.
We extracted all questions from the Japanese lower secondary school science textbooks of five publishers and grouped them by four content areas; namely, physics, chemistry, biology, and earth science. In physics, biology and earth science area "how" and "what kind of" questions are dominant. In these questions, the following verb or noun determines the concrete meaning. For example, in the physics and earth science area "relate" or "relations" are attached repeatedly. Closed questions such as yes-no questions which include hypotheses are also used frequently. They are especially dominant in the chemistry area. Such key interrogative terms are typical of the tools used to ensure the on-task flow and productive outcome of Japanese school science lessons.

Planned Actions, Reflective Practice and the Shifting Knowledge Insights from Physical Science Teachers' Case Studies

Thursday, 3.20pm – Room 4

Mpunki Nakedi
University of Witwatersrand

Annually deteriorating student performance in South Africa suggests that science teachers are not coping with the complex demands placed by the new South African curriculum. This poor performance results in sporadic reaction from the government, which further exacerbates the situation and mostly sends the schooling system into greater confusion. Central to this problem is a lack of appreciation from most teacher development agencies of the difference in philosophy underpinning the new curriculum, and the necessity for a shift in paradigm from teachers' current outlook on practice. This paper reports on some promising findings of a study which aimed to investigate useful ways to support science high school teachers as they grapple with the challenges of implementing a new topic in their classrooms.
The study employed a multiple case study approach drawing from cognitive and socio-cultural perspectives. The four participating teachers undertook self-studies supervised by the author as the method of investigation in projects they carried out for a post graduate qualification. The results reflect that engaging these teachers in topic specific meta-cognitive processes changed their perspective on planning for teaching as well as helped to develop their Pedagogical Content Knowledge (PCK) in various ways.

Social Interaction during Animation Construction: A Discourse Analysis of Discussion During the Making of a "Slowmation"

Thursday, 3.20pm – Room 8

Wendy Nielsen[1], Garry Hoban[1] & Rachael Moll[2]
[1]University of Wollongong, [2]Vancouver Island University

This research explores the intersection of social and individual processes during a collaborative group learning activity in order to move "beyond the cognitive-situative divide" (Järvela, Volet & Järvenoja, 2010, p. 15). The research is significant because this intersection is where much science learning activity resides, such as group problem-solving or laboratory activity. Study of the intersection, in part, answers calls for studies to advance understanding of the situated basis of knowledge construction during group activity (Butler, 2011; Turner & Patrick, 2008). Based in theoretical perspectives on the social construction of knowledge (Lemke, 1990; Vygotsky, 1978) and the value of learners creating representations (Hoban, Loughran & Nielsen, 2011; Prain, 2006; Tytler & Prain, 2010), the paper aims to explore how learners co-construct understandings through their interactions in an activity intended to foster science content learning. In the reported study, three preservice teachers designed and created a narrated stop-motion animation ("slowmation") as an instructional resource to explain the science concept of insect life cycles to primary students. Creating a slowmation involves generating a sequence of representations (Hoban & Nielsen, 2012): (i) research notes; (ii) storyboard; (iii) models; (iv) digital photographs; and (v) the narrated animation. Discussion during the two hour construction period is analysed using discourse analysis tools to consider the intersection of individual understandings—in the process of their development—and the social context of a group activity in which the development takes place

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Using cogenerative dialogue to transform the emotional climate of science classrooms

Thursday, 10.35am – Room 8

Jennifer Oakley
Queensland University of Technology

Many secondary school students are disengaging from science. Engaging these learners in the science classroom can be a challenge for many teachers. This ethnographic case study examines how cogenerative dialogue can influence classroom emotional climate. Using TurningPoint™ technology, analysis of classroom interactions and interviews it was found that cogenerative dialogue was a catalyst for improved engagement and behaviour in the science classroom for particular students; students identified as 'problem' students by the classroom teacher. Furthermore, these students' ongoing perceptions of emotional climate became more positive. Implications for the use of cogenerative dialogue to engage the disengaged and improve learning in the science classroom will be discussed.

I'm a Science Teacher: Why do I Need to Know about the Brain?

Thursday, 1.00pm – Room 3

Mary Oliver[1] & Jim Woolnough[2]
[1] University of Western Australia, [2]University of Canberra

Educators have been slow to engage with neuroscience, which has brought new insights to the development of cognitive functions. Theories of learning, such as constructivism and cognitive load theory, have generally avoided any direct reference to brain function. We are now many years on from the 'bridge too far' scenario; an unbridgeable gap between contemporary understandings from brain imaging, and the mind models derived from cognitive psychology Bruer (1997). This paper will document some of the recent findings in neuroscience, exploring a range of areas including the current state of knowledge, its relationship to neuromyths, and ways forward in utilizing new findings. Current knowledge in neuroscience is able to shed light on a range of areas relevant to teaching and learning, including 'attention, stress, memory, exercise, sleep and music' as well as learning difficulties such as dyslexia and dyscalculia. New understandings of working memory and the hippocampus-mediated establishment of long term memories have some resonance with existing theories of learning, including constructivist ideas of how conceptual understandings are developed. We suggest that there is a specific role to be played by science educators in facilitating the long term development and acceptance of a more scientific approach to teaching and learning.

Tracing learning about astronomy during an ICT supported inquiry

Thursday, 4.05pm – Room 9

Kathrin Otrel-Cass[1], Lars Domino Ostergaard[1], Per Johnsen[2] & Jakob Krogh[2]
[1]Aalborg University, [2]Filstedvejens Skole Filstedvej

Inquiry-based science education (IBSE) has been argued to prepare students for the modern world by opening up opportunities to query the natural and man-made world. Information communication technology (ICT) that allows more than collection of data and information but offers opportunities to collaborate, discuss and share information is claimed to aid this process.

However evidence to support such great expectations is still inconclusive. Assessment tools and the insights they may lend into students' learning vary greatly and there is a danger they fail to persuade of the potential inquiry-based learning has to offer. In this presentation we examine the cases of two year 8 classes (14 year old students) who engaged in science inquiry in their science and English lessons and collaborated with a New Zealand class to explore the topic of astronomy.
To gain insight into the students' developing ideas in astronomy we adopted a multilevel–multifaceted approach. Evidence of learning was collected at three different levels: immediate, close and proximal. We will highlight the insights we gained into students' developing science inquiry skills and knowledge and explain how the different proximities of the assessment strategies used assisted this task.

Teacher and academic Professional Learning What was achieved, what was learned

Thursday, 11.15am – Room 5

Kathryn Paige, Yvonne Zeegers, David Lloyd & Philip Roetman
University of South Australia

This paper reports on a two year action research based professional learning program (PLP) which involved early career teachers identifying and then researching an aspect of their practice in teaching science. The teachers became involved in the project because they wanted to enhance their pedagogical content knowledge about science. This collaborative project involved teachers in a low socio economic area of the Northern suburbs of Adelaide and academics from the Schools of Education and of Natural and Built Environments. The thread which linked these teachers was a shared interest in connecting students to their natural world. Our model focused on shared practices and engagement within a constructivist pedagogical framework. The teachers' continuing participation resulted in increased confidence to take risks by planning and teaching units of work that involved moving away from a text book orientated approach to teaching science. Interview transcripts from teachers at key points in the process have been analysed to identify teacher learning and to enable us to reflect on our own role

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Professor John White Webster, science educator and convicted murderer

Friday, 4.05pm – Room 6

William Palmer
Curtin University

Professor John White Webster (1793-1850) was a nineteenth century American science educator; he was the author of several well regarded university textbooks in chemistry and natural philosophy and a geological text on the island of St Michael in the Azores. He had a first degree in science (A.M.) and was also a qualified medical practitioner (M.D). He was a lecturer at Harvard University on chemistry, mineralogy and geology and became the Erving Professor of Chemistry. He was also the associate editor of the *Boston Journal of Philosophy and the Arts*.
These were considerable achievements but his personal finances were disorganised. He was deeply in debt to a fellow academic, Dr George Parkman and was accused and was convicted of Parkman's murder. Opinions regarding the quality of his teaching, writing and research vary and this presentation will explore these views. His conviction for murder deeply divided opinion in Boston at the time and now John White Webster is remembered for his crime rather than his many years as a respected science educator. The presentation will attempt to provide a balanced view of Professor John White Webster's personal life and his achievements as a science educator

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A review and analysis of the studies focused on ethical aspect regarding socio-scientific issues

Thursday, 10.35am – Room 3

Jisun Park, Hunkoog Jho & Jinwoong Song
Seoul National University

The purpose of this study is to analyze the studies on ethical aspects regarding socio-scientific issues and to give the implications for enhancing students' decision-making. In this study, we searched for the relevant studies from five international journals and two Korean journals in the field of science education. Among the articles dealing with socio-scientific issues, twenty-seven articles dealing with ethical aspects were selected. The articles were analyzed according to decision-making processes, that is, issue identification, information search, and reasoning. Concerning the process of identification, the studies concentrated on ethical sensitivity, which was defined as the ability to perceive a range of ethical problems. They were less concerned with the context where the ethical problems were emerging. Concerning information search, students were found to lack critical assessment of the information collected. Concerning reasoning, students did not make their decisions based on the considerations of plural ethical principles pertaining to the issues. The results indicate that students need to consider the ethical aspects of science research and make judgments based on critical assessment of information and plural ethical principles such as deontological ethics, consequentialism and virtue ethics.

Development and validation of a tool for measuring Topic Specific Pedagogical Content Knowledge (TSPCK) of the particulate nature of matter

Friday, 8.45am – Room 5

Phihlo Pitjeng & Marissa Rollnick
University of Witwatersrand

Pedagogical Content Knowledge refers to the knowledge used to make understanding of a particular topic accessible to learners suggesting that it is content specific. Research has shown that PCK is specialized knowledge possessed by experienced teachers. Although PCK has proven to be an important part of the knowledge base of teaching, teachers find it hard to articulate and it is thus described by many researchers as tacit. Although some studies have designed tools to capture and portray PCK there is little research on measuring the construct. In this paper we articulate the construct of Topic Specific PCK (TSPCK) and describe the development and validation of an instrument to measure TSPCK for the particulate nature of matter. The instrument consists of five topic specific components - learners' prior knowledge, curricula saliency, representations, what makes the topic difficult to teach and conceptual teaching strategies. After piloting, the instrument was administered to a group of high school science teachers and scored using a rubric adapted from a similar study on chemical equilibrium. Rasch modeling is used to carry out analysis, thus providing reliability for each item. Analysis is under way and will be presented at the conference.

Implications for teachers of primary children's free interpretation of science diagrams

Thursday, 1.45pm – Room 8

Christine Preston
University of Sydney

Science diagrams are used widely in primary schools for instruction and assessment despite the absence of substantive research into their effectiveness as aids for conceptual development. The paper will outline and general findings and discuss implications for teachers of a study designed to explore primary children's free interpretation of science diagrams in the absence of instructional intervention. This research aimed to investigate how children interact with common science diagrams and the meanings they construct from them. Semi-structured interviews with Year 3 and Year 5 children from one primary school in Australia were used to investigate the effects of diagram interaction on their conceptual understanding of five different topic areas. The results reveal insights into children's thinking and explanation building and have implications for the use of science diagrams in teaching, learning and assessment.

Scientists in Schools: Five Years On

Friday, 1.30pm – Room 7

Leonie Rennie
Curtin University

The Scientists in Schools program (SiS), funded by DEEWR and managed by CSIRO Education, is completing its fifth year. Around 2700 partnerships have been made, and currently there is at least one partnership in 12% of Australian schools. During its lifetime, SiS has been subject to three comprehensive evaluations carried out on: the Pilot project in 2007, Stage One in 2009, and most recently, at the end of 2011. This paper provides a synthesis of the nature of SiS based on the outcomes of these evaluations, focusing particularly on the results of the most recent.
This evaluation was based on online surveys of nearly 1000 teachers and scientists, and interviews with key personnel, particularly the SiS project Officers, but also partner teachers and scientists whose partnership had existed for at least one year. Attention will be given to the pattern of SiS partnerships, including the factors affecting their success and longevity, the benefits to SiS partners and to the students involved, and recommendations for getting the best out of an SiS partnership

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Teaching from Country: Queensland Aboriginal narratives and teaching of the Linnaean taxonomy in an indigenous classroom

Saturday, 9.00am – Room 5

Joel Rioux
Batchelor Institute in the Northern Territory for the *Australian Centre Indigenous Knowledges & Education* (ACIKE), a partnership with Charles Darwin University

It is difficult to engage Aboriginal students with western science topics such as the Linnaean zoological taxonomy. Yet, the study of local fauna is an area in which there is much local Aboriginal knowledge. This paper explores the effect of integrating Aboriginal and Western knowledge on the science learning of students in an Independent Aboriginal Community secondary school. It reports on an action research study conducted with twelve Year 8-9 Indigenous students in a Montessori classroom in which the teaching of Aboriginal and Linnaean classifications of animals was integrated. The study covered 83 lessons that included Elders' narratives on local fauna and specially

constructed didactic and developmental materials. Classroom observations and pre-post instruments focused on the effect of the teaching on students' pride in heritage and knowledge of culture and the Linnaean taxonomy, looking for teaching actions that appeared to stimulate strong learning responses. Preliminary results reveal that the conflation of both Aboriginal and non-Aboriginal knowledge, along with an emphasis on contextualisation, combined to strengthen both the Indigenous students' Aboriginal identity and the status of local Indigenous knowledge in the science classroom. It also appeared to deepen the Aboriginal students' understanding of the non-Indigenous Linnaean taxonomy.

More than computers and digital technologies': Perspectives on early childhood technology in Singapore and Australia

Friday, 3.20pm – Room 8

Jill Robbins & Robyn Babaeff
Monash University

Important aspects of thinking and working technologically are creativity, innovation, evaluation, problem solving, and applying imagination - along with exploring materials and analysing their uses, investigating technological processes, and using tools and machines to make functional products (VCAA, 2009). Though early childhood teachers typically provide many opportunities for young children to engage with technological materials, processes and thinking, there is a tendency for many teachers to perceive technology as specifically working with computers and digital artefacts, appearing to lack understanding of the potential for technology education embedded in many of the resources and experiences regularly included in their programs (Robbins, 2011; Robbins, Babaeff & Bartlett, 2010). This paper reports on an on-going study of early childhood teachers' understanding of technology, which began in Victoria (Australia) and has extended to Singapore, noting similarities and differences in these two contexts

It discusses the significance of teachers' conscious awareness (Vygotsky, 1987, 1998) of their current practices, and argues the need to provide support for them to gain deeper understanding of both the content of technology and specific pedagogical content knowledge. It proposes that this may lead to more informed judgments about the technology experiences the teachers provide, and, in turn, more intentional teaching to support technological thinking in children

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PCK of experienced teachers and pre-service teachers for teaching chemical equilibrium: qualitative and quantitative perspectives

Thursday, 1.00pm – Room 6

Marissa Rollnick & Elizabeth Mavhunga
University of Witwatersand

As teachers gain experience in teaching a specific topic, their ability to teach the topic effectively improves provided they have the prerequisite knowledge bases which include knowledge of subject matter, learners, general pedagogy, and context. These knowledge bases enable the transformation of subject matter knowledge into teachable form, or pedagogical content knowledge (PCK). This study investigates the role of experience and subject matter knowledge (SMK) in the development of PCK. The study uses an instrument developed to assess the quality of topic specific PCK, related to the teaching of chemical equilibrium. The instrument uses five topic specific components – learners' prior knowledge, what makes a topic difficult to teach, curricular saliency, representations and

conceptual teaching strategies. It was administered to groups of pre-service and experienced teachers, together with a subject matter diagnostic test.
Results showed a similar hierarchy of development of the components of topic specific PCK in both groups of teachers. Experienced teachers performed significantly better on both SMK and PCK tests and the two constructs are highly correlated in both cases. Qualitative analysis supports the quantitative findings highlighting the influence of classroom experience on experienced teachers' PCK.

Argument Skill Acquisition among Grade 5 and Grade 6 Elementary School Students

Friday, 11.20 – Room 4

Miki Sakamoto[1], Etsuji Yamaguchi[1], Junko Nishigaki & Tomokazu Yamamoto
[1]Kobe University, [2]Osaka City University, [3]University of Miyazaki

The aim of this research was to investigate the level of argument skill among elementary school students in Japan. This study focused McNeill & Krajcik (2011)'s first variation of argument, which includes claim, evidence and reasoning as the essential components, and examined the grade difference and gender difference in argument skills. Participants were 139 Grade 5 students and 139 Grade 6 students (10-12 years old). Students were presented with two questions along with observational and experimental data on scientific topics, and asked to write arguments to answer the questions. Students' written arguments were scored out of two according to the presence and scientific accuracy of each component. Most of the students wrote at least one claim in each question, while about half of the students did not write evidence or reasoning. Moreover, this study found a difference in students' performance between the two questions. Our results also showed that even in the final grade of elementary school, many or most students have not acquired the skill of stating an argument that connects data with claims using scientific principles. The instructions to improve students' argument skill should be re-designed

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Promotion of scientific literacy in Bangladesh: Teachers' perspective, practices and challenges

Friday, 8.45am – Room 9

Mahbub Sarkar & Debbie Corrigan
Monash University

This paper presents findings from a study exploring how scientific literacy is promoted through junior secondary science education in Bangladesh. The research investigates four areas: teachers' perspectives on scientific literacy; translation of their perspectives into teaching practices; the values they consider in science teaching in relation to scientific literacy, and the issues they perceive as challenging in their teaching for promoting scientific literacy. To explore these four areas, this research followed a mixed methods design where qualitative approaches, including interviews and observation, dominated the overall research process. This study reveals that whilst participating teachers held a range of perspectives on scientific literacy including some naive perspectives, in practice they demonstrated limited capacity to translate their perspectives into their classroom teaching practices. Also, teachers found difficulties in conceptualising many of the curriculum-identified values and consequently, found it difficult to find, develop and implement suitable teaching approaches to promote the values. The difficulties also included teachers encountering tension between their religious values and science values while they were teaching science in a culture with a religious tradition.

These results may contribute to understanding how teaching for scientific literacy is challenged by an academically oriented curriculum, large class size, limited resources, traditional examination-oriented education and limited teacher development programmes.

Teaching the Demonstration Lesson Online

Thursday, 1.45pm – Room 2

Donna Satterthwait
University of Tasmania

The Demonstration Lesson has a long pedagogic tradition in science education. Although less in fashion then previously, it is still used in science classrooms today throughout the world. And, thus as one of the defining practices of science teaching, the acquisition of the ability to perform engaging demonstrations is an important skill to address in pre-service science teacher education. However in this new world of online educational delivery, this topic can be problematic. To overcome this situation, I have developed an assignment in the initial secondary science methods unit that addresses this barrier; the task requires that the pre-service teachers videotape themselves presenting a demonstration to a group of students, uploading it to a private YouTube website, sharing the url with other pre-service teachers in their assigned small group and initiating a discussion thread on their performance to which their peers respond. The discussion threads were then analysed using software generating sociograms, and then calculating factors that provide insight into the interactions among the group members. This task requires the pre-service teacher to become more self-aware through viewing their own performance in comparison with that of others and digesting comments from peers.

How has ESSA testing of Y8 students in NSW government schools impacted science teaching and learning?

Friday, 3.20pm – Room 7

Jim Scott
University of Technology Sydney

NOTE: the abstract describes a research project yet to be undertaken. The presentation will outline initial thinking about methodology and invite feedback from the audience.
All Year 8 students in NSW government schools are required to complete the Essential Secondary Science Assessment (ESSA) test. The purpose of the test is to "provide information about student achievements which are used to support teaching and learning programs." (DEC, 2012). It features three free response items, which are marked using a SOLO-based rubric. Detailed reports of performance are provided to parents and caregivers and comprehensive feedback on individual results are provided to the school in a web-based, centralized software system called the School Measurement, Assessment and Reporting Toolkit (SMART. Teachers have access to professional development workshops related to the ESSA program and on how to use the SMART package. My research question is to find out whether ESSA has impacted the teaching and learning of science in NSW government schools. My proposed methodology is to identify government schools where ESSA results have improved the most from 2007 to 2010 and then to examine what teachers have done in those schools with aspects of the ESSA program, including the SMART package, to inform their science teaching.

Analysis of Effectiveness of the Group Discussion on Science Writing Ability of Elementary School Student

Friday, 9.30am – Room 6

Youngsik Shin & Youngseok Jhun
Seoul National University

The development of thinking ability is an important goal of science education. The act of writing has been used as the primary way to enhance it. Writing in science using theories, scientific facts and laws as writing materials promotes the acquisition of personal meaning in relation to scientific explanations. The purpose of this study was to examine the effects of a group discussion on science writing ability of elementary students. Four 6^{th} grade (11~12 age) students in Seoul, Korea were chosen for this study. They participated in eight science writing classes which dealt with socio-science issues. They went through a group discussion prior to writing. Their works were recorded and observed. Students' science works were collected and analysed based on three domains (science, logicality and creativity) related to the content of a group discussion. The result of this study showed that the content of a group discussion affected the science domain markedly. It was easy to achieve improvements in the logicality domain through science writing classes and a group discussion. Average-achieving students attained good grades in the creativity domain when the subject was related to their real life

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The collective construction of science curricula in a Kindergarten class

Friday, 4.05pm – Room 8

Christina Siry
University of Luxembourg

It is important for the field of science education to work towards understanding the nature of children's explanations of their ideas, because the widely accepted notion that students hold naïve epistemological science beliefs has been generated largely without examining students' own scientific practices and everyday language (Kumpulainen, Vasama, & Kangassalo, 2003). My ethnographic research examines how children enact developing understandings in science through multiple interactions. Grounded in sociocultural theoretical frameworks, I consider learning to be a social, cultural practice (Roth, 2006). As such, understandings are co-constructed between participants through talk (Vygotsky, 1986) and in interactions (Rogoff, 2003). With these underpinning frameworks, I have explored water activities in Kindergarten to examine how children and teachers collaboratively constructed science investigations to explore questions as they emerged from open-ended activities. The analysis reveals how children constructed science knowledges by engaging in complex approaches to "doing" science. Further, children's investigations were mediated by their own questions and explanations. My primary claim herein is that children's questions, speculations, and insights became a structure in this classroom that supported children in taking agency, as they generated science curricula as well as working theories on science phenomena.

Implementation of science based on the 5E Learning Model: Insights from teacher feedback on trial Primary Connections units

Saturday, 9.00am – Room 8

Keith Skamp[1] & Shelley Peers[2]
[1]Southern Cross University, [2]Australian Academy of Science

The Australian Academy of Science's *Primary Connections* is a curriculum and professional learning initiative that aims to enhance the status of science at the primary level. Its structure and pedagogy is based on an enhanced 5E learning model. From 2005-2011 numerous teachers have implemented trial *Primary Connections* units and provided detailed written feedback. The feedback included teachers' perceptions of the strengths and weaknesses of each of the 5E phases and many related aspects. This paper reports on insights gleaned from an analysis of more than 3000 comments from over 200 teachers and relates to 16 units across varied content strands and levels of learning. Using various lenses (e.g., purposes of the 5E phases, inquiry, language and assessment) to interpret teachers' perceptions, this analysis has revealed, among a range of outcomes, the impact *Primary Connections* is having on teachers and students, the extent to which aspects of the enhanced 5E learning model are being addressed, and areas which could further strengthen professional learning and the improvement of science pedagogy at the primary level.

The social location of scientists and their work: a study in progress

Friday, 12.45pm – Room 3

Dorothy Smith[1], Richard Gunstone[2] & Christina E Hart[3]
[1]La Trobe University, [2]Monash University, [3]University of Melbourne/La Trobe University

In this paper we report our conceptualization of a current three-year study of the development in professional scientists of a sense that their work is socially located. The project is motivated by our desire to better understand the ways in which school science curricula can more appropriately seek to accommodate both the needs of prospective scientists and the needs of those students who will not pursue science-related careers. Science and education are institutions of society, yet the school education of all students is and has been for several years de-facto framed by scientists' and curriculum decision-makers' beliefs about the science content that must be learned by future scientists. We examine these beliefs from a fresh theoretical stance regarding the needs of a science professional in today's post-patrimonial societies. We discuss the research methodology generated to enable us to explore this perspective, and what we have learned from the initial trials of our data production approaches.

Mobilising student learning in senior secondary school science

Thursday, 3.20pm – Room 6

Katherine Stewart
Macquarie University

This paper reports on a project where a team of teachers and researchers worked with a secondary science teacher and her students to use mobile technology to design and communicate science concepts to their peers and to a class of primary students. The project addresses the issue that a meaningful and engaging learning context for science needs to be created for adolescent students within the scope of the senior science syllabus.

In this study a phenomenological approach was employed to build a rich description of the learning and teaching that took place. Student groups were videoed as they planned, designed and conducted their teaching sequence. Other data included pre-and post- surveys and interviews with the teacher and students, student and teacher reflections posted to an on-line forum, and student work samples. This paper argues that when high school students are supported to take charge of their learning they are creative communicators of science. They locate effective learning in environments beyond the classroom and incorporate innovative use of mobile technologies into their teaching strategies.

Adaptive technology as an agent of conceptual change

Friday, 3.20pm – Room 5

Angela Stott
University of Cape Town

Research suggests that using multimedia within a Socratic dialogue, and using adaptive technology (software responsive to users' inputs), can improve conceptual learning relative to traditional teaching. This study evaluated an adaptive technology, with embedded multimedia, called iQuiz, guided by the question 'Is iQuiz an effective conceptual learning / teaching tool when used as (a) an electronic tutor and (b) a teaching aid?' Over 1500 physical science teachers completed pre- and post- tests, compiled from literature for this study. These identified misconceptions of the physical science concept of impetus, which iQuiz was programmed to address. Some (529) participants engaged with iQuiz electronically between answering these tests. Others (718) were taught using iQuiz as a teaching aid. The remainder (243) acted as the reference group, receiving no treatment. Improvement from pre- to post- test scores, relative to the reference group's average improvement, was as an index of intervention success. The electronic-engagement group's index was significantly higher than the taught group's index, which was significantly higher than the reference group's. It was concluded that iQuiz has potential to promote conceptual learning, with its likelihood of being effective being even greater when used as an electronic tutor than as a teaching aid.

South African physical science teachers' understanding of force concepts

Thursday 9.30 – Room 4

Angela Stott & Jenni Case
University of Cape Town

Misconceptions about force are highly prevalent amongst high school and university students throughout the world. Their prevalence amongst physical science teachers are less well understood. This paper reports quantitative research on the state of South African Physical Science teachers' understanding of aspects of force and correlations between level of understanding and various biographical factors. Data was collected from over 1500 Physical Science teachers throughout South Africa. These teachers completed a 13-item multiple choice test which probed for the presence of misconceptions about force, and a survey about themselves and their schools. The data shows a high prevalence of misconceptions about force, particularly for the impetus misconception, and particularly among less experienced, less well-resourced teachers and those whose learners have poor pass rates. This highlights the need for interventions aimed at improving teachers' understandings of physical science concepts, perhaps particularly amongst less experienced and less well-resourced teachers, and those with low learner pass rates.

Facilitating Preservice Teachers' Proficiency in ICT Pedagogy

Thursday 11.15am – Room 8

Tim Strohfeldt & Deborah Heck
University of the Sunshine Coast

In school science classrooms Information and Communication Technologies (ICT) are used to enhance the processes of teaching and learning. One of the objectives of preservice teacher education programs is to advance preservice teachers towards proficiency in ICT pedagogy. One of the challenges is to move preservice teachers beyond the utilising ICT to engage learners' attention and towards the use of ICT as an integral part of the teaching and learning experience. This paper reports on the first cycle of course redevelopment to increase the integration of ICT pedagogy within a Middle Years Curriculum course for secondary preservice teachers. The focus of the redevelopment was to model and practise ICT pedagogy in an authentic school environment. The outcomes of the curriculum change were evaluated through reflections on the course evaluation data and focus groups of students and tutors involved in the course. The results indicate the negative impact of technology limitations and the importance of assessment to engage preservice teachers in the process of developing their ICT pedagogy. Recommendations to achieve further improvements through course development are explored.

Using Argument-based Inquiry to Improve Achievement & Critical Thinking Outcomes for Traditionally Low-Achieving Students

Thursday, 9.30am – Room 6

Jonte Taylor & Mary Grace Villanueva

The need to have more than functional understanding of science becomes increasingly important as technology advances. In addition to understanding science content and the practices of science, the ability to think critically has also been identified as an invaluable skill needed for the future. Unfortunately, for students traditionally considered low-achievers, performance on science achievement tests have been considerably worse than those of the general student population. Furthermore, low-achieving students have been shown to lack the skills to think critically in and out of school settings. Research suggests that inquiry-based approaches to teaching science may have a positive impact on science achievement scores for low-achieving students. However, little evidence exists to support the use of such practices help students become better critical thinkers. The current study examines the use of an argument-based inquiry approach to teaching science, called the Science Writing Heuristic (SWH), and its impact on low-achieving students scores on science achievement tests and critical thinking measures. The findings suggest that positive impacts can be made in the areas of science achievement and critical thinking for students traditionally considered low-achieving.

Conceptualization and Development of an Instrument for Investigating Undergraduate Physics Laboratory Learning Environments: The UPLLES

Thursday, 3.20pm – Room 9

Gregory Thomas, Al Meldrum & John Beamish
University of Alberta

The quality and extent of student inquiry in first-year undergraduate Physics laboratories is a long-standing issue in science education. Recipe formats persist as the dominant element of instructional design, and these formats do not adequately support the development of students' inquiry processes. As part of a multi-year project to develop inquiry-oriented first-year Physics laboratories at the University of Alberta, a 23 item instrument, the UPLLES (Undergraduate Physics Laboratory Learning Environment Survey) was developed and validated through (a) factor analysis, using responses of 476 students, and (b) semi-structured interviews with 19 of those students. The five sub-scales of the UPLLES and their corresponding Cronbach's alpha coefficients are, Inquiry Orientation (.75), Integration (0.76), Material Environment (0.66), Student Community (0.84), and Instructor Support (0.71). The UPLLES was used, along with interviews, to evaluate existing first-year Physics laboratory environments at the University of Alberta, confirming their lack of inquiry orientation and the need for reform. These findings, the conceptualization and development of the UPLLES, and its value within a battery of measures for evaluating reform efforts in undergraduate physics laboratories are discussed.

Do learning environments afford wellness? A central conundrum in an emerging science of teaching and learning science

Friday, 9.30am – Room 8

Kenneth Tobin[1], Konstantinos Alexakos[2], Magorzata Powietrzynska[1], Natasha Dachos[2], Parvathy Nair[2], Glauco do Santos Ferreira da Silva[3] & Victor Hugo Rodriguez[1]
[1]Graduate Center of CUNY, [2]Brooklyn College, [3]University of São Paulo

Situated in a science teacher education course, the study focused on relationships between in-the-moment emotions and their physiological expression in breathing patterns, mindfulness, pulse rate, pulse strength, and oxygenation of the blood. We designed and implemented interventions, including deep abdominal breathing, to ameliorate emotions, physiology, and mindfulness. Participants learned to change their states of being to align with their preferences. As well as providing a landscape of central tendencies and contradictions for the social constructs addressed in the study, we address implications concerning participants' wellness. For example, most participants were unaware of the magnitude of their pulse rate as they taught.
The average minimum pulse rate during a class was 75 beats per minute and the average maximum was 148 beats per minute. Through breathing meditation and mindfulness participants decreased heart beat rates when they considered them to be too high. Implications for science teachers being aware their heart beat rate and knowing how to control its magnitude, for themselves and their students, affords the mediation of emotional climates and improvement of learning environments. This research contributes to an emerging science of teaching and learning, which we regard as a central constituent of science teacher education.

Let's talk teaching in the township: Operationising pedagogical content knowledge (PCK) in the context of two South African science classrooms

Friday, 11.20am – Room 5

Rene Toerien & Jenni Case
University of Cape Town

Over the past 20 years pedagogical content knowledge (PCK) has proved to be a useful construct to describe teacher practice. In this paper PCK is used as a framework to describe the teaching practice of two high school science teachers in typical South African classrooms as they teach organic chemistry.
The subjects of this study are both considered 'experts' in their contexts and both fulfil leadership roles at their respective schools. Despite this status their subject matter knowledge lacks conceptual depth and their pedagogical repertoire is limited. The challenging socio-economic environment within which they find themselves, the demands of the school and the pressure of the final examination all play a role in what eventually happens at the chalkface.Analysis of the lessons and interviews investigates the interplay between pedadogy and content, and the teachers' attempts to transform subject matter to ensure that learning takes place. The specific contextual constraints are also highlighted. The paper concludes with raising the question as to where this leaves teacher education and professional development for science teachers in South Africa.

Informal reasoning and representation construction in school science

Friday, 10.35am – Room 7

Russell Tytler[1] & Vaughan Prain[2]
[1]Deakin University, [2]La Trobe University

There has been strong research interest in reasoning in science, across a number of disciplinary and theoretical traditions. This research has mostly focused on formal, syllogistic, verbal processes involving formal logics of inductive and deductive thinking. Recent interest in argumentation as a pedagogy representing the core process of coordination of ideas and evidence follows this tradition. In this paper we will draw on data from the 'Role of representation in learning science' project, involving the video capture of classroom sequences focused on representation production, to argue that a) informal reasoning processes should be central to school science purposes and practices as they are to knowledge generation in science itself, b) representational challenges open up opportunities for reasoning in a number of ways, c) informal reasoning through representation construction involves distributed claims and backing of a different nature to those represented in formal syllogistic accounts of reasoning, and d) the current framing of argumentation in school science misrepresents the complex processes of science knowledge generation and validation. Argumentation is best seen as an emergent practice within informal model based reasoning processes focused on authentic problems.

Learning and teaching about the 2011 Japanese earthquake, tsunami and nuclear events from a socio-scientific literacy perspective: scaffolding for success

Saturday, 9.45am – Room 8

Wilhelmina Van Rooy[1] & Leah Moore[2]
[1]Australian Catholic University, [2]University of Canberra

The media coverage of the March 2011 Japanese earthquake, tsunami and nuclear events can be used to develop students' knowledge and understanding of geological concepts and related socio-scientific issues (SSI). Thematic analysis of news reports relating to this SSI allows identification of the key scientific and social concepts. Teachers can use this approach as a component of explicit teaching about the science that underpins the broader understanding of the SSI. The practice of working with mass media resources requires students to develop their science literacy skills, and because of the intimate nature of the interaction with the media this practice influences their personal social 'positioning' with respect to the SSI. This approach can help students move from their everyday, perceptual notions about geoscience phenomena, to more scientific conceptions. As students construct and reconstruct their understanding of scientific processes and phenomena, careful scaffolding permits revisiting and reframing of alternative conceptions specific to the SSI. This is a novel approach to contextualizing student interrogation of the science that underpins the SSI. The intention is that activities of this nature will trigger their sense of wonder and their curiosity about science.

The Dilemmas of Junior School Science Teaching: Societal Expectations, School Structures, Student Experiences, Teacher Accounts - a persistent issue in Science Education Research

Thursday, 4.05pm – Room 6

Sangeeta Varma
University of Melbourne

This is a collaborative descriptive study of the challenging contemporary professional environment of 3 early-mid career science teachers in an inner urban secondary school
A perceived problem of secondary student disengagement with the science curriculum and science teaching has been intensively researched over many years from the perspective of students' intrinsic and extrinsic interests or the perspective of science teachers, but surprisingly rarely together in a specific school context. The literature generally suggests that a teacher's agency is of necessity influenced by three common places; social expectations, student expectations /experiences and curricular structures that in various iterations should serve both. The influence of each of these common places was examined in discussions with the three collaborating teachers.

In the initial phase of this study the experiences and expectations of Year 8-10 students in the science classes of the three volunteer teachers were surveyed using the Spady Mitchell Instrument Model from Williams and Batten's 'Quality of School Life'. The collated class data for each teacher's classes were distributed to them to inform and support a number of discussions and interviews between each teacher and the researcher about the personal challenges of contemporary science teaching in their school and more generally in secondary schools.

"Choosing science comes more for the heart than from the brain (or the pocket)": A retrospective study of why scientists chose to study science

Friday, 1.30pm – Room 6

Grady Venville, Colin Hanbury & Nancy Longnecker
University of Western Australia

Considerable concerns have recently been raised in the literature and in the media about the 'science pipeline' and whether Australia has enough budding scientists to fill research and industry positions in the coming years. The aim of the research presented in this paper was to retrospectively survey current Australian and New Zealand scientists to ascertain why they chose to study science. The on-line survey was conducted via a link to SurveyGizmo. The data presented is from 722 respondents who answered both forced choice and open questions. Statistical analysis was perfomed using Genstat Version 12.1.0.3338 and the qualitative data were analysed thematically. The quantitative data showed that the main reasons scientists chose to study science was because they were interested in science and because they were good at science. Secondary school science classes and one particular science teacher also were found to be important factors. Of less importance were the prestige of science and financial considerations. The qualitative data confirmed these findings and showed that a passion for science was the most important factor but also highlighted the importance of other factors such as recreational pursuits like living on a farm, or camping as a child.

Developing Scientific Ideas using Writing-to-Learn Activities: The effects of

Friday, 12.45pm – Room 7

Mary Grace Villanueva, Brian Hand & Jaime Sabel
University of Iowa

Researchers have suggested that writing to learn approaches can be an effective tool for students to communicate and constitute ideas in science; yet, understanding the ways in which teachers afford students writing opportunities, alongside other productive disciplinary practices such as generating, interpreting and using evidence, has been limited. To explore the critical intersection between Grade 5 students' development of ideas and the teacher's implementation of writing and argument-based inquiry practices, students' writing samples (e.g., pre-unit probe questions, science notebook entries, laboratory report, summary writing activity), as well as field notes from classroom observations were collected over a five-week unit on "Matter." Students' pre-unit writings were analyzed to establish initial understandings and then compared to the ideas expressed in their summary writing activity at the end of the unit. Intermediary writing tasks were also analyzed to trace how students' built and revised their ideas. The findings show that, while students were engaged in frequent writing and inquiry practices, there was minimal progression of students' conceptual development. Text from all three students revealed explanations and understandings of matter which remained at a macro level. The findings suggest that writing and inquiry were used as independent exercises rather than as opportunities for critiquing and building coherent understandings of the big idea.

Improving reasoning and personalizing learning process through assessment

Friday, 12.45pm – Room 4

Bruce Waldrip[1], Vaughan Prain[2] & Peter Sellings[1]
[1]Monash University, [2]La Trobe

There is growing research interest in the challenges and opportunities learners face in representing their scientific understandings, processes and reasoning during assessment. The research involved second year high school students and examined the introduction of enhanced student voice through the use of peer and self assessment in an inquiry learning project designed to improve the quality of their explanations. This project gave students the opportunity to choose both the type and the context of learning activities. Students needed to declare their understandings and explain their reasoning behind their explanations. This set the scene for testing of the adequacy of peer assessment about their claims.
The findings show the benefits of peer assessment as a valuable learning tool that gave targeted feedback to students, allowing them to have more of a voice in their education and challenged students to reflect critically on the quality of their reasoning.

Hemispheric Preferences Related to Cognitive and Affective Learning Outcomes of Taiwanese Elementary School Students

Friday, 2.15pm – Poster 5

Tzu-Ling Wang
National Hsinchu University of Education

The major purpose of the current study was to better our understanding of student hemispheric preference and learning by examining the relationships between hemispheric preferences, gender, verbal ability, spatial ability, science achievement, and attitudes toward science class. Participants included 756 sixth-grade students in Taiwan. Data were collected from five data sources: (a) Style of Learning and Thinking Inventory to identify student hemispheric preference, (b) Chinese Language Test to assess student verbal ability, (c) PMA Spatial Relations Test to measure student spatial ability, (d) Science Achievement Test to assess student science achievement, and (e) Asian Student Attitudes Toward Science Class Survey to measure student attitudes toward science class. The results suggested that hemispheric preference and gender are highly associated. Girls tend to have higher ratio of left brain preference while boys is more likely to have right brain preference. The hemispheric preference does have impact on spatial ability and attitudes toward science class but have little effect on science achievement and verbal ability. The gender difference occurs on verbal ability, spatial ability and attitudes toward science class while this difference does not appear on science achievement.

Overqualified to be teaching? Challenges confronting science professionals becoming teachers

Thursday, 11.15am – Room 9

James Watters & Carmel Diezmann
Queensland University of Technology

Vigorous debate in the research literature exists around the importance of subject matter preparation versus professional educational training with significant implications for teacher education models. In their recent review of the status and quality of Year 11 and Year 12 science

Goodrum et al. (2011) argue that employers need to acknowledge the knowledge that new teachers bring with them from previous work experience. This paper explores the question 'what subject and professional knowledge and experiences do highly subject-matter qualified but novice science and mathematics teachers bring to teaching?' The presentation draws on a longitudinal study of initially 15 career change teachers highly qualified in the sciences. The study reports on the challenges confronting these teachers few of whom had the opportunity to draw on their specific subject matter knowledge in their beginning years of teaching. For many, the transition to teaching was challenging and unrewarding. After three years only seven teachers remained in the profession and fewer saw themselves as likely to remain in teaching for an extended career. The study highlights some of the specific induction needs that highly qualified and experienced beginning teachers require if their potential to become exceptional teachers is to be realised.

How to detect if change is being taken to heart by the science teacher

Thursday, 10.35am – Room 9

Jacolyn Weller
La Trobe University

Ownership is the key to embracing change and informs whether the teacher has stepped towards the new and feels comfortable wearing and using it as part of their ensemble. Observational data is one indication, and perhaps the most effective means to know if "the new" is being used by science teachers, but the story of the individual and the personal viewpoint paints the picture of whether a science teaching change has been taken to heart. Early identification can indicate the requirement of additional strategies to ensure change and enable greater surety of the desired outcome. Whether the focus is based on datalogging, computer pods, interactive whiteboards; technology or not, it is by conversations embedded with personal pronoun analysis that identifies the individual's location to the tool. Not only what is said, but how it is said presents the degree of connection. By colour coding when dissecting the answers to focused discussion questions the researcher can identify the degree of uptake by the individual. Ultimately, actions speak, but how we speak provides insight into whether change has been taken to heart and owned by the person.

Students' Use of Diagrams to Make Sense of Biological Evolution

Thursday, 11.15am – Room 3

Mihye Won & David Treagust
Curtin University

In recent years, many science educators have extensively discussed the complexity of teaching biological evolution. Despite the broad discussion on the influence of students' personal beliefs or social environment, there is a relatively small number of studies that suggest how best to teach evolution in class.
This study investigated how students are making sense of different pieces of evidence of evolution. After learning evolution in Year 12 Human-Biology, students were asked to draw diagrams to explain the evidence of evolution. When students were not able to draw, we showed diagrams that the teacher had used in class. We adopted diagrams as the main focus because drawing and explaining diagrams is a good way to learn and communicate science.

The results showed that the majority of students initially drew geological strata and fossils because they perceived it was the most convincing piece of evidence. Some others drew a homologous structure of forelimbs of various animals based on the class activity, and their discussion of the diagram afforded a good opportunity to elaborate on their understanding. From the interview analysis, we make suggestions regarding how teachers can best use various diagrams to guide students' learning of evolution.

A case study of investigating possible factors affecting Chemistry teachers teaching Triplet Relationship in different settings

Friday, 4.05pm – Room 4

Sibyl Wong
University of Hong Kong

Significance: Since the early eighties, chemistry educators argued the importance of teaching/learning chemistry with the idea of triplet representations (macro-micro-symbolic level). Many studies have reported that teaching/learning chemistry with explicit elaboration of the triplet relationship can result in better conceptual understanding. However, it is puzzling that explicit teaching of triplet relationship has not been a common classroom practice. Identification of the reasons behind the lack of implementation of the apparent good practice would provide valuable insights to researchers and educators the pertinent factors which might be missing in the current professional development.

Aim: Investigate the factors that can encourage or discourage, a chemistry teacher to embed triplet relationship in his/her teaching in secondary school.

Methods: Case study. Four secondary school chemistry teachers in Hong Kong were followed for an academic year. Lesson materials, field notes and videos of their lessons were taken. Interviews with teachers before the academic year, follow-up interviews with this teacher on different chemistry topics and different levels of students.

Results: Preliminary data reveal that teacher's concern of students' learning outcomes, teachers' understanding and pedagogical knowledge of triplet relationship are crucial determining factors. Other factors emerged from the data include explicit introduction and explanation of triplet relationship, computer assisted teaching/learning, class size, etc.

A study of classroom lessons in Japan designed to nurture argument skills: 5th-grade science module on pendulum movement case

Thursday, 1.00pm – Room 8

Tomokazu Yamamoto[1], Miki Sakamoto[2], Junko Nishigaki[2], Keita Maratsu[2] & Shinichi Kamiyama[2]
[1]University of Miyazaki, [2]Kobe University

Argument skills have come to be seen as an important part of science education throughout the world. We designed science lessons for fifth grade students in Japan in which students pursue the factors that affect the period of a pendulum through experiments, and determine the effectiveness of the lessons by conducting a test to ascertain their acquisition of argument skills.

In order to let the students to engage in arguments based on McNeill & Krajcik's(2011) framework, we conducted lessons by including four design elements in the designing learning tasks phase and eight design elements in the teaching strategies phase. One hundred and seven students participated in our study. We evaluated their argument skills before and after the lessons. The results of this argument test showed a significant increase in the frequency of writing evidence and reasoning which support claims.
These results imply that the lessons enabled students to improve their argument skills. However, some of the arguments written after the lessons still lacked some essential elements for argument. This result suggests that a single module is insufficient to largely improve students' argument skills.

Developing Students' Metavisual Capability in Electromagnetic Induction through A Visualization-based Instructional Package

Friday, 4.05pm – Room 5

Jennifer Yeo[1], Hye-Eun Chu[1] & Charles Chew[2]
[1]Nanyang Technological University, [2]Academy of Singapore Teachers

Electromagnetic induction (EMI) is a difficult concept for many high school students learning physics due to the difficulties of visualizing the invisible entities involved and the abstraction of processes (e.g., Saglam & Miller, 2006). This paper presents a framework based on Johnstone's (1993) triplet relationship of representations to design a visualization-based instructional package to address these difficulties. It reports how this instructional package supported students in making-sense of EMI phenomenon. Taking an experimental approach, pre- and post-tests were administered to 63 students (37 in the experimental group and 26 in the control group) to measure their achievement scores in EMI. Think-aloud interviews were conducted with 20 students (12 from the experimental group and eight from the control group) to understand their sense-making of EMI phenomenon. While no significant difference was found in the gain scores in both groups, interview data showed that students in the experimental group were better able to use discipline-consistent representations to reason about the phenomenon than those in the control group, an indication of deeper understanding of EMI. We conclude that learning EMI requires the development of competencies to use cultural-specific representations to think about phenomena. The triplet relationship of representations provided a useful framework for designing visualization-based instruction for EMI.

Learning to Teach Nature of Science: A Focus on Working with Students' Ideas

Thursday, 3.20pm – Room 3

Valerie Wing-yan Yip, Benny Hin-wai Yung & Ching Lai
University of Hong Kong

Incorporating the epistemic aspect of science has been a key feature of science curriculum reform in the last two decades. However preparing teachers to teach nature of science (NOS) has remained a great challenge. This paper examines how a two-year video-based teacher professional development (TPD) programme helped teachers focus on working with students' ideas in teaching NOS. Through a mixed-method case study of the learning experiences of three teachers, supportive features of the programme were identified. These included: (1) provision of educative curriculum materials, (2) reviewing and reflecting on the teachers' own lesson videos in a thematic approach, and (3) facilitating teachers' reflection on the videos by provision of a theoretical tool. All these features were designed in such a manner that focused teachers' attention on how students' ideas can be

used effectively develop NOS lessons. It is argued that if TPD developers provide programmes incorporating these three elements, then the reform vision of improving students' understanding of the epistemic aspect of science will be realised.

Teaching with a model for better scientific understanding: How do students actually interpret the bell-jar model for breathing mechanism?

Friday, 11.20am – Room 9

Heojeong Yoon, Mihye Won, & David F. Treagust
Curtin University

Science teachers frequently utilize models to illustrate abstract science concepts, thereby helping visualize scientific phenomena. Although models are beneficial, educational researchers have cautioned that the inherent difference between a model and the corresponding science concept could cause confusion or misconceptions, and teachers need to be aware of both advantages and disadvantages of adopting any models.

In biology, a bell-jar with balloons is an often-used model of the lungs. This model visualizes the mechanism of breathing in terms of muscle contraction and volume change in lungs rather than the active flow of air from outside to the lungs. In this study, we have observed how Year 11 Human Biology students learn breathing mechanisms with reference to the model as well as to their textbook. After the lessons, we asked the students to draw diagrams to illustrate the breathing mechanism. We observed many students were able to explain the mechanism successfully with the diagrams. However, our analysis of their diagrams and explanations reveals that students have misunderstandings that are directly attributable to the bell-jar model as well. Considering the drawbacks in using the bell-jar model, we recommend how it should be used to teach breathing mechanisms.

Pre-service Teachers' Understanding and Responses to Teacher Educators' Feedbacks on Inquiry Teaching Practice

Friday, 8.45am – Room 3

Hye-Gyoung Yoon[1], Mijung Kim[2], Yong Jae Joung[3], Young-Shin Park[4] & Byung Sug Kim[5]
[1]Chuncheon National University of Education, [2]University of Victoria, [3]Gongju National University of Education, [4]Chosun University, [5]Roosevelt University

In this study, fifteen 4th year university students in an elementary teacher education program participated in and reflected upon inquiry teaching practice. The research questions were as follows: (a) what are the characteristics of inquiry teaching in pre-service teachers' understanding? (b) How do they reflect on and respond to teacher educators' feedback?

Five science teacher educators also joined this study by reviewing the pre-service teachers' video-taped teaching practice and provided them with feedback. Employing collaborative peer teaching and reflection, this study attempted to provide pre-service teachers opportunities to teach, revise, and re-teach lessons so that they can reflect on and experience changes in their action.

Pre-service teachers demonstrated different views on inquiry teaching through their first teaching practice. When they reflected on their teaching based on teacher educators' feedbacks, they

showed incomplete understanding or encountered dilemmatic situations with the new ideas in the feedback. The teacher educators' feedback was incorporated with suspicion into their second teaching. After the second teaching, they exhibited a better understanding and acceptance of the feedback, comparing and realizing changes by themselves. The findings shed light on the roles of acting out as an important element of transformative reflection.

Education for and about sustainability: an imbalanced juggling act?

Friday, 11.20am – Room 8

Yvonne Zeegers & Ian Clark
University of South Australia

Embedding sustainability in higher education is not without its challenges. The role of universities in the context of Education for Sustainable Development (ESD) is significant not only because their research and teaching generates and transfers knowledge about sustainability, but because they also educate future professionals to enable them to contribute to a sustainable future. In the last few years there have been numerous studies describing approaches to implementing ESD ranging from courses about sustainability to total curriculum redesign but few have taken into account students' perceptions of sustainability. Those which have indicate that students make strong links to environmental sustainability but less so to the social and economic aspects of sustainability.
This presentation describes a two year study which investigated students' perceptions of sustainability. As part of the study it sought to determine whether an introductory course in a Masters program that focused on raising a balanced awareness of sustainability would produce graduates with the knowledge, understanding and commitment to drive the sustainability agenda forward.