ASERA 98

The 29th Annual Conference

of the

AUSTRALASIAN SCIENCE EDUCATION RESEARCH ASSOCIATION

9 - 12 July, 1998

Held at the Casuarina Campus

NORTHERN TERRITORY UNIVERSITY

Darwin, Northern Territory

WELCOME TO DARWIN AND ASERA 98

It is our pleasure to extend a warm welcome to all participants at ASERA 98, the 29th Annual Conference of the Association. Your support for this Conference is very much appreciated, and we hope that you find your time at the Northern Territory University an enjoyable and rewarding one. We would like to extend a particular welcome to those participating in their first ASERA Conference, and to all our visitors from overseas. Please do not hesitate to ask us anything about the Conference or the city of Darwin during your stay.

Conference Convenor
Bill Palmer

Conference Organisers:

Mr Steven Zander	Accommodation
Ms Hilary Fowler	Finance
Ms Patricia Isaacs	Program
Mr Michael Michie	Proceedings
Ms Shantha Jacob	Social events

THANKS

ASERA 98 expresses its sincere thanks to the Northern Territory University for the use of its facilities and equipment for the Conference. We would also like to thank QANTAS, RISE and CONASTA for their assistance, and Ron Price and Roger Cross for their donation of books to participants.

CONTENTS

Conference Timetable	p 2
General Information	p 3
Program Themes	p 5
Daily Program	p 6
Abstracts	p 9
Campus Map	p 30
List of Participants	p 31

CONFERENCE TIMETABLE

Thursday 9 July

7.00pm	Registration Opens	Staff Club, (3rd floor) The Commercial Building
7.00pm	Drinks and Nibbles	Staff Club, (3rd floor) The Commercial Building
9.00pm	Registration Closes	

Friday 10July

8.15am	Registration Desk Opens	Mal Nairn Auditorium
9.00 - 9.30am	Conference Opening	Mal Nairn Auditorium
9.30 - 10.15am	Session 1	Faculty of Education (Building 23)
10.15 - 10.45am	Morning Tea	Faculty of Education (Building 23)
10.45- 12.15	Session 2	Faculty of Education (Building 23)
12.15 - 1.25pm	Lunch	Cafeteria (2nd fl), The Commercial Building
1.30 - 3.00pm	Session 3	Faculty of Education (Building 23)
3.00 - 3.30pm	Aftemoon Tea	Faculty of Education (Building 23)
3.30 - 5.00pm	Session 4	Faculty of Education (Building 23)
7.00pm	Free	

Saturday 10 July

8.30am	Registration Desk Opens	Faculty of Education (Building 23)
9.00 - 10.30am	Session 5	Faculty of Education (Building 23)
10.30 - 11.00am	Moming Tea	Faculty of Education (Building 23)
11.00 - 12.30	Session 6	Faculty of Education (Building 23)
12.30 - 1.45pm	Lunch	Cafeteria (2nd fl), The Commercial Building
1.45 - 3.15pm	Session 7	Faculty of Education (Building 23)
3.15 - 3.45pm	Aftemoon Tea	Faculty of Education (Building 23)
3.45 - 4.45pm	AGM	Auditorium, Faculty of Education (Building 23)
4.45pm	Editorial Board of RISE	
Or	Networking opportunities	
6.15 pm	Conference Dinner	

Sunday 11July

8.30am	Registration Desk Opens	Faculty of Education (Building 23)
9.00 - 10.30am	Session 8	Faculty of Education. (Building 23)
10.30 - 11.00am	Morning Tea	Faculty of Education (Building 23)
11.00 - 12.30	Session 9	Faculty of Education (Building 23)
12.30 - 1.45pm	Lunch and Close	Cafeteria (2nd fl), The Commercial Building

GENERAL INFORMATION

ANNUAL GENERAL MEETING
This will be held on Saturday 10 July at 3:45 pm in the Auditorium of the Faculty of Education. (Building 23)

CHANGES TO PROGRAM
Any changes to the program will be listed on display boards at the Registration Desk, in the Faculty of Education.. These will be updated daily; please consult the display boards regularly.

CONFERENCE DINNER
The dinner will be held in an out of doors venue on Saturday, 11 July. Please also notify the Registration Desk, by 12:00 on Saturday if you require a special meal. If you have not yet registered for the dinner, and would like to attend, please see one of the Organisers as soon as possible. The caterer is Australian Gourmet Wildfoods, who have an excellent local reputation.

CONFERENCE OPENING
The Conference Opening will be held at 9:00 am in The Mal Nairn Auditorium: please see the enclosed campus map for directions, or ask one of the Organisers. The Conference will be opened by Prof.Ron McKay, Vice Chancellor of the Northern Territory University .

MAPS
A map of the Casuarina Campus buildings is included in this booklet. A map of Darwin will be on display at the Registration Desk.

MEALS
Morning and afternoon teas will be in the open area outside the Auditorium in the Faculty of Education. Lunches will be at the The cafeteria (second floor), The Commercial Building. Organisers will direct participants to these venues.

NETWORKING
Room 37 will be available throughout the conference for small groups to meet. There will also be tea and coffee facilities here for use outside of the catered morning and afternoon tea breaks.

PAPER PRESENTATIONS
All papers will be presented in the Faculty of Education (Building 23). Rooms 43, 45, 47, 48 and 51 will be used. These rooms are all off two main passages that form the adjacent sides of a square.and are within a few metres of each other. Please note that all paper presentations are planned to last for 40 minutes (with 5 minutes of that time being for changing over) and the Chairpersons will be asked to adhere strictly to that time-frame.

PARKING
Free parking available anywhere in the University. Ignore the Pay signs.

PUBLIC TELEPHONES
Public phones are located outside the auditorium in the Faculty of Education. Local calls from a public phone cost 40 cents.

PUBLIC TRANSPORT
Buses leave from in front of Building 29. See the Registration desk for the timetable.

POSTER DISPLAYS
Posters will be displayed in the Faculty of Education foyer during tea breaks on Friday and Saturday..

REGISTRATION DESK

The Registration Desk will be open on Thursday evening from 7 - 9 pm in The Staff Club, (Third floor) of the Commercial.
It will then be open each day from 8:15 am to 9 am in the Foyer of Building 23.
Otherwise it will be open at tea-breaks in the Faculty of Education foyer. On Saturday and Sunday mornings it will be open in the Faculty of Education foyer from 8.30pm.

SESSION CHAIRPERSONS

Chairs for sessions have been nominated, and information for chairs in induded in your Registration satchel. If you have been asked to be a chair but are unable to attend the session you have been nominated for, we ask that you arrange an alternate. If this is not possible, please contact one of the organisers. If you do make a change please write it on the plan near the Registration desk. It is the responsibility of presenters to contact the chairperson of their session to organise timing, etc.

SHOPPING

There is a large shopping centre at Casuarina about 15 minutes walk away.

TAXIS

Darwin Radio Taxis	89818777
Darwin Combined Taxis	812222

TOURIST ACTIVITIES

See booklet in folder and NT Tourist Bureau.

PROGRAM THEMES

As was initiated last year, we have grouped together papers with a similar focus wherever possible into sessions of several sessions using the same room. This will allow you to follow particular themes if you wish and will tend to reduce the times when interesting papers on related topics clash.The following list provided the basis for that arrangement..

- Assessment
- Attitudes to science/issues
- Conceptual understanding
- Curriculum / curriculum development
- Gender
- in science teaching/learning
- Learning & teaching
- Learning contexts
- Preservice education
- Professional development
- Research trends
- Technology education
- Tertiary science

TIMETABLE FRIDAY

FRIDAY	Room 51	Room 47	Room 48	Room 45	Room 43
8.15 am	REGISTRATION DESK OPENS				
9.00- 9.30 am	CONFERENCE OPENING				
9.30-10.15 am SESSION 1	**Léonie Rennie** Research at a Distance: Problems and Possibilities **Chair: K. Appleton**	**Bev France** Technological literacy: a realisable goal or a chimera? **Chair: M. Carr**	**Susan Hersey** How Do Teachers Know When Their Students Are Learning? Part 2 **Chair: D. Corrigan**	**Robyn White & John Wallace** The role of heroes in science curriculum change in Western Australia **Chair: F. Deshon**	
10.15-10.45 am	MORNING TEA				
10.45-11.30 am SESSION 2	**John Wallace** Paper Set 1 **Chair: R. Bucat**	**Geoff Rogers** The Designing Stage of Design, Make and Appraise: A Case Study Involving Young Children Designing. **Chair: C. Chin**	**Richard Gunstone, Brian McKittrick and Pam Mulhall** Structured Cognitive Discussions in Senior High School Physics: Student And Teacher Perception **Chair: G. Corrigan**	**Pachara Davivongse** Science and Technology Education at the Secondary Level in Thailand **Chair: G. Erickson**	
11.30-12.15 am	**John Wallace** Paper Set 2 **Chair: R. Bucat**	**Marilyn Fleer** Interactive Technology: Children's Technological Questions **Chair: R. Fawns**	**P.K. Tao** Solving qualitative physics problems together: The role of students' collaborative talks. **Chair: P. Fensham**	**Jeannie Ling Ai Yieng and Alison St. George** Implementing an Inquiry-Based Primary Science Curriculum in Malaysia: A Case study of an Experienced Teacher **Chair: S. Fankhauser**	
12.15 -1.25 pm	LUNCH				
1.30-2.15 pm SESSION 3	**David Lloyd** Future Imaging: Student Views, Mediation and Learning Through Science **Chair: A. Semple**	**Brian Salter-Duke** Learning Science Over the Internet **Chair: D. Clark**	**Mike Forret** A Model for Designing a Practical Introduction to Electronics **Chair: S. Fernand**	**Janette Griffin and David Symington** Finding an appropriate methodology for testing a school-museum learning framework **Chair: M. Fleer**	**Gordon Brown** Including the nature of science in school science: arguments from the metascientific and education literatures. **Chair: P. Awei**
2.15- 3.00 pm	**Robert Fysh and Keith B. Lucas** Religious beliefs in science classrooms. **Chair: R. Cameron**	**Jaewoo Kim** Identifying, Choosing and Controlling : three important elements in pupils' dealings with variables **Chair: P. Eastwell**	**Christina Hart, Pam Mulhall, Amanda Berry, John Loughran, Dick Gunstone.** What is the Purpose of *this* Prac? **Chair: Y. Eisen**	**Miles Barker** 'The Motion of their Juice': Science, History and Learning about Plants and Water **Chair: C. Gauld**	
3.00-3.30 pm	AFTERNOON TEA				
3.30-4.15 pm SESSION 4	**Bar Ibrahim & Sidibe Oumar Fernand** Science from the Base: How to Talk so that Children Will Listen and How to Listen so that Children Will Talk. **Chair: P. Taylor**	**Greg McPhan** The Qualitative Assessment of Concept Maps: A SOLO analysis. **Chair: P. Davivongse**	**Ian Morrison** The Effects of Co-curricular Activities on Academic achievement in Science **Chair: G. Brown**	**Ann Northover & Alister Jones** The role of subject subcultures in influencing the implementation of a new curriculum statement in New Zealand secondary schools **Chair: J. Clark**	
4.15 -5.00 pm	**Robin Hall and Lynette Schaverien** Early Learning in a Technological Culture: Researching a Child's Developing Curriculum within his Extended Family **Chair: A. Berry**	**Gerry Corrigan** The Acquisition of Process Skills and The Development of Conceptual Learning. **Chair: C. Dawson**	**Bruce Waldrip** Using student interviews to validate a learning environment questionnaire **Chair: C. K. Or**	**Bob Bucat** Content-specific pedagogical research questions: A case for "applied research" in science education? **Chair: B. Ferry**	

TIMETABLE SATURDAY

SATURDAY	Room 51	Room 47	Room 48	Room 45
8.30 am	REGISTRATION DESK OPENS			
9.00-9.45 am SESSION 5	**Deborah Corrigan, Amanda Berry, Greg Lancaster & John Loughran** Camp **Chair: R. Fysh**	**Russell Tytler** Tracking children's science conceptions in the lower primary school **Chair: B. France**	**Grady Venville, John Wallace, Léonie Rennie and John Malone** Integrating Science, Mathematics and Technology: A Case Study of Student Learning **Chair: H. Fowler**	**Filocha Haslam and Peter Fensham** Conceptions of Context in Free Response Items From TIMSS **Chair: D. Geelan**
9.45 - 10.30am	**Ken Appleton and Ian Kindt** What do I do when I don't know? Science content pedagogic knowledge for primary teachers **Chair: J. Griffin**	**Chris Dawson** 17 Years On: What Do They Like Now? **Chair: R. Groves**	**Susan J. Gribble, Léonie J. Rennie,Wendy Speering, Catherine Milne and Louise Tyson** Values in the Science Curriculum: Implications for Teaching **Chair: D. Gunstone**	**Alister Jones and Judy Moreland** Assessment in Technology Education: Developing an Initial Framework for Research **Chair: M. Hackling**
10.30-11.00 am	MORNING TEA			
11.00- 11.45 am SESSION 6	**Renato Schibeci and Ruth Hickey** Using videos for external primary science education students: A CUTSD grant report **Chair: M. Haire**	**David Palmer** Exploring the Link Between Students' Scientific and Non-Scientific Conceptions. **Chair: T. Harrison**	**Christine Chin** Learning Science Using a Deep Approach: Some Learning Strategies **Chair: E. Hart**	**Stuart Fankhauser and Russell Jones** Information Literacy in the Classroom: How Computer Literate are Students? **Chair: S. Hersey**
11.45-12.30am	**Gilda Segal & John Oversby** Teaching Chemistry to Student Primary Teachers: A Study of a Tutor Responding to the Needs of his Students **Chair: G. Henderson**	**C. J. McRobbie** Case Studies of Student Reasoning about Explanations in Chemistry **Chair: G. Hoban**	**Fran Steele** **Let's not teach biotechnology.** **Chair: B. Waldrip**	**Darrell Fisher and Ed Stolarchuk** The Effect of Using Laptop Computers on Achievement, Attitude to Science and Teacher-Student Interpersonal Behaviour in Science **Chair: B. Ibrahim**
12.30 -1.45 pm	LUNCH			
1.45-2.30 pm SESSION 7	**Marian Haire** Teaching Science in Context: Measurement in Sport **Chair: R. Hickey**	**Peter Aubusson, Kevin Watson, Gordon Brown, Denis Goodrum, Mark W. Hackling, Dick Gunstone, Cam McRobbie, Jim Watters & Carmel Diezmann** Science Education is ill! What is the cure? Part1 **Chair: P. Isaacs**	**Russell W. Jones and John W. Warner** Graphs: Acknowledged as Important Scientific Tools, Yet How are they Read? **Chair: J. Oversby**	**Geoff I Swan** Learning science: Student centred educational software **Chair: A. Jones**
2.30- 3.15 pm	**Stephen M. Ritchie** Accessing Science Teachers' Personal Practical Theories **Chair: J. Kim**	**Peter Aubusson, etc** Science Education is ill! What is the cure? Part2 **Chair: M. Lindsay**	**Keith Skamp** Atoms and Molecules for Primary Students? **Chair: J. Ling**	**Eileen Kennedy** Computer-Based Learning in Chemistry **Chair: J. Loughram**
3.15-3.45 pm	AFTERNOON TEA			
3.45-4.45 pm	ANNUAL GENERAL MEETING			
4.45 pm	VARIOUS			
6.15 pm	CONFERENCE DINNER			

TIMETABLE SUNDAY

SUNDAY	Room 51	Room 47	Room 48	Room45
8.30 am	REGISTRATION DESK OPENS			
9.00-9.45 am SESSION 8	Gaalen Erickson and Garry Hoban Learning in Professional Contexts Chair: I. MacDonald	Patricia Isaacs Teachers trying to develop professionally Chair: M. Matthews	Peter J Fensham Towards a Minimalist Science Education Chair: G. McPhan	Greg Williams and Kate Gloury Quantum Leaps in Chemistry Education for Indigenous Students. Chair: I. Mitchell
9.45 - 10.30am	Brian Ferry and Julie Kiggins Promoting Constructivist Based Learning in Science: Accomplishments and Frustrations Associated with a Preservice Teacher Education Program. Chair: J. Morland	John Oversby What is a 'scientific theory? Chair: I. Morrison	Pole Awei Developing science language skills: Should they (reading, listening, writing, speaking) be taught again ? Chair: K. Paige	Michael R. Matthews Opportunites Lost: The Pendulum in the USA National Science Education Standards Chair: D. Palmer
10.30-11.00 am	MORNING TEA			
11.00- 11.45 am SESSION 9	Ian Mitchell "Don't Give Me That Theoretical Crap, Give Me Something I Can Use": Using Cases in Teacher Research Part 1 Chair: L. Rennie	Rod Fawns Research in Teacher Education: Partnerships in Pedagogy Chair: G. Rogers	C.K. Or Scientific Literacy- the TIMSS picture Chair: J. Scott	Bill Palmer Taking Stock in Science Education: The Sesquicentenary of Professor H. E Armstrong. Chair: G. Segal
11.45-12.30am	Ian Mitchell "Don't Give Me That Theoretical Crap, Give Me Something I Can Use": Using Cases in Teacher Research Part 2 Chair: L. Rennie	Ian Macdonald School Preparation for Tertiary Study Chair: K. Skamp	Peter Eastwell The Influences of a Program of Enrichment and Extracurricular Activities on the Affect of Secondary Science Students Chair: R. Tytler	Michael Michie Factors influencing secondary science teachers to taking field trips Chair: G. Williams
12.30 -1.45 pm	LUNCH AND CLOSE			

ABSTRACTS- Alphabetical by first author

Ken Appleton and Ian Kindt
Central Queensland University

What do I do when I don't know? Science content pedagogic knowledge for primary teachers

Shulman has suggested that teaching knowledge can be considered as consisting of content knowledge of a discipline, pedagogic knowledge, and specific discipline content pedagogic knowledge. For primary teachers to teach science, this would suggest that they need to have a basic understanding of appropriate science content, a repertoire of pedagogies, and specific pedagogic applications for teaching selected science content. Some primary teachers have sufficient science content knowledge to generate science content pedagogic knowledge for a science program. However, many primary teachers have a limited grasp of science content, and consequently cannot develop appropriate science content pedagogic knowledge. Some teachers get around this problem by not teaching science. The vast majority of teachers try to teach science, even though they face difficulties in doing so. Since they cannot create their own science content pedagogic knowledge, how do they manage to teach a science program if such knowledge is necessary? In this paper we explore this question by postulating a model for generation of science content pedagogic knowledge for primary teachers, and draw on aspects of our current and past research to exemplify aspects of the model.

Peter Aubusson, Kevin Watson, Gordon Brown, Denis Goodrum, Mark W. Hackling, Dick Gunstone, Cam McRobbie, Jim Watters & Carmel Diezmann
University of Western Sydney
Edith Cowan University
Monash University
Queensland University of Technology

Science Education is ill! What is the cure?

The Australian Academy of Science received an ARC grant to carry out a project that would improve lower secondary science teaching and learning. The AAS commissioned a review of the literature regarding lower secondary science curriculum, and coordinated and part funded three research studies conducted by three universities (ECU, QUT and UWS) each collaborating with their state education department. The studies explored the extent to which a combination of professional development and exemplary curriculum materials would facilitate teacher change and improve the quality of teaching and learning. The three studies addressed different research questions and used different methodologies, however they all used two North American text-based curriculum resources that were based on a constructivist approach to teaching and learning. The three studies provide interesting insights into the problems associated with improving lower secondary science teaching and developed recommendations for further action. One interesting aspect of the three studies is that each formulated different specific research questions and hence collected different data and drew different conclusions

Pole Awei
Northern Territory University

Developing science language skills: Should they (reading, listening, writing, speaking) be taught again ?

This paper looks at the current developments in science literacy. It starts off with the definition of 'science literacy' being discussed. It attempts to change the common view that teaching literacy is the job of the English teacher. The argument is put forward for the need to base science instructions on the basic comunication skills. Highlighted in the discussion is the importance of educators focusing on the basic literacy aspects of of science as it relates to improved science content understanding and retention by students, promoting interest and motivation in science content and the extension of scientific knowledge through integrating science process skills with literacy process skills. Also discussed will be the purpose, including the preparation of scientifically literate citizens, of science instruction developed through the basic language skills. The paper brings out literacy based science instruction as lending itself to effective communication of scientific concepts and to promoting better understanding of science content. Finally, the role of science instruction based on literacy as it relates to solving learning problems of second language learners is discussed. It suggests how, in science instructions, language skills can be integrated with the content in order for the second language learner to function effectively in science.

Miles Barker
University of Waikato, New Zealand

'The Motion of their Juice': Science, History and Learning about Plants and Water

Histories today often imply that questions about the movement of fluids in plants were initially addressed, and also decisively resolved, by the meticulous experiments of Stephen Hales in eighteen century England. In fact, in demonstrating that there is a through-flow of water in plants (which we now call transpiration), Hales also had to refute the longstanding view that sap circulates. As well, a profound methodological switch was involved: Hales's successful application of experimentation in plant physiology required him to abandon the traditional approach - the search for anatomical analogies between plant conducting tissues and blood circulatory systems in animals - which can be traced back to the beliefs of Aristotle. Current textbook histories of science which document only Hales's pivotal experiments appear to promote the traditional, often unsuccessful classroom discovery strategies frequently in use today. However, an account of science history which reveals to teachers the exuberant richness and variety of scientists' investigations, theories and methods appears better able to interpret students' everyday ideas and the language they use, to suggest innovative teaching strategies, and to promote learning which is rich and complex.

Gordon Brown
Univeristy of Western Sydney, Macarthur

Including the nature of science in school science: arguments from the metascientific and education literatures.

This paper is part of a larger piece of research that seeks to inform debates about the nature of school science by analysing characterisations of science in the metascientific literatures: science history, philosophy, sociology and policy, and metascientiifc arguments in the science literature. That research has identified in those literatures, and in the education literature and the mass media, a variety of arguments for the school science curriculum to include understandings <<about>> science, along with the received understandings of the material world that traditionally comprise the content of school science. That is, there are arguments that school students should develop understandings of sociological, philosophical, historical and policy insights into science, besides the concepts and understandings of the material world. The present paper summarises these arguments for metascientific understandings in the school science curriculum, and analyses their force in the mix of current pressures on the school curriculum.

Bob Bucat
Department of Chemistry, The University of Western Australia

Content-specific pedagogical research questions: A case for "applied research" in science education?

This presentation is an extension of a talk entitled *Science: Gone missing from science education research?* which Wobbe de Vos and I presented at ASERA 97. If the claims of Shulman (1986) in advancing the notion of pedagogical content knowledge are correct, is the science education research endeavour mirroring that of teacher education and evaluation (at least in the 1980s) with its emphasis on understanding of general pedagogics, and relatively little attention to the "missing paradigm" of transforming particular science content into particular instructional content? Shulman asked "Where did the subject matter go?" and "What happened to the content?"Of course we should attempt to advance educational theory, in the same way that any other discipline does. But surely advances in theory of a discipline have only one purpose: to reflect back on, and improve, the practice of that discipline. Is the time ripe to apply the findings about student learning, in conjunction with analysis of what it means to understand particular topics in science, to generation of useful pedagogical content knowledge about those topics? This would correspond with the notion of *applied research* in the science disciplines.This session will address the issue raised above from the standpoint of a practising chemistry teacher. If indeed there is a "missing paradigm", what are valid and valuable content-specific research questions to ask about pedagogy in relation to particular topics (such as, for example in chemistry, chemical equilibrium, stoichiometry, atomic structure or .....)? Who should participate in the research to address these questions?**Reference**. Shulman, Lee S. (1986) Those who understand: Knowledge growth in teaching. *Educational Researcher* 15(2), 4-14.

Christine Chin
Nanyang Technological University, Singapore

Learning Science Using a Deep Approach: Some Learning Strategies

The purpose of this study was to identify the kinds of cognitive and metacognitive strategies associated with a deep approach to learning science. The interaction of two groups of Grade 8 students were taped while they were engaged in hands-on science activities during instruction in a chemistry unit. The students were also interviewed both before and after instruction to find out more about their understanding of the science concepts in this unit. In this paper, the focus is on case studies of two students who showed a deep approach to learning. Analysis of transcripts produced several categories which were used to classify the different strategies used by the students. Examples illustrating the use of these strategies are provided. The paper also discusses how these strategies might interact to facilitate learning in science.

Gerry Corrigan
University of Western Sydney, Macarthur

The Acquisition of Process Skills and The Development of Conceptual Learning.

This paper describes work in progress from the author's doctoral research, investigating the relationship between the decisions students make about the use of processes and both the acquisition of process skills and the development of conceptual learning. The emergent themes from the data are described and discussed.

Deborah Corrigan, Amanda Berry, Greg Lancaster & John Loughran
Monash University

Camp

The training of science preservice teachers is a complex and demanding task as these teachers are expected to acquire a diverse range of competencies in their teacher training. The dilemma for staff in preservice training courses is how to introduce and enable students to acquire fundamental skills. This paper will highlight a special program run early in a one year Graduate Diploma in Education course at Monash University designed to allow preservice teachers to become familiar with fundamental teaching skills. The sample for this study consists of science preservice teachers, although the special program described - a residential camp - is provided for all preservice teachers in the Graduate Diploma.

Pachara Davivongse
Programme Specialist in Science and Technology Education
ACEID, UNESCO PROAP

Science and Technology Education at the Secondary Level in Thailand

As countries in Asia re-engineer their education systems on the eve of the twenty-first century, to meet the requirements of their rapidly changing economics and societies, special attention is being given to the place of science and technology education in the school curricula. However, countries in the region such as Thailand face a dilemma in this regard. On the one hand, education policy-makers are keen to provide talented students at the secondary school level with an appropriate academic background to equip them for university entrance, while on the other hand they are also concerned with promoting scientific literacy and science for all, regardless of whether or not the students in question are destined for higher education.

After providing some background information on the education system in Thailand and the characteristics of science teaching in Thai secondary schools, this paper will concentrate on examining current issues and trends in science teaching in Thailand's secondary schools, including the achievements of "scientific literacy for all". Special attention will be given to examining the increasing emphasis being given on the place of process-based learning, and problem solving skills, in the science curricula.

The paper will conclude by indicating some lessons that can be learnt from the Thai experience in science and technology education which the presenter believes are also relevant to other developing countries in the region.

Chris Dawson
University of Adelaide

17 Years On: What Do They Like Now?

In 1980, together with a S.A. primary science consultant, I investigated the science interests of Year 6 and 7 students. Using a cluster sampling approach to the selection of schools, all students in those schools completed an instrument which required them to express their interest in learning about each of 77 science topics selected from textbooks being used nationally and internationally to teach primary science. In addition students responded to 19 items requiring them to express their preferences for particular teaching approaches. It was decided to repeat this work in 1997 using the same schools and an identical questionnaire.

This paper reports the difficulties encountered in this attempted replication, and provides some of the possible reasons for these. It also compares the results with those obtained 17 years earlier, thus possibly shedding some light on the effects of changes in society and in pedagogy during these years.

Peter Eastwell
Curtin University of Technology"
Science Time Educational Consultancy

The Influences of a Program of Enrichment and Extracurricular Activities on the Affect of Secondary Science Students

This session will report a quasi-longitudinal case study used to determine the effects on secondary students of participation in a program of enrichment and extracurricular science activities in terms of their interest and enjoyment in being involved in science activities, their motivation to continue to participate in science and their perceptions about scientists and about the role of science in society. The activities include competitions (e.g. the Australian Schools Science Competition, National Chemistry Quiz and Qld. School Geology Competition), excursions, guest evenings, practical investigations, an explainer program, Science Club, work experience, lectures, vacation schools and seminars. Two groups of students in a school were followed simultaneously; a junior cohort through Years 8 to 10 and a senior cohort through Years 10 to 12. Both qualitative and quantitative data were collected from 20 students; 5 girls and 5 boys from each cohort.

Gaalen Erickson and Garry Hoban
University of British Columbia, Canada
Wollongong University

Learning in Professional Contexts

The notion of the workplace being a context for professional learning as well as fulfilling employment obligations has become a key feature of many professional development programs across a range of disciplines. This changes the nature of professional development in several major ways such as the time frame involved, the type of knowledge generated and often shifts the focus of learning from the individual to a group.

The purpose of this paper is to compare three different frameworks for workplace professional development which are used in different disciplines — problem-based learning in medicine, teacher research in education and action learning in business. An example of each of these frameworks will be examined according to following criteria: the purpose of the professional learning, the design principles which underpin how each framework operates and the emergent properties of learning which occur including the type of knowledge generated.

It is hoped that identifying commonalities and differences in these frameworks will lead to a clearer understanding of the nature of the learning in various professional contexts including an understanding of when and how they should be used.

Stuart Fankhauser and Russell Jones
University of Melbourne

Information Literacy in the Classroom: How Computer Literate are Students?

This study examined the computer literacy and computer competency levels of 245 students in years 7 through 12. Specifically the study investigated: (1) computer competency and computer literacy levels of students, (2) the use and familiarity of search engines and the internet in research undertaken by students, (3) the regularity with which students consider the reliability of the information they use in research, and (4) both the number of sources of information and the type of information sources students use for research.

Year 7 and 8 students were found to have the highest rate of computer literacy, to more regularly consider the reliability of information, use a wider variety of resources, conduct research using most information/reference sources, and achieve better results using search engines than their colleagues in years 9 and 10. Year 11 and 12 students were found to have the highest levels of information literacy.

This presentation will include a description of the research methodology used in this study, a summary of the results and discussion of the implications for further research and for classroom practice.

Rod Fawns
University of Melbourne

Research in Teacher Education: Partnerships in Pedagogy

Partnerships in early teacher education between schools and universities can appear to be increasingly driven by demands of external accountability. Resultant models of partnership support simplistic interpretations of the application of subject knowledge: competence based assessments and reflective practice in initial teacher training. A consequent focus on institutional "performance" seems to militate against an emphasis on how student teachers best learn. A Neo-Vygotskian model which incorporates understandings of teaching and learning is offered as a possible framework for partnership in pedagogy in early teacher education and research. Data collected in a partnership program illustrates discussion of the framework. The complexity of the roles and responsibilities of practitioners and academic staff in teacher education and research is emphasized.

Peter J Fensham
Monash University

Towards a Minimalist Science Education

The Benchmarks for Scientific Literacy in Project 2061 are listed under 14 broad headings, many of which are not included in most countries' school science curriculum. Other recent attempts by bodies like the National Academy of Science and individuals like Roger Bybee to define scientific literacy similarly add a number of major aspects of science education to what is already being taught in school science. Hence, it is not surprising that Mike Atkin, a key figure in the recent OECD exemplary curriculum project, expressed doubts that scientific literacy was an impossible goal for school science.

In each of the above cases, Scientific Literacy is being used in a parallel sense to someone with a very high degree of linguistic literacy. On the other hand, when we speak of a country's population having a literacy level of 50%, 75%, or 95 %, we are referring to a minimal level of linguistic abilities. In this paper I wish to open a discussion of what minimalist science literacy might be like by referring to reseach on science learning, motivation, utility, wonder, and linguistic learning and acquisition.

Brian Ferry and Julie Kiggins
University of Wollongong

Promoting Constructivist Based Learning in Science: Accomplishments and Frustrations Associated with a Preservice Teacher Education Program.

This study reports on an innovation that encouraged preservice and practicing teachers to undertake science instruction from a constructivist perspective. It was anticipated that such an approach would help them to become more effective learners and instructors of science.
Findings from annual evaluations of the program have consistently shown that many children, preservice teachers and practicing teachers benefited from a demanding but enjoyable program. However few preservice teachers have been able to clearly articulate their understanding of the relationships among the underlying educational theory, their instruction and pupil learning. The paper also reports on various strategies employed to address this issue. In most cases the strategies tried had minimal impact and this issue remains a source of frustration.

Darrell Fisher and Ed Stolarchuk
Curtin University of Technology and St Hilda's School, Southport

The Effect of Using Laptop Computers on Achievement, Attitude to Science and Teacher-Student Interpersonal Behaviour in Science

This study was part of an evaluation of the effectiveness of laptop computers in grades 8 and 9 science classrooms, a sample of Australian Independent Schools. Effectiveness was determined in terms of the impact laptop comput have had on laptop students' attitudinal and achievement outcomes and their perceptions of teacher-stude interpersonal behaviour in science classrooms. Students' attitudes to science were assessed using a scale from t *Test of Science-Related Attitudes* (TOSRA) instrument, achievement was measured using scales from the *Test Enquiry Skills* (TOES) instrument and students' perceptions of teacher-student interpersonal behaviour w assessed using the *Questionnaire on Teacher Interaction* (QTI). The QTI, attitude scale and cognitive achieveme scales were administered to 433 laptop and 430 non-laptop students in grades 8 and 9 science classes, in Independent schools across four Australian states. Descriptive statistics confirmed the reliability and validity the QTI for science laptop classroom research. Generally laptop students' perceptions of teacher-stude interpersonal relationships were found to be positively associated with students' attitudinal and cogniti achievement outcomes.

Marilyn Fleer
University of Canberra

Interactive Technology: Children's Technological Questions

Technology education in schools has predominantly emphasized a design, make and appraise approach with materials, information and systems (Curriculum Corporation, 1994). This process approach to technology education has been met with a range of creative and innovative programs. However, the design questions have predominantly been driven by teachers rather than ones generated by the children. This session presents video data of children working technologically in childcare and schools in ways which highlight children's design questions. Infants, toddlers, kindergarten and Year Six children are shown designing, building and playing in their cubbies. The focus of **their** technological work is mapped and discussed.

Mike Forret
University of Waikato, New Zealand.

A Model for Designing a Practical Introduction to Electronics

The prominence of electronics in modern technological cultures, the distinct lack of classroom-based research on the learning of electronics and, in New Zealand, the imminent introduction of technology education as part of the core curriculum for all primary and secondary schools, all underscore the need for research into effective strategies for learning and teaching electronics. This paper reports the design and evaluation of a practical introduction to component electronics (14 year-old students). The teaching model is based on a view of learning that is consistent with the nature of human technology, that is, a complex, dynamic and developmental process, whereby ideas are generated and then tested for, and selected on, value. Evaluation was based on student interviews, student questionnaires, teacher interviews and classroom observations, and showed that these students responded positively to this approach to teaching and learning electronics.

Bev France
Auckland College of Education, New Zealand

Technological literacy: a realisable goal or a chimera?

Technological literacy is the aim of the New Zealand technology education curriculum. It is proposed that the components (technological knowledge, technological capability and an awareness of societal relationships) equally contribute to the development of this technology education goal. Is the full realisation of technological literacy possible in classroom programmes or is this a unrealistic fantasy which, for some teachers, can become a chimera?

Technological literacy has a range of interpretations. Is the view of technological literacy proposed in Technology in the New Zealand Curriculum (Ministry of Education, 1995) realisable in New Zealand classrooms? This paper describes and analyses a range of teachers' classroom interpretations of this goal and debates whether such a goal is feasible.

Robert Fysh and Keith B. Lucas
St Peters Lutheran College
Queensland University of Technology

Religious beliefs in science classrooms.

Science and religion are perceived by some as conflicting areas of knowledge, and previous research has tended to support this perception. In this paper, it is argued that assumptions implicit in traditional research on the nature of scientific and religious views of individuals can be misleading. This study explores the nature of such views held by students, teachers and clergy in a Christian secondary school. Using a descriptive and interpretivist approach, the authors summarise the views of 43 senior physics students, 10 science teachers and four pastors in the school. The views of some selected students, teachers and pastors are presented in detail with particular attention to whether they perceive tension between their religious and scientific beliefs and how they may seek to resolve such tension.

Susan J. Gribble, Léonie J. Rennie,Wendy Speering, Catherine Milne and Louise Tyson
Curtin University of Technology
Scitech Discovery Centre
University of Wollongong

Values in the Science Curriculum: Implications for Teaching

Recently, a Curriculum Framework has been developed and mandated for implementation in all school systems in Western Australia. This Framework is composed of overarching statements such as those related to major learning outcomes, principles for teaching, learning and assessment, and core shared values. These statements are embedded into eight learning area statements, science being one of these. The Science Learning Area Statement includes a definition of science and a rationale for teaching it in schools, outcome statements concerned with working scientifically and developing conceptual understandings, principles for science learning, teaching and assessment, science as it relates to different phases of schooling, and how science can be integrated into other areas of the curriculum.

One of the main tasks for the writers of the Science Learning Area Statement has been to explicate the core values that have been espoused as integral to the Curriculum Framework. Thirty two core values have been clustered into five main statements: a pursuit of knowledge and a commitment to achievement of potential; self acceptance and respect for self; respect and concern for others and their rights; social and civic responsibility; and environmental responsibility.

The purpose of this paper is to explore the issues associated with stating values explicitly in a science curriculum framework and the implications for planning and teaching these values to students from diverse socio-cultural backgrounds.

Janette Griffin and David Symington
University of Technology, Sydney

Finding an appropriate methodology for testing a school-museum learning framework

On the basis of earlier research and a review of relevant literature a framework was developed for school learning programs which integrate a museum visit. (Griffin & Symington 1997). This paper identifies issues involved in designing the trial of the framework, describes the trial and subsequent changes to the framework and reports reflections on the methodology used.

The trials were designed to reflect the need for teachers to adapt the learning framework to suit their individual situations and requirements. This was necessary to validly test the appropriateness of the framework for teachers' use.

The trials involved seven teachers from four schools using the framework as a basis for developing their own school-museum learning units . The whole trial program was developmental. The four school trials were spaced over a two month period, with teachers from each school able to benefit from insights gained from the experiences of teachers from the previous schools.

Whilst the essential features of the framework were shown to be sound, the data gathered during the trials suggested a number of changes which make the framework more effective in a range of contexts. The data gathered vindicated the decisions made about the trial methodology.

Richard Gunstone, Brian McKittrick and Pam Mulhall
Faculty of Education, Monash University

Structured Cognitive Discussions in Senior High School Physics: Student And Teacher Perception

Concern with the quality of student engagement and learning in senior high school physics has been evident for many years. In this study we have focussed on student engagement. Three tasks that utilised a structured discussion approach to learning concepts in mechanics were developed in collaborative work with two Grade 11 physics teachers. These tasks demanded an initial individual response from each student, then a single response from groups of three, and then a whole class interpretive discussion led by the teacher and based on the group responses. In the paper we report the detail of reactions of students and teachers to these tasks in the two classes taught by the teachers involved in the development of the tasks, and more general reactions from a further seven Grade 11 physics classes.

Marian Haire
National Standards Commission

Teaching Science in Context: Measurement in Sport

Measurement in Sport is being used in schools across Australia for the past 2 years. Is it achieving what it sets out to do? It aims to raise technological literacy in young Australians while presenting science in the context of highly motivating human activity - Sport. This innovative unit of work has been developed to provide upper secondary students with the necessary skills to make accurate measurements and to be aware of the relevance of measurement in their lives. It links measurement, science and technological innovation while achieving outcomes from the Working Scientifically strand of the science National Profile. All participants will receive a complimentary kit. This workshop will give you the opportunity to trial some of the activities, suggest improvements and evaluate how it achieves its aims.

Robin Hall and Lynette Schaverien
University of Technology, Sydney

Early Learning in a Technological Culture: Researching a Child's Developing Curriculum within his Extended Family

There is continuing dissatisfaction with primary school science and technology education. Science education researchers have addressed this dissatisfaction first, by researching children's' understandings and then through a range of teacher education initiatives. Despite the prominence of curriculum issues in establishing educational research, recent research-based attempts to improve science and technology education have almost totally neglected the curriculum, focusing instead on teaching approaches. Rapid technological change is altering knowledge and how it is generated, so early science and technology education curricula are now arguably dislocated from the cultures in which they exist. This paper refocuses research intervention in science and technology education by exploring the curriculum a child of the information age might design for himself. We document how that child is pursuing his own question, How does the tape recorder actually work? in his extended family, over time. We research the development of this child's ideas anthropologically, as one of us becomes a part of his extended family.

Already the findings suggest that this child is forging for himself a dynamic, networked and culturally-located curriculum. Such insights urge consideration of ways in which primary science and technology education might regenerate itself to support and lead cultural development for an information age.

Christina Hart, Pam Mulhall, Amanda Berry, John Loughran, Dick Gunstone.
Monash University, Clayton

What is the Purpose of *this* Prac?

The common purpose of practical work is to improve students' science content knowledge. In this session we report on our observations and analysis of practical work with a difference: where the teacher's purpose was to make students aware of how science works. We discuss the implications for learning.

Filocha Haslam and Peter Fensham
Monash University

Conceptions of Context in Free Response Items From TIMSS

The free response items on the TIMSS tests are a rich, essentially untapped pool of data for the analysis of the influence of context on scientific understanding and of how students understand the meaning of "explanation". Almost all of these items present a context that has not been used in the more established research approaches to alternative conceptions.

An analysis of "incorrect" responses to a number of free response items in the Population 3 (Year 12 students) has shown that contextual perception plays a large part in many students' understanding of what the task is that the item is presenting. Four physics items and two health-related bioplogical items have been analysed and the results suggest agreement with earlier suggestions by Pines and West and by White that items, the context of which is more easily associated with everyday experiences, are more likely to generate more alternative conceptions and more alternative perceptions.

Susan Hersey
University of Western Sydney

How Do Teachers Know When Their Students Are Learning? Part 2

Following some interviews reported at ASERA in 1996, a number of observations were identified as evidence used some teachers for judging learning. However, the researchers felt that observation of individual teachers wo provide further information - as support or in addition to what was originally identified. A teacher was obser and interviewed to obtain this further information. The results of this pilot study raise many further questi about the answer to the original question.

Ruth Hickey and Renato Schibeci
School of Education, Murdoch University

Using videos for external primary science education students: A CUTSD grant report

Many of the external students in Murdoch University's Primary Science Education unit report difficulties in planning and conducting effective teaching encounters in science with children. This is due to their 'self confessed' lack of confidence and knowledge in the science content. They tend to limit their lessons to only a few topics, and report great difficulty dealing with key concepts, such as density, Their discussions with children are hampered by the lack of clarity of their pedagogical knowledge, and because of this, they are not able to adequately extend the knowledge of the children. This problem is exacerbated because students studying externally cannot work with other students in workshop situations (as are internal students) to develop their content understandings.

A CUTSD Grant was used to develop video based materials to supplement existing unit materials, to extend external students' personal science conceptual knowledge, so they can more effectively interact with children in science activities. The video and workbook materials are built around seven video case studies of university students involved in science activities with children. These instructional videos are supported by case study commentaries.

Assessment for the science unit is closely linked to the student-child science activities, when we ask students to view an interaction, and comment on the child's science conceptual development, and the quality of the responses and questions by the student teacher.

This presentation will demonstrate some of the case studies and workbook material from the video, and describe the intended evaluation of the materials by telephone surveys. It is relevant for staff involved in primary and secondary education courses, and others interested in the use of video material for enhancing distance education.

Bar Ibrahim & Sidibe Oumar Fernand
AESTCI (Ivory Coast)

Science from the Base: How to Talk so that Children Will Listen and How to Listen so that Children Will Talk.

Many problems hinder the free flow of information and communications between parents and their children wards at homes, teachers and their pupils at school and adults and children in the general society. These problems jeopardise education in general and science education in particular.

In most African settings children are considered lacking in knowledge and wisdom, fragile in articulation and, like women, do lack adequate wits and finesse in talking. they are seen as having no opinion of their own and their thought patterns unstable and uncalculative; thus their parents, teachers and elders have to think and fashion out things for them, while they are still children. Parents, teachers and elders use different methods in performing this duty of knowledge inculcation to children. One such method, which this write-up seeks to address, is the reward of good deeds with benevolence and the reward of wrong deeds with punishments. This method has been an age-long parents-children, teachers-pupils relationship, but has it been producing the desired results? What are the consequences of punishment? What are children's opinions about punishment and about their parents and teachers who punishes them? A long-held Biblical opinion has it that punishment instils discipline which in turn brings about knowledge. (Prov. 12:1) and furthermore it says, "spare the cane and spoil the child". But is punishment really capable of instilling discipline?

The survey has found out that punishment could lead to feelings of hatred, resentment, revenge, defiance, guilt, unworthiness and self-pity. Instead of a child feeling sorry for what he has done, he becomes pre-occupied with revenge fantasies. What could be done instead?

Patricia Isaacs
Northern Territory University

Teachers trying to develop professionally

This paper tells the story of a group of teachers and their attempts to develop professionally. Initially it tells of the members of the Science Faculty in one school and the professional development activities associated with their attempts to revise the school science curriculum. The cast expands to include all the teachers of the school as they consider, decide upon and and implement changes to the structure of their school. The story concludes with some lessons they learned from their experiences.

Jaewoo Kim
Seoul National University

Identifying, Choosing and Controlling : three important elements in pupils' dealings with variables

When making hypotheses, identifying or choosing significant variables, out of the many which might have an effect, is important. Having done this, controlling the variables in some way so as to design an experiment to confirm or refute hypotheses is crucial. There has been a lot of research on how pupils control variables but this has mainly been done without considering how pupils identify or choose variables. In the research reported in this paper we suggested the three elements, identifying, choosing, and controlling, constitute the main ideas to be taught to pupils in any instruction about variables, and we explore this with pupils. The subjects were eighty 7th grade boys and girls in two classes in a school in Seoul, Korea.

Pupils in one class had lessons involving choosing variables, while those in the other class had lessons involving controlling variables. We examined the effect of the lessons on the pupils' understanding of the other elements. In the first class, the other elements were identifying and controlling; in the second class, the other elements were identifying and choosing. In order to check on the pupils' ability to control variables before the treatment started, we gave them a multiple-choice questionnaire involving two independent variables and one dependent variable. After the treatment, we gave them the same questionnaire as a post-test. In order to check on the pupils' ability to identify variables before the treatment started, we gave the pupils a manual of experiments which asked them to deal with two independent variables and one dependent variable. After the treatment we gave the pupils the same experiment from the manual. In order to check on the pupils' ability to choose variables we asked the pupils to write inquiry questions. After the treatment we repeated this process.

Alister Jones and Judy Moreland
University of Waikato, Hamilton, NZ.

Assessment in Technology Education: Developing an Initial Framework for Research

This paper will outline a new research project investigating the assessment of technology at the primary school level and in particular developing a framework for assessment. The project, Research in Assessment of Primary Technology (RAPT), is a two year project working in primary schools to develop and enhance appropriate assessment practices in technology education.

The paper will identify the importance of teachers developing knowledge of technology education, technological practice (Jones and Compton, 1998) and appropriate technology pedagogy. The influence of teachers' subject subcultures on classroom practice will be outlined. Assessment practices appropriate to the teaching and learning in primary schools will be presented, including the need for holistic assessment. The paper will discuss the initial frameworks, emerging classroom practice, the development of performance indicators, assessing technological outcomes and the assessment of tasks in technology.

The findings from the first phase of the research in schools will be presented.

Russell W. Jones and John W. Warner
The University of Melbourne

Graphs: Acknowledged as Important Scientific Tools, Yet How are they Read?

Graphs are an extremely powerful communicative and analytical tool commonly used in science (as well as in many other fields). More than 2.2 trillion graphs are published annually and these graphs are used to communicate and/or analyse a host of, often, very important information. Furthermore graphs are an integral component of most science education curricula.

However, despite the multitude of applications for which graphs are used, and the frequency of their use, little is known about how graphs communicate information to a reader or the cognitive processes that are used by a reader to read and interpret the information presented within a graph. Indeed research has consistently shown that students misinterpret graphs and this has repeatedly led to a call for further empirical research into the ways students interpret graphs. Insight into the answers to some pertinent research questions can be obtained through a study of the strategies people use to read graphs.

This paper describes the research methodology and results of a computerised empirical investigation into the viewing order by which a reader chooses to view the different components of a graph, and also the measurement of the amount of time a reader studies each of these components.

Eileen Kennedy
University of Technology, Sydney

Computer-Based Learning in Chemistry

The case study reported here is part of a larger study of chemistry education in schools and the factors that affect it. An investigation of students' and teachers' views showed that there is a dichotomy between what students want from chemistry education and teachers' views of the status of chemistry education. The students emphasised the teaching and learning of chemistry to make the subject matter clearer while the teachers concentrated on the subject matter and undervalued the teaching and learning of it.

The comparison of students' and teachers' views led this researcher, as a teacher, to consider how the gap might be narrowed by designing more effective learning environments for junior high school chemistry. The design features were based on the initial provision of chemical experiences for learners that enabled them to gain familiarity, express views, develop questions and participate in discussions with the teacher.

The use of computer-based learning was a significant early feature of the module *Learning about atoms using the Periodic Table* described here. Activities using the computer package *The Lab. Assistant* enabled students to become immersed in a chemistry environment that was entertaining yet educative. This, and the activities that followed, demonstrated that such an interactive approach can result in immense gains in the quality of learning chemistry and the subsequent value that students place on what they have learned.

This paper will enable conference participants to follow the story of the module as it was experienced by the students and teacher-researcher.

Margaret Lindsay
University of Sydney International Preparation Program

But can electrons swim? An array of International students view of a redox reaction

Jeannie Ling Ai Yieng and Dr. Alison St. George
Massey University College of Education, New Zealand

Implementing an Inquiry-Based Primary Science Curriculum in Malaysia: A Case study of an Experienced Teacher

The development of science education in Malaysia has been greatly influenced by international trends as clearly indicated in the introduction of a new primary science curriculum in 1995 which advocates inquiry learning and problem solving. The curriculum stresses active pupil participation in the meaningful learning of scientific concepts with an
equal emphasis on the development of scientific skills and thinking skills and inculcation of scientific attitudes. This case study which is part of a larger study in examining the various contextual factors and personal factors which influence the teachers in the implementation of the
inquiry-based curriculum, focuses on one of the five teachers who participated in the study. A qualitative methodology was employed and data was collected from classroom observations, interviews and document analysis. The result indicates that in a culture where the society places
tremendous pressure on administrators and teachers to provide quality education in terms of high achievement test scores, the teacher's top priority is to maximise the use of the time and resources to achieve the expected goal. This teacher was able to achieve this consistently using
her expository style of teaching. Without proper support and training, even a knowledgeable, experienced and committed teacher will face many problems in implementing an inquiry-based curriculum and may continue to emphasise teaching science as transmission of scientific knowledge. The aspect of the curriculum that deals with skills and attitudes development
will continue to be neglected. The vision of developing pupils into the self-reliant learners as advocated in the new curriculum remains distant.

David Lloyd
University of South Australia

Future Imaging: Student Views, Mediation and Learning Through Science

Futures imaging is a powerful tool in identifying student's personal views of the future. Because many students have negative (dystopic) views of the future and in particular contain images related to the science curriculum, it is necessary to takes these views seriously and use them as a central part of a science or integrated curriculum that has as its central aim, an emancipatory focus.

Dr Ian Macdonald
Monash University – Clayton.

School Preparation for Tertiary Study.

The transition from secondary to tertiary level is becoming a significant problem for school-leavers, with many students likely not to complete degrees they are well qualified for at entry. University expectations about students' learning skills are not fulfilled in many cases, with students struggling to cope with the learning requirements of tertiary study, and unprepared for the independent decision making required. This paper reports on a study across a wide range of Victorian Secondary schools (State, Independent and Catholic) into the preparation of students for tertiary study. The results are depressing. Few schools have credible programs to develop independent learning skills or prepare for university life, while some disturbing staff attitudes towards learning and teaching were revealed. Most programs are fragmented, *a d hoc* and ineffective, but there is little awareness of alternatives. The lack of communication between the two education levels, and a lack of desire to accept responsibility for students beyond the immediate scope, has resulted in an growing barrier for students that requires immediate action on both sides. Some suggestions are made.

Michael R. Matthews
University of New South Wales

Opportunites Lost: The Pendulum in the USA National Science Education Standards

This article is based on my recent book Time for Science Education (Plenum Publishers, 1998). It begins with the treatment afforded the pendulum in the US National Science Education Standards, and a number of other contemporary curriculum documents. It notes that all of these documents advocate liberal, or wide, goals for science education, including students understanding something of the historical and cultural significance of science. It notes that all the documents ignore the very significant role played by the pendulum in the foundation of modern science, in solving the longitude problem, and in enabling the first accurate clocks to be constructed. There are thus lost opportunites for realising the laudable goals that the Standards set for US science education. Finally, it is claimed that realising these cultural goals for science education requires that the history and philosophy of science be more routinely incorporated into preservice and inservice courses for science teachers.

Greg McPhan
University of New England

The Qualitative Assessment of Concept Maps: A SOLO analysis.

The focus of the research in this paper is students, concepts devlopment as revealed in collaboratively prepared concept maps bases on the concepts of matter and dissolving. The maps were completed by students in the age range 10-16 years and the analysis was carried out in two stages.

The first stage consisted of the identification of qualitatively different categories of maps followed by the formulation of generalized descriptors for each of these categories. The second stage of analysis involved the application of the SOLO Model as a theoritical tool for the interpretation of the generalized descriptors obtained in the first stage of analysis. The model has not been previously applied to tasks such as the preparation of concept maps and the analysis of both sets of concept maps revealed a similar spread of responses in terms of modes and levels of functioning.

The implication of this research are twofold. Firstly, the SOLO Model is a useful tool for revealing the complexity of cognitive structure as students progress from intuitive to formal science. Secondly, the SOLO Model provides a theoretical framework which can be applied to the many distinctly different categories of student responses to the task of constructing concept maps which has primarily been associated with quantitative forms of analysis.

C. J. McRobbie
Queensland University of Technology

Case Studies of Student Reasoning about Explanations in Chemistry

Internationally there is concern at the level of student understanding in science from science instruction. This research investigated student learning in a Year 11-12 chemistry classroom studying reaction rates and equilibrium with a focus on the students' capabilities and practice in coordinating explantions and evidence in laboratory and classroom activities. Data sources included: recording of classroom transactions and activities with video and radio microphones on selected students and the teacher; interviews with students and the teacher; a purpose developed survey form to assess student coordination of evidence and possible explanations related to equilibrium. The research showed that many students had difficulty with coordinating evidence and explanations and that the classroom environment was not conducive to the development of these skills.

Michael Michie
Northern Territory Department of Education

Factors influencing secondary science teachers to taking field trips

A series of interviews with 28 secondary science teachers was used to determine the influences on those teachers to take field trips. The interviews were evaluated using an interpretivist methodology and indicate a range of influences. Science teachers are in general willing to use field trips as part of their pedagogy because they feel that their students need hands-on, real life experiences or to examine applications of science which augment their classroom studies.

Other influences that are identified and evaluated relate primarily to the teaching/learning outcomes, the support of members of the school community and the factors that facilitate or hinder teachers taking field trips. The influence of teachers' past experiences is also evaluated. There are a number of implications for schools. Teachers feel constrained by administrative procedures but this needs to be balanced against consideration of the legal implications of 'duty of care'. Student behaviour needs to be balanced by accessibility to arrange of teaching/learning strategies. And, as more venues come on line, there is a need for appropriate professional development and curriculum support materials.

Ian Mitchell
Monash University

"Don't Give Me That Theoretical Crap, Give Me Something I Can Use": Using Cases in Teacher Research

The Project for Enhancing Effective Learning (PEEL) is now in its 14th year. During that time a great deal has been learnt about many aspects of learning, teaching, change, teacher research and school-university collaboration. Documenting and sharing this accumulated wisdom has revealed a range of important problems and issues associated with two related groups of processes. One is capturing, recording and analysing the very complex nature of skilled classroom practice; the other is communicating this practice to other teachers in ways that are perceived as practical i.e. accessible, relevant, interesting and credible, but which also allow teachers to generalise the practice to other contexts.

There is no single solution to the problems in these areas, however both the writing and the sharing of teacher-authored cases are becoming increasingly important in the teacher research and development associated with PEEL. This session will begin with the discussion of a case which involves me in a way I found professionally shocking. The case raises some important issues associated with teaching for conceptual change, it also illustrates how the process of case writing can expose aspects of tacit teacher wisdom that are crucial to classroom success and which were previously invisible. The latter part of the session will focus on issues of the features of a good case, structuring case-writing sessions and using cases in a range of contexts.

Ian Morrison
The Southport School, Queensland

The Effects of Co-curricular Activities on Academic achievement in Science

Students are constantly exposed to a multitude of factors that effect, positively or negatively, their academic studies and results. As Fraser (1989) states *"the quality of life in (schools) is of great importance and students' reactions to and perceptions of their school experiences are significant"*. My belief is that quality co-curricular activities have a positive effect upon student academic outcomes.

The crux of the matter is in the word *quality*, not from the school perspective but from how students perceive these activities. Anecdotal evidence from the past five years indicates a strong correlation between co-curricular involvement and positive student achievement, and the aim of my doctoral study is to formalize this evidence. Currently I am continuing to collect and analyze data from my school's historical student records, and am investigating the development of diagnostic tools that will enable me to accurately interpret these data.

An integral part of this whole investigation is the role to be played by teachers adopting a constructivist approach to their teaching and how this methodology can link educational environments with student attitudes and approaches to their studies. Students who are independent, organized and capable of self-direction are those more likely to succeed in academic studies. Where these values are promoted within a school's co-curricular program, students' development in these areas is accelerated with consequent translation to their academic program.

Ann Northover & Alister Jones
UNITEC Institute of Technology, New Zealand
University of Waikato, New Zealand

The role of subject subcultures in influencing the implementation of a new curriculum statement in New Zealand secondary schools

New Zealand now has a national curriculum statement in Technology education, the implementation of which has been supported by extensive Ministry of Education funded teacher development. This paper arises from one such teacher development programme, based in the technological area of biotechnology. It involves a case study of seven teachers from three co-educational secondary schools and follows them through their participation in a technology education teacher development programme in order to identify changes to perceptions and practice that may occur as a result of such involvement.

The nature of the pre-existing subcultures evident in the three schools is examined, and the impact of these subcultures on teacher expectations and practice in biotechnology is demonstrated. Teachers' initial perceptions of technology, biotechnology and technology education are found to be principally determined by and reflective of the teaching subculture in which they work. Exposure to professional development in biotechnology education can effect change to such perceptions and to the teaching programmes developed, but such changes are likely to be transitory if teachers continue to work within their prior subculture. The implications for curriculum implementation and teacher development in technology education are discussed.

C.K. Or
The University of Hong Kong, Hong Kong SAR, CHINA.

Scientific Literacy- the TIMSS picture

Reforms in school science education have constantly stressed on enabling students to achieve scientific literacy. Yet what this goal of science education means is subjected to various interpretations. The lack of a consensus on the concept of scientific literacy among science educators and scientists has been claimed to be one main cause for the failure of earlier curriculum efforts.

The Third International Mathematics and Science Study (TIMSS) was set to measure the attainment of science literacy for students at three populations. Designing a framework of scientific literacy for the Population 3 study (at Year 12) has been controversial because of the absence of a common science curriculum framework. For Populations 1 and 2, such framework did exist and was used as the blueprints for setting related assessment items. Selection of testing items at Population 3 had then gone through a process seeking for compromise among key science educators with different conception of scientific literacy.

The presentation would report on a study to explore and analyze the concept of scientific literacy having been incorporated in the TIMSS Population 3 study, through the lenses from two important positions of scientific literacy - Project 2061 and Roberts' Curriculum Emphasis.

John Oversby
The University of Reading, UK.

What is a 'scientific theory'?

The relative places of 'theory', 'model' and 'data' are explored in this philosophical investigation of the meanings of fundamental terms within science education. As well as acknowledging difficulties in the process of clarification, an attempt will be made to understand these meanings within a specific chemical context. Also included will be some thinking about the concept of 'law'.

David Palmer
The University of Newcastle.

Exploring the Link Between Students' Scientific and Non-Scientific Conceptions.

Many students have difficulty in applying their conceptions consistently to a range of relevant situations or contexts, but our understanding of why they are unable to do this is still relatively poor. In the present study, individual interviews were carried out with 63 Year 6 students and 44 Year 10 students. The interviews were designed to investigate how students applied their conceptions of biological role (i.e., every living thing has a role to play in nature) to different types of living things, and to identify any patterns of reasoning which resulted in inconsistent responses. A significant proportion of students from both age groups indicated that some organisms had roles and others did not. Their explanations indicated that they were using an "if . . . then" type of reasoning which linked their scientific and non-scientific conceptions.

Bill Palmer
Northern Territory University

Taking Stock in Science Education: The Sesquicentenary of Professor H. E Armstrong.

A substantial part of this paper will be about the life of Henry Edward Armstrong (1848 -1937) and his influence on science and science education. His influence in the United Kingdom has been pervasive, but in the Americas, his work scarcely rates a mention. Is Armstrong's influence still detectable in Australia's science education?

Rennie, Léonie
Curtin University of Technology

Research at a Distance: Problems and Possibilities

Late in 1997, I agreed to write a review about gender, scientific and vocational education in Asia and the Pacific. When I began to think about how I might obtain the necessary information, the enormity of this task hit me. How was I to do a review of a large number of countries I wasn't sure I could list even with the aid of an atlas, nearly all of which I had not visited, and which included more than half of the world's population? Further, these countries had widely varying cultures and attitudes to gender, not to mention political and economic climates which were of varying stability. In this paper, I outline the approaches that I took to try to uncover the issues relating to gender, scientific and vocational education in many Asian and Pacific countries. Some approaches were profitable, some were not, but over all the main problems, still unresolved, are what value can be given to the findings of my research at a distance, and do I have the right to write about gender and the educational policies and practices of countries when I am not there?

Stephen M. Ritchie
School of Education, James Cook University

Accessing Science Teachers' Personal Practical Theories

The personal practical theories of science teachers, sometimes referred to as craft knowledge, have received little attention by science education researchers. These theories are thought to guide teachers' actions during classroom activities and are formed over years of practice. In this exploratory paper, the following questions are considered: What are personal practical theories? Who should access teachers' personal practical theories? How should personal practical theories be accessed? How might the act of accessing personal practical theories affect those teachers whose theories have been accessed? How should data about personal practical theories be reported and for whom? My views on these questions are illustrated by data from my recent study of primary school teachers.

Geoff Rogers
Curtin University of Technology

The Designing Stage of Design, Make and Appraise: A Case Study Involving Young Children Designing.

An exploratory case study of an early years class involved in a Design, Make and Appraise [DMA] program was conducted. It was found that a number of factors and structural / organisational issues emerged during the implementation process. One issue of significance that emerged was the fact that there appeared to be a weak link existing between the children's designing stage and their making and appraising stages. This paper will attempt to explore some possible reasons as to why the children in this study did not visibly link the designing stage with the other two stages of making and appraising. Because there was found to be a lack of research studies that focussed on the designing stage of DMA with young children, it was therefore necessary to explore associated aspects of designing such as children using computers to design and drawing pictures and diagrams during science lessons. Other aspects of the designing stage that will be briefly mentioned include scale, copying and perspective. The analysis of young children's design capabilities was found to be very complex and worthy of a more in-depth treatment than was possible in this present study. The paper concludes with a brief mention of some of the implications for teachers as they implement the design stage of DMA in their classrooms.

Brian Salter-Duke
Northern Territory University

Learning Science Over the Internet

The author's experience with designing learning materials for use over the internet, primarily via the World Wide Web (WWW), started as team leader of a successfull 1995 CAUT grant entitled "Learning modules for computational chemistry over AARNET". In 1997, this project introduced a coursework Master's degree offered by three Australian universities. This contribution will describe the philosophy behind this project and look wider by using this experience to consider the general advantages and disadvantages of using the WWW as the main media for presenting coursework to students.
Successful WWW materials have to take into account the special features of the media. In particular, they need to use the opportunities offered by either server-side or browser-side tools to make the materials interactive. Close interfacing with other internet tools facilitates interaction. Wide use of the WWW for presenting coursework will only be successful if much more research is carried out on how students best learn using this media and if the results of such research are incorporated into materials. The WWW is an exciting prospect for improving learning, but it is not the panacea that some managers believe it to be.

Gilda Segal & John Oversby
University of Reading, UK.
University of Technology, Sydney

Teaching Chemistry to Student Primary Teachers:
A Study of a Tutor Responding to the Needs of his Students

Here we explore the teaching of a chemistry discipline subject at University level to a group of student primary teachers in an English University. Although the students had all chosen science as their specialism, they varied greatly in their prior knowledge of chemistry and in their confidence in learning it. Would their needs be met by serving up a traditional University fare of content in abundance to be recalled and regurgitated in final examinations? No! thought the tutor. His innovative and research-based approach to teaching one section of the discipline subject, dissolving, is analysed here from sociocultural perspectives that inquire into his pedagogical content knowledge and subject matter knowledge. From this study, recommendations for teaching Chemistry to student primary teachers include: modelling an authentic science-in-the-making approach to deep learning a few concepts of significance to the discipline; embedding philosophical discussions about the nature of theory, models and explanations within the content and practice of teaching and learning those concepts; incorporating a variety of tools to promote metacognitive thinking; critically analysing the common understanding of related concepts such as physical and chemical change.

Keith Skamp
Lismore Campus, Southern Cross University

Atoms and Molecules for Primary Students?

Should the focus of primary school chemistry be on the macroscopic, the microscopic or the symbolic? Previous studies are cautious in their conclusions, although at times problematic. Here a Year 5 and 7 class in a Queensland primary school were taught about atoms and molecules using a sequence advocated by Leisten[1]. Data obtained by using the ACER's (1991) *Tapping Students' Science Beliefs*, and interviews with students and teachers, both before and following the instructional sequence, suggest that many primary students appear to appreciate aspects of the particulate nature of matter (the 'microscopic'), although in some instances the learning may be context specific, and there is ambiguity about whether the learning is short or long term. However the students seem to really enjoy the learning experiences, many of which focussed on the use of molecular models. This paper will report the results of this study and raise questions about the implications for the primary curriculum.

1. Leisten, J. (1995). Teach atoms earlier! *School Science Review, 77(279)*, 23-27.

Fran Steele
University of Western Sydney

Let's not teach biotechnology.

Biotechnology has the potential to alter human life. Already biotechnology, and in particular the technique of genetic manipulation, is changing the nature of agriculture, medicine and industry. In the future biotechnology may allow scientists to clone people, abolish genetic defects from the human race and create 'perfect' beings. Education in biotechnology has become of paramount importance.as the present generation of students will be expected to make decisions about its application.

This study examines the relationship between the teacher and biotechnology in the NSW secondary school. Figures from the HSC exam suggested that few teachers in NSW were willing to teach the electives that offered a substantial amount of biotechnology content. To find out more about why teachers were not willing to teach biotechnology a survey was sent to a sample of science teachers in the NSW secondary school system and a subset of teachers were interviewed about their views on biotechnology. The reasons for teaching, or not teaching, were identified. This researcher went in search of a way to overcome the obstacles identified.

Geoff I Swan
Edith Cowan University

Learning science: Student centred educational software

The use of computers in teaching science has risen dramatically in the last decade due to teachers in all sectors having greater access to more powerful hardware and increasingly sophisticated educational software. With the advent of student centred interactive multimedia over the last few years, the locus of control has shifted away from the teacher and toward the student. This has far reaching implications for educational policy and pedagogy in all disciplines, not just science.

Physics educational software is at the forefront of this multimedia revolution and two quite different packages will be demonstrated. Preliminary research on student usage of both packages will be presented, and the technological future for science education discussed.

P.K. Tao
The University of Hong Kong

Solving qualitative physics problems together: The role of students' collaborative talks.

A study was carried out to investigate the effects of peer collaboration on students' performance in solving qualitative physics problems. A test consisting of 5 problems was administered to a sixth form (Year 12) class in two schools in Hong Kong. To solve these problems which contained no numerical quantities, students needed to understand the physical situations presented and to apply basic physics concepts/principles rather than equations and formulae. Half of the students in each class were randomly assigned to take the test individually and the other half to work collaboratively in dyads (the abilities of the singletons and dyads were matched such that there was no significant difference between their HKCE physics exam grades). While the dyads worked together on the problems their collaborative talks were audio-recorded and transcribed. It was found that the mean scores of the dyads were higher than those of the singletons in the overall test and each of the problems. Analysis of the rich data of collaborative talks showed many incidences of co-construction in which students built on each other's ideas to arrive at the problem solution. It is argued that such co-construction enabled students to solve problems which otherwise they could not do individually.

Russell Tytler
Deakin University

Tracking children's science conceptions in the lower primary school

A previous study of cohorts of primary school children identified a clear age-dependence in both their learning and their retention over time of science conceptions. Access to and control of language, and associations children were able to make with prior experience, seemed to be important age-related factors, but insights into the way these might interact were not possible. This paper describes a current study which will trace individual children's learning and conceptions in their first years of schooling. Results from a range of conceptual probes, group discussions, observation of classroom sequences, and interviews, are being used to construct individual case studies that we hope to continue across the lower primary school years. Our initial findings, for children in the first semester of the prep year, show the complexity of the links between socio-cultural features of the classroom, and conceptual learning. A range of dimensions of individuals' conceptual ecologies, including personal orientations to learning and schooling, cognitive strategies, language, and epistemological and ontological positions , are being explored with a view to generating a better understanding of the parameters that drive conceptual progression in science. The paper will also raise a number of methodological issues.

Grady Venville, John Wallace, Léonie Rennie and John Malone
Curtin University of Technology

Integrating Science, Mathematics and Technology: A Case Study of Student Learning

The integration of content from the science, mathematics and technology learning areas is well grounded in the philosophy of middle schooling. However, there is a notable absence of recent empirical research to show if and/or how students learn science and mathematics concepts in integrated settings. This paper will present a case study of a year 9 class that participated in a technology project constructing a solar boat that involved science and mathematics components on electric circuits, statistical analysis and the reading of sun charts. The case study focuses on three pairs of students in the class and analyses their patterns of learning. The discussion examines the relevance of the results of this study to the literature on integrated learning.

Bruce Waldrip
Central Queensland University

Using student interviews to validate a learning environment questionnaire

The purpose of this study was to develop and validate an instrument to assess culturally-sensitive factors of science students' learning environments, and to examine associations between these factors, students' achievement of enquiry skills, students' attitudes to science and teacher-student interactions. A measure of culturally-sensitive factors of the learning environment, namely the Cultural Learning Environment Questionnaire (CLEQ), was developed. The instrument, which was influenced by Currie's characterisation of learning style theories (Information Processing, Social Interaction, Instructional Preference), Grashna's contrasting styles (Dependent-Independent, Competitive-Collaborative, Avoidant-Participant) and Hofstede's four dimensions of culture (Power-Distance, Uncertainity-Avoidance, Individualism, and Masculinity-Femininity) and contained seven scales. With a sample of almost 4,000 secondary science students, the reliability of the CLEQ scales ranged from 0.69 to 0.86. Regression analysis indicated the most consistent predictors of student-teacher interpersonal behaviour were the Collaboration, Deference, Competition, Teacher Authority and Modelling scales. The most consistent predictors of students' attitudes and achievement were Equity, Competition, Deference, Modelling and Congruence.

This paper describes the process by which the content and construct validity of the scales were verified to a greater extent than what is usually done. Some scale descriptors were altered. For many scales, interviews showed a range of understandings as to the original intent of the scale.

John Wallace
Curtin University of Technology

Paper Set Title: Beyond the modern: Writing science education research
Discussant: Gaalen Erickson
There are three papers in this set examining different approaches to the postmodern "crises" of legitimation and representation (Denzin and Lincoln, 1994) in educational research.

Paper 1: Writing our lived experience: beyond the (pale) hermeneutic?
David R Geelan and Peter C S Taylor
This paper addresses — through the dialectical use of both theoretical discussion and an 'impressionistic tale' — the value of narrative modes of representation for richer hermeneutic-phenomenological understandings of teachers' lived experience in classrooms.

Paper 2: Phenomenological inquiry and writing
Peter C S Taylor

Paper 3: What does it means to write "contrapunctually" about science classrooms?
John Wallace
Thinking 'contrapuntally' (Said, 1993) about classrooms and using different textual forms is a particular challenge for science education which has, until recently, been steeped in traditional forms of reporting research. This paper presents a modest attempt to take up this challenge by deconstructing the notion of a single classroom reality imposed onto other voices.

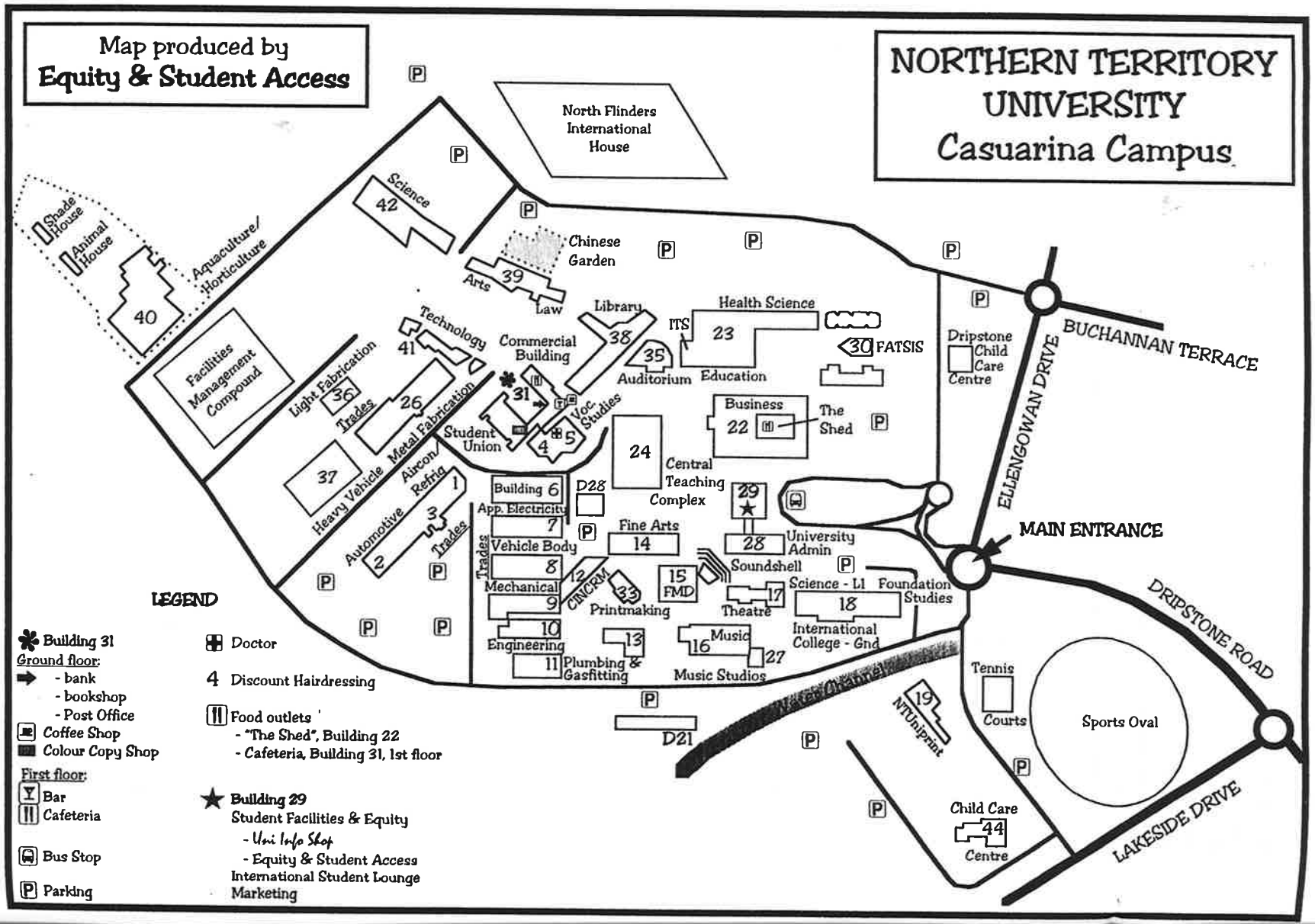
Robyn White & John Wallace
Curtin University of Technology

The role of heroes in science curriculum change in Western Australia
Participants in the changing context of school education in the 1990s frequently overlook instances of perceived successful curriculum reform from the past. In Western Australia, experienced science teachers continue to attest to the effective implementation of new junior high school science curriculum at the end of the 1950s and again in the late 1960s. This paper examines the influence of two highly visible science educators in promoting these apparently successful and consensual changes to school science teaching practice. In the absence of historical documentation, the study relies on the stories told by a number of key participants in the local science education community. The change agents credited with influence can be viewed as leaders or *heroes*. The paper reviews the processes used in science curriculum reform in schools from the 1950s until the 1970s and the relevance of these factors in the contemporary context.

Greg Williams and Kate Gloury
Northern Territory University

Quantum Leaps in Chemistry Education for Indigenous Students.

Despite the fact that Aboriginal people have their own cultural knowledge of a wide range of materials and sophisticated preparation and processing techniques, access to the strictly codified knowledge of chemistry in a western scientific tradition is often problematic. For us as teachers and educators, an appreciation and understanding of appropriate learning styles is leading to increased access and greater success for Aboriginal students, and consequently others, in their study of Chemistry. The support of a culturally safe environment, and the establishment of links between bridging and degree programs in science, are promoting articulation into higher education of students from diverse cultural backgrounds.


Map produced by
Equity & Student Access
NORTHERN TERRITORY UNIVERSITY
Casuarina Campus
North Flinders International House
Science 42
Chinese Garden
Arts 39
Law
Shade House
Animal House
Aquaculture/ Horticulture
40
Facilities Management Compound
Technology 41
Commercial Building
Library 38
ITS
Health Science 23
Education
Auditorium 35
30 FATSIS
Dripstone Child Care Centre
BUCHANNAN TERRACE
ELLENGOWAN DRIVE
Light Fabrication
Trades 36
26
Metal Fabrication
31
Voc. Studies
Student Union
4
5
Business 22
The Shed
24
Central Teaching Complex
37
Heavy Vehicle
Aircon/ Refrig
Automotive
1
2
3
Trades
Building 6
App. Electricity
D28
29
7
Vehicle Body
Fine Arts 14
University Admin 28
MAIN ENTRANCE
8
Mechanical
12 CINCRM
33 Printmaking
15 FMD
Soundshell
17 Theatre
Science - L1
18 International College - Gnd
Foundation Studies
DRIPSTONE ROAD
9
10 Engineering
11 Plumbing & Gasfitting
13
16 Music
27 Music Studios
Water Channel
D21
19 NTUniprint
Tennis Courts
Sports Oval
Child Care 44 Centre
LAKESIDE DRIVE
LEGEND
Building 31
Ground floor:
- bank
- bookshop
- Post Office
Coffee Shop
Colour Copy Shop
First floor:
Bar
Cafeteria
Bus Stop
Parking
Doctor
4 Discount Hairdressing
Food outlets
- "The Shed", Building 22
- Cafeteria, Building 31, 1st floor
Building 29
Student Facilities & Equity
- Uni Info Shop
- Equity & Student Access
International Student Lounge
Marketing

ASERA 98 LIST OF PARTICIPANTS

Dr Ken Appleton
Faculty of Education and Creative Arts,
Central Queensland University
Rockhampton, 4702.
k.appleton@cqu.edu.au

Mr Pole Awei,
Faculty of Education,
Northern Territory University,
DARWIN, NT, 0909, Australia.
pawei@banda.ntu.edu.au

Mr Miles Barker
University of Waikato
Hamilton
New Zealand
mbarker@waikato.ac.nz

Ms Amanda Berry
Faculty of Education,
Monash University,
Wellington Road,
Clayton, 3168 Victoria.
amanda.berry@education.monash.edu.au

Mr Gordon Brown
Faculty of Education,
University of Western Sydney (Macarthur)
PO Box 555, Campbelltown 2526
NSW.
g.brown@uws.edu.au

Dr Robert Bucat
Department of Chemistry
The University of Western Australia
Nedlands, W.A. 6907
bucat@chem.uwa.edu.au

Ms Rosemary Cameron
Dickson College
Phillip Avenue, Dickson
ACT, 2602
rosemarycameron@hotmail.com

Dr Malcolm Carr
10 Wymer Terrace
Hamilton New Zealand.
mdcarr@waikato.ac.nz

Dr Christine Chin
School of Science,
National Institute of Education
Nanyang Technological University
469 Bukit Timah Road, SINGAPORE,
259756.
chinhlc@nievax.nie.ac.sg

Ms Diane Clark
Faculty of Education,
Northern Territory University
DARWIN, NT, 0909
d_clark@banks.ntu.edu.au

Ms Julie Clark
Australian Catholic University
179 Albert Rd, Strathfield, 2135
J.Clark@mary.acu.edu.au (Julie Clark)

Ms Debbie. Corrigan
Faculty of Education, Monash University,
Wellington Road, Clayton, 3168
Victoria.
Debbie.Corrigan@Education.monash.edu.au

Mr Gerry Corrigan
Faculty of Education
University of Western Sydney (Macarthur)
PO Box 555, Cambelltown, NSW 2560.
g.corrigan@uws.edu.au

Dr Pachara Davivongse,
Programme Specialist in Science
and Technology in UNESCO
Box 967, Prakanong Post Office, Bangkok,
10110, Thailand.
UHBGK@UNESCO.ORG

Dr Chris Dawson
Graduate School of Education,
University of Adelaide, Adelaide
S.A. 5005
cdawson@arts.adelaide.edu.au

Mr Fred Deshon
Education Department of Western Australia
151 Royal Street,
East Perth, WA, 6004
Fred.Deshon@eddept.wa.edu.au

Mr Peter Eastwell
Science Time Educational Consultancy
"Willow Downs", M/S 623
Warwick Qld 4370

Mr Yehudit Eisen
Department of Science Education
School of Education, Tel-Aviv University,
Tel-Aviv, Israel.
eisen@post.tau.ac.il

Mr Gaalen Erickson
Faculty of Education,
University of British Columbia
Vancouver, B.C.
Canada V6T IZ4
gaalen.erickson@ubc.ca

Mr Stuart Fankhauser
Department of Science and Mathematics Education
University of Melbourne, Parkville,
Victoria, 3052.
s.fankhauser@pgrad.unimelb.edu.au

Dr Rod Fawns
Department of Science and Mathematics Education
The University of Melbourne, Parkville,
Victoria, 3052.
r.fawns@edfac.unimelb.edu.au

Dr Peter Fensham
Faculty of Education, Monash University
Clayton VIC 3168
AUSTRALIA
Peter.Fensham@Education.monash.edu.au

Mr Sidibe O. Fernand,
AESTCI,
14 BP 1139, ABIDJAN, 14
COTE D'IVOIRE

Mr Brian Ferry
University of Wollongong
Northfields Avenue,
Wollongong,
NSW 2522
Brian_Ferry@uow.edu.au

Dr Marilyn Fleer
University of Canberra
Canberra, ACT
fleer@education.canberra.edu.au

Mr Mike Forret
University of Waikato
Hamilton
New Zealand.
mforret@mailserv.waikato.ac.nz

Ms Hilary Fowler
Darwin High School,
DARWIN, NT

Dr Bev France
1 Seymour Road, Hampton Hill,
MiddxTW12 IDD
England.
b.france@ace.ac.nz

Mr Robert Fysh
r.fysh@mail.stpeters.qld.edu.au

Dr Colin Gauld
St George Campus
University of New South Wales,
Oatley NSW 2223.
c.gauld@unsw.EDU.AU

Mr David Geelan
Science & Maths Education Centre
Curtin University, GPO Box U1987
Perth, WA, 6107.
bravus@innocent.com

Ms Kate Gloury FATSIS,
Northern Territory University,
DARWIN, NT, 0909, Australia.
kgloury@banda.ntu.edu.au

Dr Denis Goodrum
Edith Cowan University
Mount Lawley,
Western Australia 6050

Ms Susan Gribble
Curtin University of Technology
GPO Box U1987, Perth WA 6845.
j.gribble@smec.curtin.edu.au

Ms Janette Griffin
University of Technology, Sydney
PO Box 222, Lindfield, 2070
Australia.
j.griffin@uts.edu.au

Mr Robin Groves
Educational Consultant ,
PO Box 244
Mt Hawthorn WA 6016
grovesr@ozemail.com.au

Dr Dick Gunstone
Faculty of Education
Monash University,
P.O. Box 88, Clayton
Victoria, 3168, Australia
Dick.Gunstone@Education.monash.edu.au

Dr Mark Hackling
Edith Cowan University
Mount Lawley,
Western Australia 6050.
m.hackling@cowan.edu.au

Ms Marian Haire,
Measurement Skills Project Officer
National Standards Commission.
mhaire@nsc.gov.au

Mr Robin Hall
Robin.Hall@uts.edu.au

Dr Terry Harrison
Department of Science and Mathematics Education
The University of Melbourne, Parkville,
Victoria, 3052, Australia.
t.harrison@edfac.unimelb.edu.au

Ms Christina E. Hart
Faculty of Education, Monash University
Wellington Road, Clayton, 3168
Victoria

Ms Susan Hersey
University of Western Sydney
or 78 Whitegates Road
LONDONDERRY
2753 NSW
n9601017@garbo.nepean.uws.edu.au

Mr Garry Henderson
School of Education, University of Ballarat
PO Box 663, Ballarat, Victoria.
g.henderson@ballarat.edu.au

Ms Ruth Hickey
School of Education, Murdoch University
South Street
MURDOCH, Western Australia 6150.
hickey@murdoch.edu.au

Mr Garry Hoban,
University of Wollongong
Northfields Avenue,
Wollongong,
NSW 2522.
Garry_Hoban@uow.edu.au

Ms Elaine Home
49 East Street,
Mt Hawthorn, WA 6016.

Mr Bar Ibrahim
AESTCI,
14 BP 1139, ABIDJAN, 14
COTE D'IVOIRE

Ms Pat Isaacs
St John's College
Darwin, NT.
iisaacs@taunet.net.au

Ms Shantha Jacob,
N T Department of Education,
Darwin.
Shantha.Jacob@nt.gov.au

Dr Russell Jones
Department of Science and Mathematics Education
The University of Melbourne, Parkville,
Victoria, 3052.
r.jones@edfac.unimelb.edu.au

Dr Alister Jones
Centre for Science, Mathematics and Technology Education Research
PB 3105, University of Waikato, Hamilton
New Zealand.
a.jones@waikato.ac.nz

Ms Eileen Kennedy
University of Technology,
Sydney, NSW
Eileen.Kennedy@uts.edu.au

Mr Jaewoo Kim
Department of Physics Education,
Seoul National University,
San 56-1, Shillim Dong, Kwanak-Gu,
151-742, Republic of Korea.
jaewoo@plaza1.snu.ac.kr

Ms Margaret Lindsay
International Preparation Program,
Bldg G12 261
Sydney University, NSW 2006
mlindsay@mail.usyd.edu.au

Ms Jeannie Ai Yieng Ling,
Massey University College of Learning,
Palmerston North,
New Zealand.
J.Y.Ling@massey.ac.nz

Mr David Lloyd
Building A 209
University of South Australia, Holbrooks Road,
Underdale, SA, 5032.
david.lloyd@unisa.edu.au

Mr John Loughran
Faculty of Education,
Monash University,
Wellington Road,
Clayton, 3168 Victoria.
john.loughran@education.monash.edu.au

Dr Keith Lucas
Queensland University of Technology
Centre for Mathematics and Science Education
Queensland University of Technology
Locked Bag 2, Red Hill, Qld. 4059.
k.lucas@qut.edu.au

Mr Ian Macdonald
Faculty of Education,
Monash University
Wellington Road, Clayton, 3168
Victoria.
imacdonald@swin.edu.au

Dr Michael Matthews
School of Education Studies, University of New South Wales
Sydney, 2052, NSW
AUSTRALIA.
m.matthews@unsw.edu.au

Mr Gregory McPhan
Dangars Falls Road,
Armidale, NSW, 2350.
gmcphan@metz.une.edu.au

Dr Cam McRobbie
Centre for Mathematics and Science Education
Queensland University of Technology
Victoria Park Road, Kelvin Grove Qld 4059
c.mcrobbie@qut.edu.au

Mr Michael Michie,
N T Department of Education,
Darwin.
mmichie@ozemail.com.au

Dr Ian Mitchell
Faculty of Education,
Monash University,
Wellington Road,
Clayton, 3168, Victoria.
ian.mitchell@education.monash.edu.au

Mr Adringra Koffi Modeste,
AESTCI,
14 BP 1139, ABIDJAN, 14
COTE D'IVOIRE.

Ms Judy Moreland
Centre for Science, Mathematics and Technology Education Research
PB 3105, University of Waikato, Hamilton
New Zealand.

Ms Pam Mulhall
Faculty of Education,
Monash University,
Wellington Road, Clayton,
3168, Victoria.
pam.mulhall@education.monash.edu.au

Mr C. K Or
Department of Curriculum Studies,
The University of Hong Kong
Pokfulam Road, HONG KONG.
ckor@hkucc.hku.hk

Ms Kathryn Paige
University of South Australia
Holbrooks Road, Underdale,
SA, 5032.Kathy.Paige@unisa.edu.au

Dr David Palmer
Faculty of Education,
The University of Newcastle.
eddhp@cc.newcastle.edu.au

Mr Eric Regioli,
University of Sydney
eregoli@mail.usyd.edu.au

Dr Stephen Ritchie
School of Education
James Cook University of North Queensland
Townsville Q 4811
Australia.
Stephen.Ritchie@jcu.edu.au

Dr Brian Salter-Duke
School of Chemistry;
Faculty of Science,
Northern Territory University,
DARWIN, NT 0909, Australia.
b_duke@lacebark.ntu.edu.au

Dr Gilda Segal
School of Teacher Education,
University of Technology, Sydney, Kuring-gai Campus.
G.Segal@uts.edu.au

Mr Ian Morrison
The Southport School
Southport QLD AUSTRALIA.
igm@tss.qld.edu.au

Ms Ann Northover
Teacher Education Centre
UNITEC Institute of Technology Private Bag 92025
Mt Albert, Auckland, New Zealand.
anorthover@unitec.ac.nz

Dr John Oversby,
Department of Science & Technology Education
The University of Reading,
Bulmershe Court
Earley, Reading , RG6 1HY, UK.
J.P.Oversby@reading.ac.uk

Mr Bill Palmer
Faculty of Education,
Northern Territory University
DARWIN NT, 0909, Australia.
bill.palmer@darwin.ntu.edu.au

Mr Neil Piggott
6 Harrison Grove
Northfield, SA, 5085

Dr Leonie Rennie,
Science & Mathematics Education Centre
Curtin University, GPO Box U1987
Perth, WA, 6107.
L.Rennie@info.curtin.edu.au

Mr Geoff Rogers
14 Spence Avenue
MYRTLE BANK SA 5064.
geoffr@olis.net.au

Mr Jim Scott
NSW Department of Education and Training
3A Smalls Road. Private Bag 3
Ryde, NSW, 2112.
jimsci@ozemail.com.au

Ms Ann Semple
9 Bayview St
PRAHRAN EAST 3181
asemple@netspace.net.au

Dr Keith Skamp
School of Education,
Southern Cross University
PO Box 222,LINDFIELD NSW 2070.
kskamp@scu.edu.au

Ms Debra Smith
11 Cavell Terrace Ashgrove
Queensland 4060

Ms Fran Steele
University of Western Sydney
n9601918@scholar.nepean.uws.edu.au

Mr Ed Stolarchuk
EStolarchuk.Staff.StHildas@sthildas.qld.edu.au

Dr Geoff Swan
Edith Cowan University, Physics Program
2 Bradford St., Mt Lawley 6050, Perth, WA
Australia.
g.swan@cowan.edu.au

Dr Ping-Kee Tao
Department of Curriculum Studies,
The University of Hong Kong,
Pokfulam Road, HONG KONG, CHINA.
pktao@hkucc.hku.hk

Dr Peter C. S. Taylor
Science & Maths Education Centre
Curtin University, GPO Box U1987
Perth, WA, 6107
itaylorp@info.curtin.edu.au

Dr Russell Tytler
Centre for Studies in Mathematics, Science and Environmental Education
Deakin University
221 Burwood Highway
Burwood, Victoria 3125
Australia.
tytler@deakin.edu.au

Dr Grady Venville
Science and Mathematics Education Centre
Curtin University of Technology
GPO Box U1987, Perth WA 6001.
rvenvill@alpha2.curtin.edu.au

Dr Bruce Waldrip
Faculty of Education and Creative Arts
Central Queensland University
Mackay, Qld
Australia, 4740.
b.waldrip@cqu.edu.au

Dr John Wallace
Science and Mathematics Education Centre
Curtin University of Technology
GPO Box U1987Perth WA 6845, Australia.
iwallace@alpha8.curtin.edu.au

Mr Kevin Watson
University of Western Sydney.
k.watson@nepean.uws.edu.au

Dr Dick White
Faculty of Education
Monash University,
Wellington Road, Clayton, 3168 Victoria.
richard.white@education,monash.edu.au

Mr Greg Williams
FATSIS,
Northem Territory University,
DARWIN, NT, 0909, Australia.
gwilliam@darwin.ntu.edu.au

Dr Jim Woolnough
Dickson College, Phillip Avenue
Dickson
ACT, 2602.
jwoolno@atrax.net.au

Mr Steven Zander,
Nightcliff High School
Nightcliff.
stant@topend.com.au

Ms Yvonne Zeegers
Faculty of Education, Magill Campus
University of South Australia, St.
Bernards Road,
Magill, South Australia 5072
yvonne.zeegers@unisa.edu.au