



Stage 3  
Interim research and evaluation report 10

**University science educators' workshop:  
July 2007**

A research report for the Australian Academy of  
Science

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## Introduction

A number of national and international reports have highlighted how important primary science is for developing interest in science and commencing the learning journey towards scientific literacy (ATSE, 2002; Goodrum, Hackling & Rennie, 2001). Other reports have indicated that, although science should be a priority in primary schools it has low status, is poorly resourced and many primary teachers lack science teaching pedagogical content knowledge and hence have low confidence and self-efficacy for science teaching (e.g., Angus et al., 2004; Hackling & Prain, 2005). Research indicates that if teachers' practice is to be reformed they need the support of ongoing professional learning and curriculum resources which help teachers build their pedagogical content knowledge, bring about changes in their beliefs about the purpose of science teaching and about effective practice, and increase their confidence (Goodrum, Hackling & Trotter, 2003; Hackling & Prain, 2005; Sheffield, 2004).

Australia has a history of reasonably successful initiatives that have been taken to reform the teaching of science at the secondary and primary levels (e.g. Australian Science Education project [ASEP], Web of Life, Primary Investigations and *Primary Connections*), and the most successful of these have combined curriculum resources with professional learning. Reform agendas are often promoted through professional learning programmes for in-service teachers (e.g. Queensland's Spotlight on Science, Victoria's Science in Schools and WA's Primary Science Project) because it is the experienced teachers in schools that have most influence over school curriculum and culture (Anderson & Mitchener, 1994). Fresh graduate teachers are mentored by experienced teachers and have an influence over their practice, often shaping their practice so that it more closely conforms to that of the school rather than that promoted in their teacher education programme. As Loughran (2007) argues, new teachers need to be supported in professionalisation rather than being socialised into traditional pedagogical practices.

There are significant concerns internationally about the high attrition rate amongst new graduate teachers in their first years of teaching (National Commission on Teaching and America's Future, 1996), as it is in the early years that teachers are more likely to experience difficulties, become disillusioned and leave the profession (Wanzare, 2007). There is increasing interest in enhancing induction and mentoring programmes for newly qualified teachers so they are more effectively supported in the transition to teaching (Draper, Christie & O'Brien, 2007).

*Primary Connections* is unique in that it has taken a highly strategic and innovative approach to teacher professional learning, combining initiatives with both in-service and pre-service teacher professional learning. An ideal scenario would see new teachers developing innovative and effective science teaching practices in their pre-service education, going into schools and being mentored by experienced teachers who share the same beliefs and practices and teaching using the same curriculum resource, *Primary Connections*. The *Primary Connections* project is developing primary science curriculum resources and associated professional learning resources, training professional learning facilitators to deliver professional learning workshops to in-service teachers throughout Australia, and providing professional learning for science educators who teach science education units to pre-service primary school teachers in all Australian universities that have a teacher education programme.

This report outlines the findings from an evaluation of a workshop for university science educators conducted in July 2007.

## Purpose

The purpose of the workshop was to inform university science educators about the *Primary Connections* programme, its teaching and learning model, curriculum resources, professional learning model and resources, and to support them implement elements of *Primary Connections* in primary science units in teacher education courses. A copy of the workshop programme is attached as Appendix 1.

The purpose of this study was to elicit from the university science educators information about: their beliefs about teacher professional learning, experiences of the workshop and feedback about the workshop and the professional learning resources, and any further support needs.

## Method

A questionnaire based survey method was adopted to gather information from the science educators at the end of the workshop. Questionnaires are effective and economical for gathering information from large numbers of participants and the data gathered are relatively easy to code and analyse.

The questionnaire included a mix of open response questions and closed objective items. A copy of the questionnaire is attached as Appendix 2.

## Sample

Sixty science educators drawn from Australian universities that offer a teacher education programme attended the workshop held in July 2007 at the Australian Academy of Science. In addition to this group, a further sixty-four university science educators attended a similar workshop in February 2007. The roles of the science educators attending the workshops are summarised in Table 1.

Table 1: Roles of participants

Role at institution	Uni sci educators Feb 07 (n=62)	Uni sci educators July 07 (n=52)	Total (n=114)	
	Number	Number	Number	Per cent
Professor/Associate Professor/Dean	2	2	4	3.5
Senior lecturers/Lecturers/ Course co-ordinators	47	33	80	70.0
Associate Lecturer/Tutor	13	11	24	21.1
Other	0	6	6	5.3

Workshop participants spanned the full range of academic roles from deans to tutors. The largest group of participants were the senior lecturers, lecturers and course co-ordinators who would be expected to be tenured staff, while the next largest group comprising associate lecturers and tutors would be expected to be contracted sessional staff on fixed short-term appointments.

## Results

Data reported are based on the 52 questionnaires that were returned. In most cases, categories of responses from open response questions have not been condensed, so the full range of responses can be seen. Data are reported for the science educators' beliefs about professional learning, self-efficacy and confidence as professional learning facilitators, achievement of workshop aims and rating of how well they have been prepared by the workshop for facilitating *Primary Connections* workshops, feedback on the workshop and resources, and needs for further support.

### Beliefs about high quality teacher professional learning

The characteristic of quality teacher professional learning cited by the science educators were grouped into three categories; overall, presentation, and topic. The categories of response cited by more than 10% of respondents included: purposeful and ongoing (23%), based on sound pedagogy (21%), opportunity provided to apply ideas in the workshop (21%), credible and prepared presenter (13%), stimulating and engaging delivery (13%), relevant topic (26%) that can be used directly in the classroom (11%). Participants at the February workshop more frequently mentioned: involves dialogue, collaboration and sharing between participants (25%); reflection on learning (14%); and, based on sound theory and research (21%).

Table 2: Science educators' responses to the question: What do you believe are the most important characteristics of high quality teacher professional learning? (n=47)

Characteristic	Number of responses	Per cent of respondents with this response
<b>OVERALL</b>		
Purposeful and ongoing, not one offs	11	23.4
Sound pedagogy	10	21.3
Good resources, support materials	4	8.5
Funded, in school time	3	6.4
<b>PRESENTATION</b>		
Opportunity to apply ideas in w/s	10	21.3
Presenter credible and prepared	6	12.8
Delivery stimulating, engaging	6	12.8
Recognition of participant experience	3	6.4
Balanced programme	3	6.4
Reflects on learning during workshop	3	6.4
Teachers are part of the planning	2	4.3
Provides research evidence to support claims	2	4.3
Collaboration, sharing included	1	2.1
Models what you want	1	2.1
<b>TOPIC</b>		
Relevant topic	12	25.5
Can be used directly in classroom	5	10.6
Develops PCK	3	6.4

Flexible, can be modified to suit context	3	6.4
Grounded in classroom practice	2	4.3
Student centred	2	4.3
Keeps big picture in mind	1	2.1
Contextualised	1	2.1
Challenges beliefs and prior practices	1	2.1
<b>Total number of responses</b>	<b>96</b>	

### Self-efficacy and confidence as a professional learning facilitator

The science educators' beliefs' about their effectiveness with aspects of teacher professional learning facilitation were elicited using nine items to which the educators rated their effectiveness on a five-point scale. These data are reported in Table 3. The science educators' ratings of self-efficacy were quite positive, with mean item ratings greater than 4.2/5 for six of the nine items.

Table 3: Science educators' self-efficacy ratings as professional learning facilitators (n=52)

Aspect of self-efficacy as professional learning facilitator	Per cent with this response					Mean and standard deviation	
	SA	A	UN	D	SD	mean	sd
I am effective in eliciting teachers' prior knowledge and beliefs and adjusting the professional learning workshop to meet the needs of the teachers	33	56	12	0	0	4.21	.64
My science content knowledge enables me to answer teachers' science questions effectively	42	44	12	2	0	4.27	.74
My knowledge of effective science teaching practices enables me to answer teachers' science pedagogy questions effectively	35	58	8	0	0	4.27	.60
I am quite comfortable with having my professional learning workshops evaluated	58	37	6	0	0	4.52	.61
I am able to pose engaging tasks for teachers to work on in small groups in my workshops	44	52	4	0	0	4.40	.57
My deep understanding of the culture of primary schooling enables me to give valuable advice to teachers on matters of primary science pedagogy	25	47	20	8	0	3.90	.88
My deep understanding of the culture of early childhood education enables me to give valuable advice to ECE teachers about science pedagogy	16	20	26	32	6	3.08	1.2
My deep understanding of literacy teaching practice enables me to give valuable advice on integrating literacy education into science education	18	39	27	16	0	3.59	.96
I am able to choose and apply effective facilitation tools and techniques to enhance the learning of teachers in workshops	42	48	10	0	0	4.33	.65

Note. SA = strongly agree = 5, A = agree = 4, UN = undecided = 3, D = disagree = 2, SD = strongly disagree = 1

Mean item scores ranged from a high of 4.52/5 to a low of 3.08/5. The highest mean self-efficacy scores were for items relating to having their workshops evaluated, posing teachers engaging tasks, and using effective facilitation tools and techniques. Lowest scores were recorded for aspects requiring knowledge of early childhood teaching culture and literacy teaching practice.

Total scores for the self-efficacy scale were calculated by aggregating item scores (1-5) over the nine items giving a maximum self-efficacy scale score of 45. Scores for the science educators' attending February and July workshops are summarised in Table 4. The mean self-efficacy scale score for the participants at the February workshop (38/45) was higher than for participants at the July workshop (36/45). None of the July workshop science educators had a scale score of less than 25/45 and 65% of them had a score greater than 35/45 meaning that they had a mean rating of at least 4/5 on the nine self-efficacy items.

Table 4: Frequency of total scale scores for self-efficacy as a professional learning facilitator for science educators at the February and July workshops

Total scale score (/45)	Uni sci educators Feb 07 (n=56)		Uni sci educators July 07 (n=52)	
	Number	Per cent	Number	Per cent
5-25	0	0	0	0
26-30	5	9	5	10
31-35	6	11	13	25
36-40	27	48	24	46
41-45	18	32	10	19
Mean total self efficacy score /45	38.21		36.25	
S.D.	4.28		5.35	

Note. Self-efficacy score = sum of nine self-efficacy scores for each participant, (/45), with the most positive response given the value of 5 and the least positive the value of 1 on a five-point agreement scale

The responses of the science educators to the self-efficacy items were compared with those of the 2006 cohort of professional learning facilitators. Table 5, compares the February and July cohorts of science educators' mean item scores after their two-day workshop, with the PLFs mean scores after their end of term 3 workshop following five days of familiarisation with *Primary Connections* and training in facilitation. All three groups responded to eight items and the science educators responded to a new ninth item. On all items, the July cohort of science educators had the lowest ratings of self-efficacy.

Table 5: A comparison of mean self-efficacy item scores for university science educators attending February and July workshops and professional learning facilitators at the end of term 3 in 2006

Aspect of self-efficacy as professional learning facilitator	Mean scores		
	Uni sci eds Feb	Uni sci eds July	PLF end term 3, 2006
I am effective in eliciting teachers' prior knowledge and beliefs and adjusting the professional learning workshop to meet the needs of the teachers	4.36	4.21	4.4
My science content knowledge enables me to answer teachers' science questions effectively	4.41	4.27	4.3
My knowledge of effective science teaching practices enables me to answer teachers' science pedagogy questions effectively	4.66	4.27	4.4
I am quite comfortable with having my professional learning workshops evaluated	4.57	4.52	4.6
I am able to pose engaging tasks for teachers to work on in small groups in my workshops	4.45	4.40	4.4
My deep understanding of the culture of primary schooling enables me to give valuable advice to teachers on matters of primary science pedagogy	4.13	3.90	4.4
My deep understanding of the culture of early childhood education enables me to give valuable advice to ECE teachers about science pedagogy	3.34	3.08	3.8
My deep understanding of literacy teaching practice enables me to give valuable advice on integrating literacy education into science education	3.86	3.59	4.4
I am able to choose and apply effective facilitation tools and techniques to enhance the learning of teachers in workshops	4.45	4.33	-

The science educators' confidence with facilitating professional learning workshops related to various aspects of *Primary Connections* was elicited by asking them to rate their confidence against seven items on a five-point confidence scale which ranged from very confident no confidence. These data are reported in Table 6.

Table 6: Science educators' ratings of their confidence with facilitating professional learning workshops on aspects of primary science and literacy teaching at the end of the February workshop (n=52)

Confidence with facilitating workshops	Per cent with this response					Mean and standard deviation	
	VC	C	OK	LC	NC	Mean	SD
Introducing <i>Primary Connections</i> and its five underpinning principles	43	45	10	2	0	4.29	.73
Linking science with literacy	39	45	12	4	0	4.20	.80
Understanding and applying the 5Es teaching and learning model in primary science	47	47	6	0	0	4.41	.61
Conducting investigations in primary science	62	33	6	0	0	4.56	.61
Using co-operative learning strategies	58	33	10	0	0	4.48	.67

Using embedded assessment processes and effective questioning techniques	54	29	17	0	0	4.37	.77
Co-ordinating the science programme in a primary school	31	37	24	4	2	3.94	.96

Note. VC = very confident, C = confident, LC = low confidence, NC = no confidence

Mean confidence scores for all aspects of *Primary Connections* were high and ranged from 3.94/5 to 4.56/5. The science educators had greatest confidence with facilitating workshops related to conducting investigations and using co-operative learning strategies.

The responses of the two cohorts of science educators to the confidence items were compared with those of the 2006 cohort of professional learning facilitators (Table 7). Mean item scores for all groups were all greater than 4/5, except for one item for the July cohort of science educators. This item related to co-ordination of science in a primary school which was not directly addressed in the science educators' workshops.

Table 7: A comparison of mean confidence scores for university science educators attending February and July workshops and professional learning facilitators at the end of term 3, 2006

Confidence with facilitating workshops	Mean scores		
	Uni sci eds Feb 07	Uni sci eds July 07	PLFs end term 3, 06
Introducing <i>Primary Connections</i> and its five underpinning principles	4.43	4.29	4.6
Linking science with literacy	4.21	4.20	4.4*
Understanding and applying the 5Es teaching and learning model in primary science	4.66	4.41	4.5*
Conducting investigations in primary science	4.71	4.56	4.5
Using co-operative learning strategies	4.62	4.48	4.5
Using embedded assessment processes and effective questioning techniques	4.52	4.37	4.4*
Co-ordinating the science programme in a primary school	4.04	3.94	4.5

Note. \* These statements were slightly different in the PLF 2006 questionnaire.

### Achievement of workshop aims

The science educators were asked to what extent the workshop aims had been achieved for them. They rated aim achievement on a five-point scale ranging from a large extent to a limited extent (Table 8). Responses were generally positive with greater than 70% of responses in the two highest categories for all aims except the one regarding familiarity with the roles of School Co-ordinator, Professional Learning Facilitator and Jurisdiction Co-ordinator, and the support for professional learning available in each jurisdiction, which in hindsight was an unrealistic aim as some aspects were not addressed in the workshop.

Table 8: Science educators' responses to the question: To what extent have the aims of the workshop been achieved for you? (n=52)

Workshop aim	Percent of respondents with this response				
	To a large extent		OK		To a limited extent
Understanding of the theoretical underpinnings of the programme and research findings regarding the impact of the programme on teachers, students and schools	52	33	13	0	2
Understanding of the <i>Primary Connections</i> teaching and learning model and the professional learning model	58	27	13	2	0
Understanding of the pedagogical approaches used to support the development of literacies of science and investigation skills, and how assessment is embedded in the teaching and learning programme	42	37	17	4	0
Familiarity with the curriculum and professional learning resources developed by the programme	35	44	17	4	0
Familiarity with the roles of School Co-ordinator, Professional Learning Facilitator and Jurisdiction Co-ordinator, and the support for professional learning available in each jurisdiction	6	42	35	13	4
Familiarity with examples of professional learning sessions for in-service teachers	31	42	17	8	2
Awareness of opportunities to use <i>Primary Connections</i> resources to exemplify aspects of primary science teaching in pre-service science education units	50	33	12	6	0

A large majority of the science educators believed they were very well prepared or well prepared for facilitating *Primary Connections* professional learning workshops for both in-service (73%) and pre-service teachers (84%) which is an important indicator of the success of the workshop (Tables 9 and 10).

Table 9: Science educators' responses to the question: How well prepared do you feel for facilitating *Primary Connections* professional learning workshops for in-service teachers? (n=51)

Science educators' responses (per cent)				
Very well prepared	Well prepared	OK	Poorly prepared	Very poorly prepared
24	49	25	2	0

Table 10: Science educators' responses to the question: How well prepared do you feel for incorporating elements of *Primary Connections* into your pre-service teacher education programme?" (n=51)

Science educators' responses (per cent)				
Very well prepared	Well prepared	OK	Poorly prepared	Very poorly prepared
41	43	16	0	0

### Feedback on the workshop and needs for further support

Aspects of the workshop that the science educators found particularly helpful were the opportunity for networking and the workshop sessions. The February cohort rated sessions that outlined the theoretical rationale for the programme and the research findings far more highly than the July cohort who found learning about *Primary Connections* and teaching science and literacy more useful. Feedback from the February cohort indicated that they would have liked input from classroom teachers using *Primary Connections*. This was included for the July cohort and 12% of participants indicated this was helpful. A range of other aspects are reported in Table 11.

Table 11: Science educators' responses to the question: What aspects of this two-day workshop did you find particularly helpful? (n=50)

Helpful aspects	Number of responses	Per cent of respondents with this response
Networking	12	24
The workshops	11	22
Learning about literacy and science	9	18
General understanding of <i>Primary Connections</i>	9	18
Practical applications	8	16
Theoretical rationale	6	12
Classroom teachers input	6	12
Investigating session	5	10
Workshop discussions	5	10
Learning about the 5Es model	4	8
Resources package	3	6
Good balance, structure	3	6
Role modelling of a workshop	2	4
Lots of things	2	4
Knowledgeable presenters	1	2
None	1	2
Confirms what I am doing	1	2
<b>Total responses</b>	<b>86</b>	

When asked what improvements could be made to the workshop, a common response was 'none' (21%). The most commonly cited improvements were to reduce the amount of lecture delivery, particularly on the first day (26%) and to make it sound less like a sales pitch (17%). Other suggestions are reported in Table 12.

Table 12: Science educators' responses to the question: What improvements could be made to the workshop? (n=47)

Suggested improvements	Number of responses	Per cent of respondents with this response
None	10	21
Sitting too long, less lectures, less talk on the first day	12	26
Don't let it sound like a sales pitch	8	17
Do/model some activities	6	13
Too rushed/make longer/do less	4	9
Pitch more to an academic audience	3	6
Faster pace	2	4
More focus on research	2	4
Give background reading before the workshop	2	4
Shorter session on research	1	2
More on assessment	1	2
More on how to use PC with pre-service teachers	1	2
More time for discussion	1	2
More small group sessions	1	2
Watch the acronyms	1	2
<b>Total responses</b>	<b>55</b>	

The science educators were asked what further support they needed in their role of facilitating professional learning about *Primary Connections*. The most common response was that they needed time to learn more about PC first or to teach it themselves (25%). Other frequently mentioned needs were for regular updates of resources (18%) and ongoing support from the Academy (11%). Sixteen per cent indicated they needed no further support. These data are summarised in Table 13.

Table 13: Science educators' responses to the question: What further support will you need for your role as a *Primary Connections* professional learning facilitator?" (n=40)

Support needed	Number of responses	Per cent of respondents with this response
<b>None</b>		
I don't need any additional support	7	16
<b>People</b>		
Academy/PC team support	5	11
Contact with other facilitators	3	7
Email contact for Q & A	3	7

Have buddy, mentor	1	2
<b>Resources</b>		
Regular updates of resources	8	18
Access to website	4	9
Money	2	5
<b>Not yet</b>		
Need to learn/teach PC myself first	11	25
<b>Skills</b>		
Need to observe trial teacher with PC	4	9
Strategies for implementation	4	9
<b>Not me</b>		
I am not a facilitator	2	5
<b>Total responses</b>	<b>54</b>	

The science educators' initial impressions of the professional learning resources, which were prepared for in-service teacher professional learning rather than for the pre-service teachers they teach, were very positive. The most common responses were that they were excellent, good, were detailed and had a good structure, flexible and teacher friendly (Table 14).

Table 14: Science educators' responses to the question: What are your initial impressions of the draft *Primary Connections* professional learning resources, which were developed for use by facilitators of workshops for in-service teachers?" (n=50)

Initial impression	Number of responses	Per cent of respondents with this response
Excellent, good	20	40
Detailed, good structure	20	40
Use is flexible	5	10
Teacher friendly	5	10
Didn't get time to look at it	4	8
Good for use with pre-service teachers	3	6
Negative comment	2	4
Supported by research	2	4
<b>Total responses</b>	<b>62</b>	

Eighty-eight per cent of responses were positive, eight per cent were neutral and only four per cent were negative.

When asked to rate the resources on a five-point scale, 94% of the science educators who responded to the question rated them in the top two categories excellent or good (Table 15) and more than half (56%) indicated that no changes were required (Table 16).

Table 15: Science educators' responses to the question: The draft *Primary Connections* professional learning resources are ... (n=47)

Science educators' responses (per cent)				
Excellent	Good	Satisfactory	Poor	Totally inadequate
53	41	6	0	0

Of the suggestions for changes to the professional learning resources, none was mentioned by as many as 10% of the participants. Suggestions included a greater focus on science content, more on assessment, provide links to state outcomes, models for implementation in different sectors, more on use of ICTs and making resources available on CD.

Table 16: Science educators' responses to the question: What changes would you like made to the professional learning resources that were prepared for facilitators of workshops for in-service teachers??" (n=45)

Changes to professional learning resources	Number of responses	Per cent of respondents with this response
None	25	56
Greater focus on developing teachers' knowledge of the science content	3	7
More on assessment, more work samples	2	4
Give outcomes for each state	2	4
Models for implementation in different sectors	2	4
More ICT	2	4
Provide CD of the resources for each module	2	4
A DVD showing a teacher teaching a whole unit	1	2
Further development of the science background knowledge CD	1	2
More colour	1	2
Whole school planning guide	1	2
Other	3	7
<b>Total responses</b>	<b>46</b>	

Given that the resources were designed to support professional learning for in-service teachers, the science educators were asked if additional resources were required to support them in their work with pre-service teachers. A majority said no, however, 43% said yes (Table 17) and their suggestions included a DVD for pre-service teachers showing a teacher teaching a PC unit using appropriate pedagogy, resources showing links to other learning areas, supplying the resources for each professional learning module on a CD, resources illustrating the incorporation of PC resources into a teacher education unit, and a website.

Table 17: Science educators' responses to the question: Is there a need to develop any additional resources to support university science educators incorporate elements of *Primary Connections* into pre-service teacher education programmes? If yes, what resources would you like developed? (n=46)

Are additional resources needed?	Number of responses	Per cent of respondents with this response
No	26	55
Yes	20	43

Resources to develop	Number of responses
A DVD for pre-service teachers showing pedagogy	3
Links to learning areas	3
Resources for each module on a CD	3
Incorporating PC into a university unit	2
A website	2
More resources for content	1
Help on dealing with student misconceptions	1
A glossary	1
<b>Number of responses</b>	<b>21</b>

As can be seen from Table 17, there is no consensus by a significant number of science educators about what additional resources should be developed; all suggestions were made by less than five participants.

When invited to make any further comments, 35 did so and all comments were very positive indicating appreciation for a high quality workshop. Comments praised presenters, the workshop, PC and the, resources, networking, accommodation and food (Table 18).

Table 18: Science educators' responses to the question: Any other comments? (n=35)

Comment on workshop	Number of responses	Per cent of respondents with this response
Praise for presenters and workshop	25	52
Praise for PC and resources	7	15
Valuable networking opportunity	1	2
Accommodation, food praised	1	2
Use as primary national science curriculum	1	2
<b>Number of responses</b>	<b>35</b>	

## Key Findings

Key findings arising from analysis of the results are summarised below.

Number	Key finding	Supporting data
1	The 114 university science educators who participated in the February and July workshops were drawn from all 36 Australian universities that offer pre-service teacher education programmes. Seventy-four per cent of the participants were deans, professors, associate professors, senior lecturers, lecturers or course co-ordinators who are likely to be tenured staff with ongoing appointments in teacher education.	Table 1
2	The science educators believed that quality professional learning needs to be relevant to the teachers' needs, purposeful and ongoing, based on sound pedagogy, delivered by a knowledgeable and credible facilitator in a stimulating and engaging manner.	Table 2
3	At the end of the workshop the science educators had high self-efficacy on six of nine aspects of facilitation; they had lower self-efficacy on aspects of facilitation requiring an understanding of early childhood and primary teaching, and literacy teaching.	Table 3
4	After the workshop 65% of the science educators had high self-efficacy scale scores (> 35/45) and none had a low (< 26/45) self-efficacy scale score. Science educators that had completed a two-day workshop in July had slightly lower levels of self-efficacy than the February cohort and the 2006 PLFs who had completed five days of facilitation training.	Tables 4 and 5
5	The science educators had high levels of confidence (scores > 4/5) with facilitating workshops related to six of seven aspects of <i>Primary Connections</i> . Confidence levels were a little lower, but of a similar magnitude to those of the February cohort of science educators and the 2006 cohort of PLFs who had completed five days of facilitation training.	Table 6 and 7
6	When asked about the extent to which the workshop outcomes had been achieved, no less than 70% of participants rated six of seven outcomes in the two highest of five response categories. Most positive responses were for understanding the theoretical underpinnings of the programme and the research findings, understanding the teaching and learning and professional learning models, and awareness of opportunities to use PC to exemplify aspects of pre-service science education.	Table 8
7	Eighty-four per cent of the science educators reported that they were very well or well prepared for facilitating <i>Primary Connections</i> workshops with pre-service teachers, and 73% indicated they were very well or well prepared for facilitating workshops with in-service teachers.	Tables 9 and 10
8	The science educators found the opportunity for networking, the three workshop sessions and opportunities to learn about <i>Primary Connections</i> and its approach to science and literacy teaching the most helpful.	Table 11

9	The science educators suggested that the workshop could be improved by reducing the amount of lecturing, especially on the first day, and avoiding it sounding like a sales pitch.	Table 12
10	The most common support needs related to having time to become more familiar with <i>Primary Connections</i> , having regular updates on resources, and having ongoing contact with the Academy support team.	Table 13
11	Ninety-four per cent of the science educators rated the professional learning resources as excellent or good, and a majority could not identify any need for change. Suggestions for change included a greater focus on developing understanding of science content, more on assessment and resources to link implementation to states and sectors.	Tables 14 – 16
12	When asked if there is a need to develop any additional resources for pre-service teacher education a majority said 'no'. Suggestions for additional resources included a DVD for pre-service teachers showing PC being taught using good pedagogy, resources that show links to other learning areas, and making the resources for each module available on a CD.	Table 17
13	When given the opportunity to provide any other comments, responses were overwhelmingly positive with praise for the workshop, presenters, networking, accommodation and meals.	Table 18

### Discussion and Conclusions

The February and July workshops for university science educators were very successful at a number of levels: they attracted staff from all Australian universities that offer a pre-service teacher education programme; the participating science educators who completed the workshops developed high levels of confidence and self-efficacy for facilitating *Primary Connections* professional learning, achieved key aims of the workshop, gave *Primary Connections* and its resources strong endorsement, and gave the workshops a very positive evaluation.

A large majority of participants at the February and July workshops for science educators appear from their middle to senior academic ranks to be tenured staff on ongoing appointments. Only one-fifth was associate lecturers or tutors who are likely to be on fixed-term sessional appointments. There is likely to be some limited need for training of new sessional staff who are appointed to teach science education units over the next few years if the effective use of *Primary Connections* in pre-service teacher education is to be sustained.

The beliefs of the July workshop participants about effective teacher professional learning focussed on relevance, being purposeful and ongoing, based on sound pedagogy with opportunities for teachers to apply ideas in the workshops. The February workshop participants seemed to have a richer view of effective professional learning and emphasised the need for dialogue, collaboration and sharing between participants, and the need for reflection on learning.

At the end of the two-day workshop, the July workshop participants had high levels of confidence for facilitating *Primary Connections* professional learning and medium to high levels of self-efficacy. Self-efficacy was lowest for giving advice to early childhood teachers

about science pedagogy. This may reflect a low proportion of the science educators having experience with and/or responsibility for teacher professional learning for the early years. Overall, the July workshop participants had lower confidence and self-efficacy than the February workshop participants and the 2006 cohort of PLFs who had received five days of training.

More than 70% of the science educators indicated that they had achieved aims related to: understanding the theoretical underpinnings of PC; understanding the teaching and learning model and the professional learning model; understanding the pedagogical approaches of PC; awareness of opportunities for using PC; exemplify aspects of primary science teaching in pre-service science education units; and, familiarity with the curriculum and professional learning resources and examples of workshops that can be used. A large majority believed they had been very well or well prepared for facilitating workshops in both pre- and in-service contexts.

Given that the science educators had high levels of confidence and self-efficacy for facilitation, understood the theoretical and pedagogical aspects of PC, were familiar with PC and its resources and believed they were well prepared for facilitating professional learning one would expect them to be effective facilitators.

Feedback on the workshop itself was very positive. Participants found the opportunity for networking, the small-group workshop sessions, and learning about *Primary Connections* and its approach to teaching science and literacy particularly helpful. As with the February workshop, the July workshop participants would prefer less lecture material on the first day, however, it was interesting to note that some July participants reacted to a perceived 'sales pitch' for PC as presenters were strong advocates for the programme. The only needs for further support mentioned by more than 15% of participants were updates on resources, and time to learn more about or teach with PC.

The *Primary Connections* professional learning resources were given a very positive evaluation and a majority of participants indicated that no changes were needed and no additional resources were required. However, there were a few participants who suggested that there should be: a greater focus on developing teachers' content knowledge; additional resources for assessment; resources to link PC to states' outcomes and to link PC to other learning areas; a DVD for pre-service teacher education showing teachers teaching PC illustrating good pedagogy; and that the resources for each professional learning module be available on a CD. Each of these suggestions needs some consideration.

The supply of workshop sets of curriculum units, updates on the development of new curriculum units, the supply of revised professional learning resource modules, and update sessions at the ASERA conference will enable the science educators to remain well-resourced and up-to-date in their knowledge of the programme.

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Appendix 1: Workshop programme

## Establishing Connections

A Conference for University Science Educators about *Primary Connections*  
Australian Academy of Science  
The Shine Dome, ACTON, ACT  
20-21 July, 2007

**DAY 1**      Opening and introductions  
Theoretical rationale for *Primary Connections*  
Curriculum resources  
Linking science with literacy  
Rotation 1 of interactive workshops

A WARM WELCOME TO THE FELLOWS OF THE ACADEMY IN ATTENDANCE.

**DAY 2**      Rotation 2 & 3 of interactive workshops  
*Primary Connections* research programme  
*Primary Connections* Indigenous Perspective  
Programming a primary science education unit incorporating *Primary Connections*  
Teaching a *Primary Connections* curriculum unit

A series of three concurrent 85 minute interactive workshops will explore the major features of the programme demonstrating facilitation techniques used by professional learning facilitators with in-service teachers.

Participants will be allocated to a workshop group designated by a sticker on their name tags. Workshop groups stay together for three separate workshops. Timetable schedules for the workshops will be available at Registration at the Shine Dome and on signs around the workshop spaces. The workshops and presenters are:

- **5Es teaching and learning model & embedded assessment**  
Presenters: *Ms Robyn Bull & Ms Aimee Theodore*
- **Linking science with literacy, Ian Potter House**  
Presenters: *Professor Vaughan Prain & Ms Louise Rostron*
- **Investigating & cooperative learning, Jaeger Room, Dome**  
Presenter: *Professor Mark Hackling & Ms Margaret Noakes*

**DAY 1**

<b>TIME</b>	<b>FOCUS</b>	<b>PRESENTER/S</b>
<b>8.30</b> (30mins)	<b>Registration, satchel collection</b> <b>Tea and coffee</b>	
<b>9.00</b> (20mins)	<b>Welcome addresses</b> MC: Ms Louise Rostron Professional Learning Officer Australian Academy of Science	Professor Kurt Lambeck President Australian Academy of Science  Ms Marie Hird Branch Manager Curriculum Branch Department of Education, Science and Training
<b>9.20</b> (10mins)	<b>Introductions</b> <i>Primary Connections</i> team Research Consultants Introduce yourself to the people nearest you	Ms Shelley Peers Managing Director <i>Primary Connections</i> project Australian Academy of Science
<b>9.30</b> (20mins)	<b>Opening Address</b> <ul style="list-style-type: none"> <li>• Purpose of <i>Primary Connections</i></li> <li>• Purpose of the pre-service conference</li> <li>• Origin of <i>Primary Connections</i></li> <li>• History of the project</li> </ul>	Shelley Peers
<b>9.50</b> (5mins)	<b>Housekeeping</b>	Ms Shannon Newham Executive Assistant Education & Public Awareness Australian Academy of Science
<b>9.55</b> (20mins)	<b>Participant expectations</b>	Ms Louise Rostron & Ms Robyn Bull Professional Learning Officers Australian Academy of Science
<b>10.15</b> (30mins)	<b>Morning Tea</b>	
<b>10.45</b> (30mins)	<b>Setting the scene</b> <ul style="list-style-type: none"> <li>• Theoretical rationale</li> <li>• Five principles</li> <li>• Teaching and learning model</li> <li>• Professional learning model</li> <li>• Links to national statements</li> </ul>	Professor Mark Hackling Edith Cowan University Research Consultant to <i>Primary Connections</i>
<b>11.15</b> (15mins)	<b>Question/answer session</b>	Mark Hackling

<b>11.30</b> (30mins)	<b>Setting the Scene</b> <ul style="list-style-type: none"> <li>• Orientation to exemplary curriculum units</li> <li>• Science Background CD</li> <li>• Website resources</li> </ul>	Robyn Bull
<b>12.00</b> (30mins)	<b>Exploring the curriculum units</b> <ul style="list-style-type: none"> <li>• Navigate using a checklist</li> <li>• Compare stage units</li> <li>• Concentrate on literacy focuses</li> <li>• Focus on the investigations (Elaborate)</li> </ul>	
<b>12.30</b> (45mins)	<b>Lunch</b>	
<b>1.15</b> (15mins)	<b>Question/answer session on curriculum resources</b>	Shelley Peers, Mark Hackling, Vaughan Prain, PC Team
<b>1.30</b> (30mins)	<b>Setting the Scene</b> <ul style="list-style-type: none"> <li>• Academic/research review about linking science with literacy</li> </ul>	Professor Vaughan Prain La Trobe University Research Consultant to <i>Primary Connections</i>
<b>2.00</b> (5mins)	<b>Move to workshop space</b>	
<b>2.05</b> (85mins)	<b>Rotation 1 of interactive workshops</b> <ul style="list-style-type: none"> <li>• Linking science with literacy</li> <li>• 5Es and assessment</li> <li>• Investigating and cooperative learning</li> </ul>	Vaughan Prain & Louise Rostron  Robyn Bull & Aimee Theodore Mark Hackling & Margaret Noakes
<b>3.30</b> (15mins)	<b>Afternoon Tea</b>	
<b>3.45</b> (30mins)	<b>Question Generator Process Question/answer session</b>	Louise Rostron to co-ordinate in Dome
<b>4.15</b>	<b>Close Day 1</b>	
<b>6.30-10.30</b>	<b>Dinner at the First Floor Restaurant, Kingston</b>	

## DAY 2

TIME	FOCUS	PRESENTER/S
9.00 (85min)	<b>Rotation 2 of interactive workshops</b> <ul style="list-style-type: none"> <li>• Linking science with literacy</li> <li>• 5Es and assessment</li> <li>• Investigating and cooperative learning</li> </ul>	All workshop presenters
10.25 (5mins)	<b>Move to Morning Tea</b>	
10.30 (30mins)	<b>Morning Tea</b>	
11.00 (15mins)	<b>Primary Connections Indigenous Perspective</b>	Robyn Bull
11.15 (30mins)	<b>Setting the Scene</b> <ul style="list-style-type: none"> <li>• Academic/research review of the research programme</li> </ul>	Mark Hackling
11.45 (5mins)	<b>Move to workshops</b>	
11.50 (85min)	<b>Rotation 3 of interactive workshops</b> <ul style="list-style-type: none"> <li>• Linking science with literacy</li> <li>• 5Es and assessment</li> <li>• Investigating and cooperative learning</li> </ul>	All workshop presenters
1.15 (5mins)	<b>Move to Lunch</b>	
1.20 (40mins)	<b>Lunch</b>	
2.00 (75mins)	<b>Programming a science education unit</b>  <b>Teaching a <i>Primary Connections</i> unit</b>	Mr Iain Hay, University of Canberra Ms Sue Wilson, Australian catholic University Ms Jo Burns (Garran Primary School) & Ms Jennie Bailey (Evatt Primary School)
3.15 (30mins)	<b>Panel discussion &amp; questions</b>	
3.45 (10mins)	<b>Questionnaire</b>	
3.55 (5mins)	<b>Revisit expectations, correlation chart</b> <b>Close</b>	
4.00	<b>Bus to Airport</b>	

**Appendix 2: Workshop evaluation questionnaire**

**Australian Academy of Science: *Primary Connections* Programme**

**University Science Educators Workshop  
Workshop Evaluation Survey**

*Dear Colleague*

*We seek your views about the workshop you have just completed. Data from this survey will be aggregated and summarised so that it will not be possible to identify any respondent in any reports of this research. Data will be used for research purposes only. We request your name for follow-up purposes only.*

*Please answer this questionnaire honestly and frankly. Respond in the way that it is, rather than portraying things as you would like them to be seen.*



*Professor Mark W Hackling  
Edith Cowan University*

ID number

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For office use only

**Your background**

Your name: \_\_\_\_\_

Your university: \_\_\_\_\_

**About professional learning**

What do you believe are the most important characteristics of high quality teacher professional learning?

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## Your self-efficacy and confidence as a facilitator of pre and in-service teacher professional learning

Please indicate the degree to which you agree or disagree with each statement below by ticking the appropriate box to the right of each statement:

SA = Strongly Agree; A = Agree; UN = Uncertain;  
D = Disagree; SD = Strongly Disagree

Item	Statement	SA	A	UN	D	SD
1	I am effective in eliciting teachers' prior knowledge and beliefs and adjusting the professional learning workshop to meet the needs of the teachers					
2	My science content knowledge enables me to answer teachers' science questions effectively					
3	My knowledge of effective science teaching practices enables me to answer teachers' science pedagogy questions effectively					
4	I am quite comfortable with having my professional learning workshops evaluated					
5	I am able to pose engaging tasks for teachers to work on in small groups in my workshops					
6	My deep understanding of the culture of primary schooling enables me to give valuable advice to teachers on matters of primary science pedagogy					
7	My deep understanding of the culture of early childhood education enables me to give valuable advice to ECE teachers about science pedagogy					
8	My deep understanding of literacy teaching practice enables me to give valuable advice on integrating literacy education into science education					
9	I am able to choose and apply effective facilitation tools and techniques to enhance the learning of teachers in workshops					

Please rate your confidence with facilitating professional learning workshops focusing on the following aspects of primary science and literacy teaching

VC = Very confident; C = Confident;  
LC = Limited confidence; NC = No confidence

Item	Aspect	VC	C	OK	LC	NC
1	Introducing <i>Primary Connections</i> and its five underpinning principles					
2	Linking science with literacy					
3	Understanding and applying the 5Es teaching and learning model in primary science					
4	Conducting investigations in primary science					
5	Using co-operative learning strategies					
6	Using embedded assessment processes and effective questioning techniques					
7	Co-ordinating the science programme in a primary school					

## Feedback on the two-day university science educators workshop

To what extent have the aims of the workshop been achieved for you?

Aim		To a large extent		OK		To a limited extent
To develop an enhanced.....		1	2	3	4	5
1	understanding of the theoretical underpinnings of the programme and research findings regarding the impact of the programme on teachers, students and schools					
2	understanding of the <i>Primary Connections</i> teaching and learning model and the professional learning model					
3	understanding of the pedagogical approaches used to support the development of literacies of science and investigation skills, and how assessment is embedded in the teaching and learning programme					
4	familiarity with the curriculum and professional learning resources developed by the programme					
5	familiarity with the roles of School Co-ordinator, Professional Learning Facilitator and Jurisdiction Co-ordinator, and the support for professional learning available in each jurisdiction					
6	familiarity with examples of professional learning sessions for in-service teachers					
7	awareness of opportunities to use <i>Primary Connections</i> resources to exemplify aspects of primary science teaching in pre-service science education units					

**How well prepared do you feel for facilitating *Primary Connections* professional learning workshops for in-service teachers?**

**Tick one box.**

Very well prepared	Well prepared	OK	Poorly prepared	Very poorly prepared

**How well prepared do you feel for incorporating elements of *Primary Connections* into your pre-service teacher education programme?**

**Tick one box.**

Very well prepared	Well prepared	OK	Poorly prepared	Very poorly prepared

What aspects of this two-day workshop did you find particularly helpful?

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What improvements could be made to the workshop?

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What further support will you need for your role as a *Primary Connections* professional learning facilitator?

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**Feedback on the *Primary Connections* professional learning resources**

What are your initial impressions of the draft *Primary Connections* professional learning resources, which were developed for use by facilitators of workshops for in-service teachers?

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The draft professional learning resources are.... (tick one box)

Excellent	Good	Satisfactory	Poor	Totally inadequate

What changes would you like made to the professional learning resources that were prepared for facilitators of workshops for in-service teachers?

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Is there a need to develop any additional resources to support university science educators incorporate elements of *Primary Connections* into pre-service teacher education programmes?

Yes / No

If yes, what resources would you like developed?

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**Any other comments**

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Thank you for responding to this questionnaire; your feedback will be very useful