PrimaryConnections®
Linking science with literacy

Stage 3
Interim research and evaluation report 2

Professional Learning Facilitators workshop: January 2006

A research report for the Australian Academy of Science

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The views expressed in this report do not necessarily represent the views of the Australian Academy of Science nor the views of the Australian Government Department of Education, Science and Training. The author accepts responsibility for the views expressed and all errors and omissions in this report.

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Introduction and Background to the Study

Primary science in Australia

High quality teaching of both science and literacy in Australian primary schools is a national priority in order to develop citizens who are scientifically literate and who can contribute to the social and economic well-being of Australia as well as achieve their own potential. Student achievement in science is therefore being monitored through the national assessments of Year 6 students' scientific literacy for which sample testing was undertaken in October 2003 and will be repeated in 2006. Parents rate science as the third most important subject for their primary school children after English and mathematics (ASTEC, 1997).

The teaching of science in primary schools has been a cause for concern for some time and despite the recognition of science as a priority area of learning, science teaching has a low status in the primary curriculum. Science as a learning area, has the second lowest allocation of time in the primary school curriculum averaging 2.7% of teaching time (Angus et al., 2004). Many primary teachers lack confidence and competence for teaching science (Appleton, 1995; Palmer, 2001; Yates & Goodrum, 1990) and consequently score poorly on self-efficacy scales that measure the extent to which primary teachers feel capable of teaching science effectively (Riggs & Knochs, 1990). The 2001 national review of the status and quality of science teaching and learning (Goodrum, Hackling & Rennie, 2001) indicated that the teaching of science in primary classrooms is patchy and recommended that if primary teachers of science are to be effective in improving student learning outcomes, they need access to quality professional learning opportunities supported by rich curriculum resources. It also argued that to develop quality science education resources, collaboration between jurisdictions is essential and could reduce wasteful duplication in the preparation of resources. The *Primary Connections* programme was developed in response to these concerns.

Recent national assessments of scientific literacy and international assessments of science achievement present a sobering picture of the health of primary science in Australia. Less than 60% of sampled Year 6 Australian students in 2003 attained the national proficiency standard in six of eight jurisdictions (MCEETYA, 2005). The Trends in International Mathematics and Science Study (TIMSS) shows that the science achievement of Australian Year 4 students has remained stable between assessments made in 1994 and 2002 at a level which was above the international mean, however, countries such as Singapore, England and the United States which scored at a similar level to Australia in TIMSS 1994, have improved their scores to the extent that in 2002 their average scores were significantly higher than those of Australia (Thomson, 2004).

Primary Connections

Primary Connections is an initiative of the Australian Academy of Science funded by the Australian Government through the Department of Education, Science and Training. All Australian states and territories, government, catholic and independent school sectors, and science and literacy professional associations were represented on a project reference group that provided direction for the conceptualisation and implementation of the project.

Primary Connections aims to improve science and literacy learning outcomes through providing an innovative programme of professional learning supported with high quality curriculum resources based on a sophisticated teaching and learning model.

The *Primary Connections* project has been implemented in three stages. Stage 1, funded by the Australian Academy of Science sought and gained the support and involvement of all jurisdictions and sectors, and conceptualised the project. Stage 2 funded by DEST involved developing nine curriculum units and a professional learning programme and

trialing the programme in 56 schools throughout Australia. The Stage 2 trial focussed on 106 trial teachers who participated in a five-day professional learning programme in January 2005 and three follow-up one-day professional learning workshops. These trial teachers taught units developed by the Academy of Science in Terms 1 and 3 of 2005, and they taught a unit developed by the trial teachers themselves using a *Primary Connections* template, in Term 2. In addition to these trial teachers who participated in a total of eight days of professional learning, there was a smaller group of case study school teachers who received only one day of professional learning as preparation for teaching two supplied *Primary Connections* units in Terms 1 and 3 of 2005. These case study teachers were based at four schools which opted for a whole of school implementation in 2005.

The experiences of the trial teachers were the subject of a research study reported by Hackling and Prain (2005) and a supplementary report focused on the experiences of the cases study teachers who implemented *Primary Connections* in four case study schools in 2005 (Hackling, 2006).

Stage 3 of the project, funded by the Australian Government, commenced in 2006 with a professional learning workshop designed to prepare a cohort of *Primary Connections* professional learning facilitators who would have the skills and resources to facilitate professional learning workshops for schools implementing *Primary Connections*.

Primary Connections is a professional learning programme comprising professional learning workshops and curriculum resources. The workshop conducted in January 2006 was designed to provide trained facilitators who can deliver the professional learning component of the programme in all jurisdictions and sectors.

Previous Research on Professional Learning

As Anderson and Michener (1994) indicated in their review of research on science teacher education, whilst improved pre-service teacher education is important and influential, it will never be the key impetus for education reform. The potential for significantly improving the education system lies with practising teachers' professional learning. Furthermore, Anderson and Michener (1994) concluded that successful teacher professional learning occurs in the school context with changes initiated in a systemic and sustained manner.

A recent report from England by the Council for Science and Technology (2000) addresses the question of 'what would make a material difference in helping science teachers in primary and secondary schools develop and improve their professional practice, individually and collectively?' Apart from evidence obtained from other English research and OFSTED inspections, the Council commissioned a survey (Dillon, Osborne, Fairbrother, & Kurina, 2000). Twenty focus groups covering 50 schools all over England, and randomly selected samples of over 900 head teachers and 1500 science teachers from 1300 primary and secondary schools participated in this survey. The Council concluded that:

> We are convinced that there is considerable scope for securing a step change in science teachers' performance and hence in the science education of their pupils, by creating a pro-CPD [continuous professional development] culture, one in which a life time of professional learning is very much the norm and is assisted by modern, effective arrangements. (Council for Science and Technology, 2000, p. 4)

Loucks-Horsley, Hewson, Love and Stiles (1998) identified a range of strategies that are used to support teacher professional learning. While some of these strategies have greater potential than others in improving teaching and learning, each strategy can make a contribution depending on the special circumstances and settings in which teachers find themselves. The strategies include immersion in industry-based activities, action research

(e.g., Grundy, 1995), collaborative work with peers or researchers (e.g., the *PEEL* project, Baird & Northfield, 1995; and the *Science in Schools* project, Tytler, 2002), curriculum-based initiatives (e.g., *Primary Investigations*, Australian Academy of Science, 1995), and other professional learning workshops or courses.

There is an extensive range of professional development courses offered to teachers, from one-off isolated lectures to intensive postgraduate qualifications. Unfortunately, the most common approach is the single, 'stand alone' workshop or seminar that seems to have the least impact in improving teaching practice. In fact they may be perceived as being imposed rather than owned by teachers, lacking credibility, non-sustainable, brief and a one-off event rather than part of long-term sustainable and effective programme (Guskey & Huberman 1995). The teachers from Ingvarson and Loughran's Australian study (1997) mostly worked in complete isolation from colleagues at their school and consequently had no method of interacting collaboratively and being supported by their peers. The involvement of teachers working collaboratively, reflecting on their current practices, recognising new possibilities and identifying issues to be addressed can engage them in forms of inquiry into their own professional practice. Participative inquiry involves cooperative participation in the construction of professional knowledge relevant to the context of the workplace (Reason, 1998).

Much of the evidence at the Senate Inquiry into the Status of the Teaching Profession (1998) was critical of current professional development arrangements, referring to their 'ad hoc' and 'piecemeal nature'. Research clearly shows that professional development that is independent of the school context or the broader support for curricular or instructional change is unlikely to have an impact on educational practice (Anderson & Michener, 1994). On the basis of the evidence they received, the Senate Inquiry (1998) indicates that successful professional development programmes include some of the following features:

- Teachers have significant input into the programme
- It is well structured, long-term and comprehensive
- It involves a variety of collaborative partners
- It includes evaluation, feedback and ongoing support
- The costs are shared between government and schools
- Courses are accredited or recognised in career structures
- Courses meet national standards.

Sparks and Loucks-Horsley (1990), in their review of research on staff development, also recognise the importance of leadership from administrators. Good professional development is a balance between systemic leadership and teacher contribution. Neither the imposed curriculum reforms of the 1970s nor the school-based curriculum developments of the 1980s and 1990s have resulted in the system-wide teacher change that had been hoped for. It is suggested that effective teacher change require both systemic leadership and school involvement.

Curriculum development and curriculum implementation are increasingly being used as components of professional development programmes. Bybee (1997) explains that curriculum development and professional development are both high risk, high cost activities for a school or system. The potential benefits, however, are significant. In their definitive review of the literature on educational change, Fuller and Steinberger (1991) suggest that substantial educational change is generally the result of systemic efforts and that professional development is an essential ingredient. Curriculum reforms provide the basis for systemic change but without professional development it is unlikely the change will be sustained. In Ohio's *Statewide Systemic Initiative*, aimed at improving middle school science and mathematics, professional development was a key ingredient. Four years into

the reform, a comprehensive assessment of its effectiveness found that professional development, a curriculum that focuses on problem-solving, and materials to support student inquiry were given the highest ratings as leading to improved learning in science. Further, professional development sustained over time was recognised by principals and teachers as more beneficial than short-term professional development, especially by teachers who had experienced both types of development (Kahle & Boone, 2000).

Curriculum resource development is more successful when curriculum experts and teachers collaborate. *Primary Investigations*, developed by the Australian Academy of Science, has been cited as a successful example of this approach (Appleton & Symington, 1996; ASTEC, 1997; Fensham, 1998). The project began with extensive research with teachers to determine their needs (Goodrum, Cousins, & Kinnear, 1992), and the curriculum resources were developed and trialled extensively with over 500 teachers over a period of three years. This teacher input provided the basis of a resource that provides appropriate content and adaptability to local conditions. A sustained school-based professional development programme supported the implementation of the resource.

The *Collaborative Australian Secondary Science* Programme (CASSP) brought together three complementary components to support teacher professional learning: professional development workshops to explain and model new practices; curriculum resources to exemplify how these practices could be brought together into a coherent learning sequence and to support teachers implement the new practices; and, opportunities for collegial reflection on practice and provision of peer support through participative inquiry (Hackling, Goodrum & Deshon, 1999). The CASSP project funded by DEST was implemented in 28 schools with 122 teachers and approximately 3000 Year 9 students. The initiative supported many teachers to move from teacher-centred strategies towards more student-centred and investigative approaches and greater use of assessments for learning (Goodrum, Hackling & Trotter, 2003). Case study research demonstrated that, for some teachers, these experiences raised the level and nature of teachers' concerns about their practice and understanding of the new teaching-learning strategies, which facilitated the successful implementation of the new practices (Sheffield, 2004).

The value of curriculum-based professional learning programmes has gained further support from a recent meta-analysis of 37 professional learning studies, which demonstrated that curriculum development, replacement and implementation approaches had the highest impact on student learning (Tinoca, 2004).

Teachers' beliefs and professional knowledge

Teachers' professional practice is influenced by a number of factors including their beliefs, pedagogical content knowledge, the professional climate of their workplace, curriculum frameworks and assessment regimes, and limitations in resources.

Recent Australian studies have illustrated the powerful influence of teachers' beliefs about the nature of science and what constitutes effective science teaching practice on the science teaching practices of both primary and secondary teachers (Keys, 2003; Sheffield, 2004). Having opportunities to explore the rationale for new practices and to engage in deep reflections on their practice are therefore important elements of professional learning programmes.

Teachers enact highly complex bodies of professional knowledge for teaching science. This pedagogical content knowledge comprises knowledge of: science, science teaching strategies, science curricula and learning outcomes, students and students' learning, assessment strategies, contexts and cultures (Gess-Newsome, 1999). As a consequence of limited studies of science and science curricula in initial teacher education, many primary teachers have limited science pedagogical content knowledge and this is corroborated by an extensive and long-standing body of research that shows that primary teachers have low confidence, competence and self-efficacy beliefs about their ability to teach science effectively (Appleton, 1995; Palmer, 2001; Riggs & Knochs, 1990; Yates & Goodrum,

1990). Enhancing teachers' pedagogical content knowledge is likely to lead to greater confidence and self-efficacy for teaching science. Opportunities for exploring science teaching strategies, principles of effective teaching and learning, the science concepts, investigation skills and literacies of science associated with units of work are therefore important components of effective professional learning programmes for primary teachers of science.

Method

Professional learning facilitators were recruited by the Academy of Science through high ranking officials in each jurisdiction and sector. A total of 89 participants were brought to Canberra for a three-day workshop in January 2006. Details of the participants' state and sector or origin is reported in the results section.

An outline of the professional learning workshop is attached at Appendix 1.

The intended outcomes for the workshop were to develop:

- Understanding of the *Primary Connections* project, teaching and learning model and curriculum resources
- Understanding of the *Primary Connections* professional learning model and resources, and how it can be adapted to a wide variety of settings and jurisdictional structures and cultures
- Understanding of principles of effective professional learning
- Skills and confidence of facilitation professional learning workshops based on *Primary Connections* resources
- Network of colleagues with whom you could discuss issues that arise as a *Primary Connections* facilitator

A team of science education experts including Professors Mark Hackling, Vaughan Prain, Russell Tytler and Denis Goodrum supported by Academy of Science staff Shelley Peers, Nola Shoring, Claudette Bateup, Emma Anderson and Ross Buchanan conducted the workshop for a total of 89 participants.

The workshop commenced with an initial research data collection. An extensive questionnaire was used to collect background and baseline data about the participants. Questions included open response items, objective items and agreement scale items. At the end of the workshop participants completed a second questionnaire which collected data to evaluate the impact of the workshop and data that could be used to improve future workshops and the professional learning resources. The two questionnaires are attached as Appendices 2 and 3.

Coding manuals were developed to guide the coding of data and its entry into spreadsheets that could be downloaded into SPSS for calculation of descriptive statistics. Responses to open-ended questions were categorised into categories and the frequency of responses in each category was recorded. Agreement scale items were coded from 5 to 1 i.e., from the most positive to the least positive response.

Results

The results of the study are reported in three main sections. First, the background and characteristics of the participants in the workshop are outlined; second, the impact of the workshop is described; and third, the participants' initial evaluation of the professional learning resources is reported.

The participants
Eighty-nine participants attended the professional learning facilitators workshop; of these 85 completed the initial and end of workshop questionnaires.

Demographics
The origin of the participants in the PLF workshop was analysed by jurisdiction, sector and geographic location and these data are reported in Tables 1-3.

Table 1: State of origin of participants at Professional Learning Facilitators workshop (n=89)

State of origin	Number	Per cent
WA	16	18.0
SA	8	9.0
NT	5	5.6
QLD	16	18.0
NSW	14	15.7
ACT	7	7.9
VIC	17	19.1
TAS	6	6.7

All jurisdictions were represented at the PLF workshop with most participants attending from Victoria, Queensland, Western Australia and New South Wales.

Table 2: Origin of participants at Professional Learning Facilitators workshop by sector (n=89)

Sector	Number	Percent
Government	63	70.8
Catholic	11	12.4
Independent	9	10.1
Other	6	6.7

Most participants worked in the Government school sector with smaller but strong representations from the Catholic and Independent sectors plus six participants from other work places which included science centres.

Table 3: Regional location of professional learning facilitators (n=85)

Location of facilitators	Number	Per cent
Metropolitan	58	68.2
Regional	18	21.2
Rural	9	10.6

Participation was spread between metropolitan, regional and rural settings with most in metropolitan settings and almost one third working in regional and rural settings.

Eighty-two percent of participants were female.

Background, experience and qualifications
The initial questionnaire sought to determine the professional background, experience and qualifications of participants so that future training might take account of these factors and address the particular needs of the participants. These data are reported in Tables 4-9.

Fifty of the 85 participants were based in schools as class teachers, deputy principals, science co-ordinators or principals. Of the school-based participants, 12 were experienced *Primary Connections* trial teachers

Table 4: Professional background and role in 2006 (n=85)

Role in 2006	Number of people	
	Primary background	Secondary background
Class teacher	19	0
Science coordinator	9	1
Deputy	18	0
Principal	3	0
General education advisor	13	2
Literacy consultant	4	0
Science consultant	5	11
Totals	71 (84%)	14 (16%)

Of the 35 participants who were not school-based, most were general education advisors with fewer having specific responsibilities for science and literacy advising. The large majority of these advisors were based in education sector offices with smaller numbers working for science centres and professional associations. Sixteen percent of the participants had a secondary background and almost all of these were science consultants.

Table 5: Years in employment in education sector (n=85)

Years of employment in education sector	Number of responses	Per cent of respondents with this response
5 or less	7	8.2
6 to 10	5	5.9
11 to 15	10	11.8
16 to 20	11	12.9
21 to 25	17	20.0
26 to 30	23	27.1
31 to 35	7	8.2
More than 35	5	5.9

Only 8% of participants had five years or less of experience in education and the majority (61%) had more than 20 years of experience.

Table 6: Experience with *Primary Connections* and/or Primary Investigations (n=85)

PC trial teacher in 2005	Taught with Primary Investigations
18.8%	44.7%

A little less than one-fifth of participants were experienced *Primary Connections* trial teachers and 45% had previously taught Primary Investigations and would therefore have an understanding of the 5Es model and co-operative learning.

Table 7: Post secondary qualifications (n=85)

Post-secondary qualifications	Number of responses	Per cent of respondents with this response
Bachelor of Education or Teaching	49	57.6
Diploma of Teaching	22	25.9
Diploma of Education	39	45.9
Bachelor of Arts	11	12.9
Bachelor of Science	13	15.3
Other diploma	4	4.7
Other certificate	2	2.4
Masters degree	20	23.5
Certificate of teaching	5	5.9
PhD	2	2.4
Total responses	167	
No response to question	2	2.4

The most common initial teacher education qualifications were BEd, BTch, Dip Tch and Dip Ed. Twenty-two participants also had a higher degree.

Table 8: Highest level of science content/discipline studied by educators in the study. (n=85)

Highest level of science study	Number of respondents	% of respondents
Year 10	10	11.8
Year 12	31	36.5
1-3 undergraduate science units	15	17.6
Science Major	23	27.1
Postgraduate science	4	4.7
Not indicated	2	2.4

Participants were also asked to report their highest level of science discipline studies. Thirteen participants reported they had completed a BSc degree, however, 48% had no more than Year 12 science studies and 12% had no more than Year 10 science studies.

Table 9: Current studies being undertaken by survey group (n=85)

Current studies	Number of responses	Per cent of respondents with this response
Not studying at present	69	81.2
Masters degree	8	9.4
Certificate of some type	2	2.4
B.Ed	2	2.4
PhD	4	4.7

Most of the participants were not currently engaged in further formal studies; 9% were completing a master degree.

Confidence and self-efficacy as a science teacher

The participants responded to two scales to gauge their confidence with science teaching and self-efficacy beliefs about being an effective science teacher. Data are reported for the professional learning facilitators (PLFs) at the beginning of the workshop and are compared to data from the 2005 trial teachers (TTs).

Table 10: Mean ratings of confidence with aspects of science teaching for professional learning facilitator workshop participants compared with trial teachers in 2005

Aspect of science teaching	Mean rating of aspect (/5)		
	PLF initial survey (n=75)	TTs initial survey (n=89)	TTs end term 2 survey (n=89)
1. Engaging students' interest in science	4.43	3.89	4.45
2. Managing hands-on group activities in science S	4.39	3.82	4.37
3. Managing discussions and interpretation of science observations	4.19	3.46	4.13
4. Explaining science concepts	3.89	3.26	3.90
5. Teaching science processes	4.05	3.28	4.02
6. Developing literacy skills needed for learning science	4.05	3.57	4.27
7. Assessing children's learning in science	3.83	3.01	3.72
8. Using computers and ICTs in science	3.72	2.84	3.64
9. Using a constructivist model to plan science units of work	3.97	2.89	3.88
Mean total confidence score (/45)	36.56	30.02	36.38

NC = No confidence = 1, LC= Limited confidence =2, OK = 3 C = confident= 4, VC = Very confident = 5

The PLFs are clearly confident with science teaching strategies and have an equivalent total confidence scale score equivalent to the TTs at the end of term 2 in 2005 when they had completed a total of eight days of workshops and had taught two units. As with the TTs, the PLFs had least confidence with using computers in science, assessing learning in science and explaining science concepts.

The PLFs responded to the same self-efficacy for science teaching scale as the TTs responded to in 2005. Mean self-efficacy item scores are reported for PLFs and TTS in Table 11 and frequency of science teaching total self-efficacy scale scores are reported in Table 12.

Table 11: Mean self-efficacy ratings of professional learning facilitator workshop participants compared with trial teachers in 2005

Self-efficacy item	Mean score (/5)		
	PLF initial survey (n=75)	TTs initial survey (n=89)	TTs end term 2 (n=89)
1. I am continually finding better ways to teach science	4.36	3.76	4.37
2. Even when I try very hard, I don't teach science as well as I do most subjects	1.98	2.76	2.03
3. I know the steps necessary to teach science concepts effectively	3.99	3.37	4.09
4. I am not very effective in monitoring science experiments	2.25	2.78	1.99
5. I generally teach science ineffectively	1.83	2.40	1.76
6. I find it difficult to explain to students why science experiments work	2.07	2.62	2.08
7. I am typically able to answer students' science questions	3.93	3.51	3.94
8. Given a choice, I would not ask the Principal to evaluate my science teaching	2.17	2.93	2.54
9. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better	1.85	2.40	1.92
10. When teaching science, I usually welcome student questions	4.77	4.35	4.62

5= SA = strongly agree, 4=A = agree, 3=UN = undecided, 2=D = disagree, 1=SD = strongly disagree
** these items are negative, low agreement scores indicate high self-efficacy

The PLFs' science teaching self-efficacy scores are generally high and are of a similar order to those of the TTS at the end of term 2 in 2005 when they had completed eight days of workshops and had taught two units.

Table 12: Frequency of science teaching total self-efficacy scale scores for professional learning facilitators and for trial teachers in 2005

Score	PLF Initial survey (n= 75)	TTs initial survey (n=89)	TTs end term 2 survey (n=89)
1-10	0	0	0
11-20	1	2	0
21-30	4	20	1
31-40	28	50	49
41-50	42 (56%)	17 (19%)	39 (44%)
Mean self efficacy score for all facilitators	40.9	35	41
S.D.	6.26	6.8	4.5

Total self-efficacy scale score = sum of 10 self-efficacy scores for each person, (/50), with the most positive response given the value of 5 and the least positive the value of 1.

Beliefs about primary science and literacy teaching

The initial questionnaire elicited information from participants regarding their beliefs about primary science and literacy teaching. Beliefs about the purpose of teaching a subject and the characteristics of quality teaching of that subject influence practice. Participants were also asked about aspects of typical classroom practice that need to be improved. Where appropriate, comparisons have been made between the responses of the professional learning facilitators (PLFs) on their initial questionnaire (January 2006) and those of the trial teachers (TTs) on their initial questionnaire (January 2005).

Table 13: Response to the question "What do you believe is the main purpose of teaching science in the primary years of schooling?" (n=85)

Main purpose	Number of responses	Per cent of PLFs with this response (n=85)	Per cent of TTs with this response (n=100)
Cognitive	41	48.2	48
Affective	64	75.3	52
Scientific literacy	53	62.4	62
Total responses	158		

The 85 respondents gave a total of 158 responses to this question about the purpose of primary science teaching. Responses related to cognitive (understandings and process skills) and affective (attitudes, interest, curiosity) learning outcomes and to the development of scientific literacy. More of the PLFs (75%) mentioned affective learning outcomes than the TTs (52%).

When asked about important characteristics of quality primary science teaching the PLFs responses included inquiry-based pedagogy, teacher knowledge and skill, good curriculum, enthusiasm and integration with other learning areas which are consistent with the *Primary Connections* approach.

Table 14: Responses to the question "What do you believe are the most important characteristics of high quality primary science teaching?" (n=85)

Characteristic	Number of responses	Per cent of PLFs with this response (n=84)	Per cent of TTs with this response (n=100)
Inquiry based pedagogy	65	76.5	70
Teacher knowledge and skill	39	45.9	31
Good curriculum	34	40.0	36
Enthusiasm	13	15.3	8
Integrated with other learning areas	11	12.9	0
Good resources	5	5.9	19
Total responses	167		

More PLFs than TTs believed that teacher knowledge and skill, enthusiasm and integration were important characteristics of good teaching, however, more TTs than PLFs mentioned the need for good resources.

The PLFs believe that the most important aspects of typical primary science teaching that need to be improved are: teacher confidence and ability, inquiry-based pedagogy, teacher knowledge, the status of science and access to quality resources (Table 15).

Table 15: Responses to the question “What aspects of typical primary science teaching need to be improved?” (n=85)

Aspect to be improved	Number of responses	Per cent of respondents with this response
Confidence/ability to teach	42	49.4
Pedagogy inquiry based	28	32.9
Teacher knowledge & skill	24	28.2
Importance & ranking of science	20	23.5
Resources, access to IT	16	18.8
Linked with other learning areas	8	9.4
Assessment	3	3.5
Curriculum	2	2.4
Total responses	144	
No response	2	2.4

The PLFs were also asked about the most important characteristics of quality primary literacy teaching. The PLFs indicated that quality literacy teaching occurred in context and was embedded with other learning areas, there should be explicit teaching of literacies and quality literacy teaching caters for a range of learning styles (Table 15). These beliefs are consistent with the *Primary Connections* approach which explicitly teaches the literacies of science in the context of science.

Table 16: Responses to the question “What do you believe are the most important characteristics of high quality primary literacy teaching?” (n=85)

Characteristic of literacy teaching	Number of responses	Per cent of respondents with this response
In context, embedded in all KLAs	39	45.9
Explicit development of literacy skills	27	31.8
Caters for all learning styles	18	21.2
Teacher understanding of literacy development	16	18.8
Enthusiasm	14	16.5
Variety of genres covered	13	15.3
Age/ability appropriate	12	14.1
Assesses levels early,	11	12.9
Depth and quality encouraged	2	2.4
Total responses	152	
No response	7	8.2

Teachers were also asked about aspects of literacy teaching that need to be improved; these data are reported in Table 17.

Table 17: Responses to the question “What aspects of typical primary literacy teaching need to be improved?” (n=85)

Aspects of literacy teaching to improve	Number of responses	Per cent of respondents with this response
In context, embedded in all	29	34.1
Explicit development of literacy skills	19	22.4
Caters for all learning styles	15	17.6
Teacher understanding of literacy development and training for this	16	18.8
Relevant and current resources	8	9.4
Variety of genres covered	4	4.7
Assesses levels early,	7	8.2
More process skills, less busy work	6	7.1
Total responses	111	
No response	9	10.6

The PLFs mentioned the need to improve the contextualising of literacy teaching, explicit development of skills, catering for a range of learning styles, teachers understanding of literacy development and relevant resources to support literacy teaching. Most of these aspects are addressed effectively by *Primary Connections*.

Facilitation experience

Participants were asked about the amount and type of professional learning facilitation that they had completed in the past. These data are reported in Table 18.

Table 18: Experience in facilitating professional learning for teachers (n=85)

Area or Experience	Number of responses	Per cent of respondents with this response
Primary multiple learning areas	21	24.7
Primary science	16	18.8
Prim literacy	7	8.2
Prim general education	7	8.2
Primary numeracy	4	4.7
None	4	4.7
Prim & sec science	11	12.9
Prim & sec multiple learning areas	10	11.8
Prim & sec general education	4	4.7
Prim & sec literacy	1	1.2

Only 5% of participants had no experience of facilitating professional learning. Most of the facilitation experience was in multiple learning areas in a primary setting and in primary science. Sixteen of the 85 participants indicated they had experience of primary science professional learning facilitation.

The amount of facilitation experience varied with the background and professional roles of participants. Tables 19A and B indicate that far more of the non-school based participants had conducted greater than five days of PD compared with the school-based participants.

Table 19A: Experience in facilitating teacher professional learning: comparison between groups of facilitators (n=85)

Role in 2006	**Numbers with facilitation experience**			
	None	**1 to 5 days**	**> 5 days**	**Total**
PC trial teacher	0	7	4	11
Teachers new to PC	3	17	15	35
District/central office	1	2	24	27
Professional association	0	2	3	5
Science organization	0	0	4	4
Totals	4	28	50	82
No response to question				3

Table 19B: Experience in facilitating teacher professional development: teachers compared with others (n=85)

	Numbers with facilitation experience			
	None	**1 to 5 days**	**> 5 days**	**Total**
Teachers	3	24	19 (41%)	46
Others	1	4	31 (86%)	36
Totals	4	28	50	82
No response to question				3

Forty-one percent of classroom teachers had more than 5 days experience of facilitating professional learning, whereas 86% of other facilitators (advisers and consultants at education offices, professional associations and science centres) had more than 5 days experience.

Beliefs about professional learning

The initial questionnaire elicited the PLFs beliefs about professional learning as these beliefs are expected to influence their practice as PLFs. The end of workshop evaluation also asked the same question to determine if the workshop had influenced the participants understanding and beliefs about professional learning. These data are reported in Tables 20 and 21.

Table 20: Responses to the question "What do you believe are the most important characteristics of high quality teacher professional learning?" at the beginning of the workshop compared to the end of the workshop.

Characteristic	**Per cent of respondents**	
	Beginning of workshop (n=84)	End of workshop (n=83)
Relevant topic	48.8	56.6
Delivery stimulating, engaging	21.4	51.8
Recognition of participant experience	25	42.2
Collaboration, sharing included	28.6	34.9
Presenter credible & prepared	21.4	24.1
Opportunity to apply in workshop	26.2	21.7
Ongoing support provided	19	20.5
Sound pedagogy	7.1	14.5
Clear outcomes	4.8	12.0
Balanced programme	4.8	7.2
Funded, in school time	8.3	7.2
Good resources	3.6	0

The PLFs mentioned more characteristics of quality professional learning following the workshop than they mentioned before. At the end of the workshop the PLFs believed that relevance and meeting the needs of teachers, an engaging delivery, recognition of teachers' existing knowledge and beliefs, a collegial and collaborative approach, the presenter being credible and well prepared, opportunities to apply and practise new skills in the workshop and the provision of on-going support were the most important characteristics of quality professional learning.

When asked about aspects of typical professional learning that needed to be improved the PLFs focussed on the need for more active and hands-on workshops, the need for on-going support, more and high quality facilitators, tailoring of workshops to the needs of the teachers to enhance relevance, and attention being paid to the timing of workshops so they are included both within the school day as well as after school hours (Table 21).

Table 21: Responses to the question "What aspects of typical teacher professional learning need to be improved?" (n=85)

Aspect of professional learning to improve	**Number of responses**	**Per cent of respondents with this response**
More hands on, less lecturing	19	22.4
Ongoing support & follow up	16	18.8
More facilitators	10	11.8
Tailor to needs & knowledge of group	10	11.8
Timing (in school time, at school)	10	11.8
Relevant to classroom/era	9	10.6
Length & pace of workshops	8	9.4
Resourcing	8	9.4
Develops teacher pedagogy, not one offs	8	9.4
Quality of facilitators	9	10.6
Raise value of pd	4	4.7
Everything	1	1.2
Total responses	112	
No response	8	9.4

Factors influencing the uptake of PC and effectiveness as a PLF

The main factors expected to determine the uptake of *Primary Connections* are the priority given to science, resourcing, support from school administration and the time made available for professional learning workshops (Table 22).

Table 22: Responses to the question "What factors will influence the uptake of *Primary Connections* by schools in your jurisdiction and sector?" (n=85)

Factor	Number of responses	Per cent of respondents with this response
Ranking of science in school /region	31	36.5
Money, resources	31	36.5
Support from administration	22	25.9
Time available for pd	20	23.5
Curriculum issues/other programmes that take priority	20	23.5
Quality of promotions, awareness	14	16.5
Skill as a presenter	4	4.7
Total number of responses	143	
No response	5	5.9

When asked about factors effecting how effective they will be as PLFs, the most common response was the time needed to prepare and present the workshops. Time was a particular concern for the school-based participants (Table 23).

Table 23: Responses to the question "What factors will influence how effective you can be as a *Primary Connections* professional learning facilitator?" (n=85)

Stages	Number of responses	Per cent of respondents with this response
Amount of time I have (to prepare for and present pd)	48	56.5
Money, resources	27	31.8
Ranking of science in school /region	20	23.5
Support from administration	16	18.8
Quality of promotions, awareness	15	17.6
Skill as a presenter	7	8.2
Curriculum issues/other programmes that take priority	5	5.9
Total	138	
No responses	3	3.5

Goals for participating in the workshop

The participants were asked in the initial questionnaire about their goals for the workshop. The most common responses were to find out about *Primary Connections*, how to facilitate workshops, personal professional development and learning how to help other teachers (Table 24).

Table 24: Teachers response to the question “What are your personal goals for participating in this workshop?” (n=85)

Goal	Number of responses	Per cent of respondents with this response
Find out about PC	45	52.9
How to facilitate PC workshops	35	41.2
Personal professional development	30	35.3
Help teachers teach science better	29	34.1
Network	7	8.2
Total responses	**146**	
No response	1	1.2

Impact of the workshop

The impact of the workshop is reported here in terms of the achievement of the workshop outcomes, adequacy of preparation for the role of PLF, and changes to self-efficacy and confidence as a PLF.

Achievement of outcomes and adequacy of preparation

In the workshop evaluation survey, the participants indicated how successful the workshop had been in achieving its intended outcomes. These data are reported for all participants in Table 25A and for groups of participants in Table 25B.

Table 25A: Achievement of workshop aims (n=85)

Workshop aim	Number of respondents with this response				
	To a large extent		OK		To a limited extent
Understanding of the *Primary Connections* project, teaching and learning model and curriculum resources	50	29	3	2	1
Understanding of the *Primary Connections* professional learning model and resources, and how it can be adapted to a wide variety of settings and jurisdictional structures and cultures	23	47	11	3	1
Understanding of principles of effective professional learning	32	39	12	2	0
Skills and confidence of facilitation professional learning workshops based on *Primary Connections* resources	27	35	18	3	2
Network of colleagues with whom you could discuss issues that arise as a *Primary Connections* facilitator	47	35	3	0	0

No less than 73% of participants rated all the outcomes in the two highest response categories. Most positive responses were for networking and understanding the teaching and learning model and the curriculum resources. The least positive response was for the outcome related to skills and confidence of facilitation and this lower response was due to the low confidence of the school-based participants (Table 25B) who had less experience of facilitation (Table 19B).

Table 25B: Per cent of each employment group who felt aim had been achieved quite a lot or to a large extent. (n=85)

Workshop aim	Professional role in 2006					
	Class teachers who trialled PC n = 12	Class teachers new to PC n = 35	Education office consultants & advisers n = 28	Professional association n = 6	Science centres n = 4	Total n = 85
Understanding of the *Primary Connections* project, teaching and learning model and curriculum resources	92%	94%	89%	100%	100%	93%
Understanding of the *Primary Connections* professional learning model and resources, and how it can be adapted to a wide variety of settings and jurisdictional structures and cultures	83%	77%	86%	83%	100%	82%
Understanding of principles of effective professional learning	75%	74%	93%	100%	100%	84%
Skills and confidence of facilitation professional learning workshops based on *Primary Connections* resources	67%	57%	89%	83%	100%	73%
Network of colleagues with whom you could discuss issues that arise as a *Primary Connections* facilitator	100%	97%	96%	100%	75%	96%

The participants were also asked at the end of the workshop how well prepared they were for facilitating *Primary Connections* workshops. These data are reported for all participants in Table 26A and by group in Table 26B.

Table 26A: Responses to the question “How well prepared do you feel for facilitating *Primary Connections* professional learning workshops?” (n=83)

Teachers responses (per cent of participants)				
Very well prepared	Well prepared	OK	Poorly prepared	Very poorly prepared
25.9	40.0	25.9	5.9	0

Two-thirds of respondents indicated that they were very well or well prepared for their facilitation role, however, some were not as confident about their readiness for their role as facilitators. Analysis by group shows that it is the teachers in schools new to *Primary Connections* who feel they need further support for taking on this role (Table 26B).

Table 26B: Responses to the question "How well prepared do you feel for facilitating *Primary Connections* professional learning workshops?" by professional role in 2006 (n=83)

Group	n	Well or very well prepared	OK or poorly prepared
Trial teacher	12	9 (75%)	3
Class teacher new to PC	34	17 (50%)	17
District/central office adviser	27	21 (77%)	6
Professional association consultant	6	5 (83%)	1
Science organisation consultant	4	4 (100%)	0
Total		56 (67%)	27
		67%	33%

The participants were also asked what further support they would need in their role as facilitators. These data are reported in Table 27.

Table 27: Responses to the question "What further support will you need for your role as a *Primary Connections* professional learning facilitator?" (n=85)

Support needed	Number of responses	Per cent of respondents with this response
Acadamy/PC team support [1]	24	28.2
Regular updates of resources	20	23.5
Need to work with/observe PC trial teacher	16	18.8
District office support	15	17.6
Contact with other facilitators[1]	13	15.3
Money [2]	6	7.1
Need to teach PC myself first[3]	6	7.1
More time to prepare	6	7.1
School admin support	4	4.7
Have buddy, mentor	4	4.7
Provide a workshop set of PC books[4]	3	3.5
Official badges for facilitators [5]	2	2.4
None	9	10.6
Total responses	128	100

[1]Of greatest concern to new teachers (12/35)and education office staff (7/28)
[2]Of greatest concern to education office staff (4/28)
[3]Only teachers new to PC
[4]Professional association and science centre consultants only
[5]Only class teachers

The most common support needs related to support from the Academy of Science, regular updates on resources, the need to work with trial teachers, support from the district office and contact with other facilitators.

When asked how the workshop could be improved, the most common suggestions were to increase the amount of activity work and to do more modelling of activities. The organisation of the Making Connections folder and having more time to work with colleagues from within their jurisdiction were also mentioned (Table 28).

Table 28: Responses to the question "What improvements could be made to the three-day workshop for professional learning facilitators? (n=85)

Suggested improvements	Number of responses	Per cent of respondents with this response
More doing, less listening	24	28.2
Do/model some activities [2]	20	23.5
Match file order to presentation order	11	12.9
Meet state colleagues earlier/more time with them	11	12.9
Give background reading before w/s [1]	7	8.2
More input from PC trial teachers	7	8.2
Separate workshop on presentation skills	7	8.2
Make first two days less confusing [3]	7	8.2
Make auditing session less confusing [3]	7	8.2
Tailor sessions to meet needs of different groups [4]	6	7.1
More time preparing modules to present at workshops	3	3.5
None	14	16.5
Total responses	124	100

[1]Teachers new to PC and education office advisers only
[2]Mostly education office advisers (13/28 of these)
[3]Teachers new to PC only
[4]New teachers were the only group who did not seek this

Self-efficacy and confidence as a PLF

Participants responded to a self-efficacy as a facilitator scale and to a confidence with aspects of facilitation scale at the beginning and end of the workshop. Data regarding the impact of the workshop on facilitators' self-efficacy and confidence are reported in Tables 29-31.

Table 29: Mean self-efficacy ratings of workshop participants as professional learning facilitators (n=80)

Aspect of self-efficacy as professional facilitator	Mean score (/5)					
	Whole group (n=80)		School-based PLFs (n=44)		Others (n=36)	
	Initial	End w/sh	Initial	End w/sh	Initial	End w/sh
1 I am effective in eliciting teachers' prior knowledge and beliefs and adjusting the professional learning workshop to meet the needs of the teachers	3.93	4.10	3.66	3.98	4.25	4.25
2 My science content knowledge enables me to answer teachers' science questions effectively	3.47	3.93	3.36	3.89	3.61	3.97
3 My knowledge of effective science teaching practices enables me to answer teachers' science pedagogy questions effectively	3.79	4.14	3.70	4.02	3.89	4.28
4 I am quite comfortable with having my professional learning workshops evaluated	4.11	4.24	3.84	4.05	4.44	4.47
5 I am able to pose engaging tasks for teachers to work on in small groups in my workshops	4.05	4.26	3.86	4.18	4.28	4.36

6 My deep understanding of the culture of primary schooling enables me to give valuable advice to teachers on matters of primary science pedagogy	3.81	4.05	3.75	4.05	3.89	4.06
7 My deep understanding of the culture of early childhood education enables me to give valuable advice to ECE teachers about science pedagogy	3.28	3.50	3.30	3.52	3.25	3.47
8 My deep understanding of literacy teaching practice enables me to give valuable advice on integrating literacy education into science education	3.78	4.09	3.84	4.16	3.69	4.00
Mean total self efficacy score (/40)	30.21	32.3	29.32	31.84	31.31	32.86
SD for total scores	4.35	3.98	4.21	4.03	4.33	3.9

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

The total self-efficacy scale score for all PLFs increased from a mean of 30.21 at the start of the workshop to 32.3 at the end of the workshop. School-based PLFs initially rated themselves as less efficacious than other facilitators but by the end of the workshop, their self-efficacy ratings had improved significantly. Other facilitators' self-efficacy also improved by the end of the workshop. School-based PLFs rated themselves as more efficacious than other facilitators on items to do with early childhood culture, early childhood and literacy integration (items 7and 8). The lowest rating item for all facilitators was number 7, about understanding of early childhood culture.

The frequency of total self-efficacy scale scores are reported in Table 30 in levels of self-efficacy, i.e., 1-10 very low; 11-20 low, 21-30 high and 31-40 very high self-efficacy.

Table 30: Frequency of total self-efficacy scale scores as professional learning facilitators for surveys at beginning and end of January 2006 workshop

Facilitation total self-efficacy scale score	**Whole group (n=80)**		**School-based PLFs (n=44)**		**Others (n=36)**	
	Initial	**End**	**Initial**	**End**	**Initial**	**End**
1-10	0	0	0	0	0	0
11-20	2	0	2	0	0	0
21-30	43	27	27	15	16	12
31-40	35	53	15 (34%)*	29 (66%)*	20 (56%)*	24 (67%)*
Mean self efficacy score for all facilitators	30.21	32.3	29.32	31.84	31.31	32.86
S.D.	4.35	3.98	4.21	4.03	4.33	3.9

Total PLF self-efficacy scale score = sum of eight self-efficacy scores for each person, (/40) with the most positive response given the value of 5 and the least positive the value of 1
* percentage of sub-group

There were two PLFs (both school-based) with low self-efficacy at the start of the workshop and none by the end of the workshop. The number of PLFs with very high self-efficacy

increased from 35 to 53 by the end of the workshop. It is anticipated that only those with very high self-efficacy as PLFs are likely to actively seek out opportunities to be a facilitator. About two-thirds of both school-based and other PLFs had developed very high self-efficacy by the end of the workshop.

The participants also responded to a confidence with facilitating scale. These data are reported in Table 31.

Table 31: A comparison between school-based PLFs and other professionals in the survey of mean ratings of confidence with facilitating professional learning workshops on the following aspects of primary science and literacy teaching at the beginning and end of workshop (n=80)

Aspect of facilitating	**Mean score (/5)**					
	Whole group (n=80)		**School-based PLFs (n=44)**		**Others (n=36)**	
	Initial	**End workshop**	**Initial**	**End workshop**	**Initial**	**End workshop**
An introduction to *Primary Connections*	3.37	4.20	3.34	4.07	3.42	4.36
Coordinating the science programme in a primary school	3.86	4.13	3.91	4.07	3.81	4.22
Assessment of learning in primary science	3.75	3.95	3.70	3.84	3.81	4.08
Conducting investigations in primary science	4.05	4.26	4.02	4.16	4.08	4.39
Cooperative learning strategies	4.15	4.23	4.00	4.05	4.33	4.44
Developing literacies needed for learning science	3.69	4.15	3.73	4.11	3.64	4.19
Using an inquiry model to plan primary science units of work	3.90	4.30	3.77	4.16	4.06	4.47
Mean total confidence score (/35)	26.78	29.18	26.48	28.45	27.14	30.17
SD for total scores	5.04	4.06	4.74	4.00	5.44	3.90

NC = No confidence = 1 LC= Limited confidence =2, OK = 3 C = confident= 4, VC = Very confident = 5

School-based PLFs were less confident at the beginning of the workshop compared to other facilitators and their overall confidence as measured by the mean total confidence scale score increased by only 1.97 compared to an increase of 3.03 for other facilitators. The greatest increase in confidence over the course of the workshop was for items 1 (introducing PC) and 6 (developing science literacies). PLFs had lowest confidence with assessing learning in primary science at the end of the workshop. Follow-up workshops will need to provide further support in this area.

Initial evaluation of professional learning resources

The participants' initial evaluation of the professional learning resources was positive with 94% of PLFs rating the resources as excellent or good (Table 32).

Table 32: Responses to the question “What is your initial evaluation of the draft *Primary Connections* professional learning resources?” (n=82)

Teachers responses (per cent of PLFs)				
Excellent	Good	Satisfactory	Poor	Totally inadequate
45.9	48.2	2.4	0	0

When asked what changes they would like made to the resources, the most frequent response (57%) was none. The more frequent of the requests for change included making the folder more user friendly so it is easier to navigate through and locate resources, providing an overview for the package, making links to outcomes for each state and providing a short promotional resource for school principals.

Table 33: Teachers response to the question “What changes would you like made to the professional learning resources?” (n=85)

Changes to professional learning resources	Number of responses	Per cent of responses
None	48	57.1
More user friendly folder	12	14.3
Overview for whole package	8	9.5
Give outcomes for each state	6	7.1
Short promo package for principals	4	4.8
More ICT	3	3.6
More on literacy	3	3.6
More on cooperative learning	3	3.6
Include hands on session	2	2.4
Models for application in different sectors	2	2.4
More on assessment	2	2.4
Total responses	**93**	**100**

Key Findings

Analysis of data presented in this report has highlighted a number of key findings. These are listed in the following table.

Number	Key finding	Supporting data
1	Participants were representative of all jurisdictions, sectors and rural, regional and metropolitan locations.	Tables 1-3
2	A majority (50/85) of participants were school-based including teachers new to PC, PC trial teachers, science co-ordinators, deputy principals and principals. The other participants included general education, science and literacy advisors.	Table 4
3	The large majority (84%) had a primary background	Table 4
4	Most participants were highly experienced and many had previously taught Primary Investigations.	Tables 5-6

5	Most participants had a four-year initial teacher education, one-quarter has a higher degree and half had completed no more than Year 12 studies in science. About one-fifth were completing further studies.	Tables 7-9
6	At the commencement of the workshop the participants had relatively high levels of science teaching confidence and self-efficacy, similar to those of trial teachers who had completed eight days of professional learning workshops and had taught two units in 2005.	Tables 10-12
7	Participants identified affective outcomes, cognitive outcomes and development of scientific literacy as purposes for teaching primary science	Table 13
8	Participants' beliefs about the characteristics of quality science teaching were consistent with those of the project (inquiry-based pedagogy, high levels of teacher knowledge, skill and enthusiasm, good curriculum and integration with other learning areas).	Table 14
9	Participants identified teacher confidence, knowledge and skill, inquiry pedagogy, the status of science and resources as the most important aspects of primary science teaching that need to be improved.	Table 15
10	Participants identified teaching literacies in the context of other learning areas, the explicit development of literacies, catering for a range of learning styles and teachers who understand literacy development as important characteristics of quality literacy teaching, and all of these needed to be improved in typical literacy teaching.	Table 16-17
11	Only 5% of participants had no experience of professional learning facilitation and one-fifth had experience of primary science facilitation. School-based PLFs had less facilitation experience than other PLFs.	Table 18-19
12	The PLFs mentioned more characteristics of quality professional learning following the workshop than they mentioned before. At the end of the workshop the PLFs believed that relevance and meeting the needs of teachers, an engaging delivery, recognition of teachers' existing knowledge and beliefs, a collegial and collaborative approach, the presenter being credible and well prepared, opportunities to apply and practise new skills in the workshop and the provision of on-going support were the most important characteristics of quality professional learning.	Table 20
13	When asked about aspects of typical professional learning that needed to be improved the PLFs focussed on the need for more active and hands-on workshops, the need for on-going support, more and high quality facilitators, tailoring of workshops to the needs of the teachers to enhance relevance, and attention being paid to the timing of workshops so they are included both within the school day as well as after school hours	Table 21
14	The main factors expected to determine the uptake of *Primary Connections* are the priority given to science, resourcing, support from school administration and the time made available for professional learning workshops	Table 22

15	When asked about factors effecting how effective they will be as PLFs, the most common response was the time needed to prepare and present the workshops. Time was a particular concern for the school-based participants	Table 23
16	The most common goals of participants for the workshop were to find out about *Primary Connections*, how to facilitate workshops, personal professional development and learning how to help other teachers	Table 24
17	When asked about the extent to which the workshop outcomes had been achieved, no less than 73% of participants rated all the outcomes in the two highest response categories. Most positive responses were for networking and understanding the teaching and learning model and the curriculum resources. The least positive response was for the outcome related to skills and confidence of facilitation and this lower response was due to the low confidence of the school-based participants who had less experience of facilitation.	Tables 19 and 25
18	Two-thirds of respondents indicated that they were very well or well prepared for their facilitation role, however, some were not as confident about their readiness for their role as facilitators. Analysis by group shows that it is the teachers in schools new to *Primary Connections* who feel they need further support for taking on this role.	Table 26
19	The most common support needs related to support from the Academy of Science, regular updates on resources, the need to work with trial teachers, support from the district office and contact with other facilitators.	Table 27
20	When asked how the workshop could be improved, the most common suggestions were to increase the amount of activity work and to do more modelling of activities. The organisation of the Making Connections folder and having more time to work with colleagues from within their jurisdiction were also mentioned	Table 28
21	Self-efficacy beliefs about effectiveness as a professional learning facilitator increased as a result of the workshop. School-based PLFs had lower self-efficacies than other PLFs. At the end of the workshop no participants had low self-efficacy and two-thirds had very high self-efficacy.	Tables 29-30
22	School-based PLFs were less confident at the beginning of the workshop compared to other facilitators and their overall confidence as measured by the mean total confidence scale score increased by only 1.97 compared to an increase of 3.03 for other facilitators. The greatest increase in confidence over the course of the workshop was for facilitating workshops on an introduction to *Primary Connections* and developing science literacies. At the end of the workshop PLFs had lowest confidence with facilitating workshops on assessing learning in primary science. Follow-up workshops will need to provide further support in this area.	Table 31
23	The participants' initial evaluation of the professional learning resources was positive with 94% of PLFs rating the resources as excellent or good.	Table 32

24	When asked what changes they would like made to the resources, the most frequent response (57%) was none. The more frequent of requests for change included making the folder more user friendly so it is easier to navigate through and locate resources, providing an overview for the package, making links to outcomes for each state and providing a short promotional resource for school principals	Table 33

Discussion and Conclusions

The workshop attracted a most appropriate sample of participants as they were representative of all jurisdictions, sectors and geographic locations and were experienced and well qualified except for science discipline studies. Most participants had a primary teaching background. They were as a group both confident about teaching science and had relatively high self-efficacy beliefs about the effectiveness of their science teaching.

The participants' beliefs about the purpose of primary science teaching and the characteristics of effective science teaching were consistent with the research literature (e.g. Goodrum, Hackling & Rennie, 2001) and with the focus of the *Primary Connections* project.

Most participants had some experience of facilitating professional learning, however, school-based PLFs had less experience of facilitation. The PLFs had an improved understanding of the characteristics of effective professional learning after the workshop and their beliefs about effective professional learning were consistent with the research literature (e.g. Senate Inquiry, 1998) and the approach of *Primary Connections*.

The priority given to science within jurisdictions, resourcing, support provided by school leaders and time made available by schools for professional learning were identified as key factors that will influence the uptake of *Primary Connections*. Time available in busy workloads for preparing and delivering workshops was the key factor identified by PLFs that is likely to limit their effectiveness. There is therefore a need for continued advocacy to make science a high priority within jurisdictions and to make space within PLFs' workload for *Primary Connections* professional learning facilitation.

The participants had realistic goals for the January workshop and there was a high level of satisfaction with achieving the intended learning outcomes. It should be noted that some PLFs with less experience and lower confidence and self-efficacy for facilitation need further support from the Academy of Science, district offices and from other PLFs. Follow-up workshops and the support of a jurisdiction co-ordinator will be essential for this group.

The January workshop increased the confidence and self-efficacy of participants for facilitation. At the end of the workshop two-thirds had very high self-efficacy. Both confidence and self-efficacy were lower for school-based PLFs than for other PLFs. Confidence was lowest for facilitating workshops on assessment. Follow-up workshops will need to provide further support with assessment.

The workshop was evaluated very positively by the PLFs, however, there were suggestions for improvement. These included an increase in activities and modelling of strategies, improvement of the organisation of the Making Connections folder, links to jurisdictional outcomes and the inclusion of promotional material suitable for principals.

The professional learning resources were evaluated very positively by the PLFs and the majority indicated that there was no obvious needs for improvement, however, there is a need for further detailed evaluation of these resources as PLFs gain experience in using them.

Recommendations

The following recommendations follow from the analysis of the data and the discussion of findings:

1. There is a need for the Academy of Science to be actively involved in continued and high level advocacy for making science a priority in the primary school curriculum and for adequate jurisdictional resourcing of professional learning facilitators so that they have time to prepare for and present professional learning workshops.
2. Although a large proportion of PLFs have developed high levels of confidence and self-efficacy for professional learning facilitation, there are a significant number who need further training and support to raise their confidence to the point that they will actively seek out opportunities for professional learning facilitation. All PLFs will need on-going support, co-ordination and training in relation to facilitation strategies and assessment in science.
3. Findings from the evaluation of the January 2006 workshop need to be translated into an improved programme and folder design for a further workshop in January 2007 that will be needed to train additional PLFs given that many of the 2006 trained PLFs are based in schools and will have limited opportunities to work with other schools than their own.
4. The professional learning modules need to be subject to a systematic evaluation as PLFs gradually gain experience with facilitating workshops based on these resources. Evaluation data needs to be used to direct the revision of these resources for inclusion in the Making Connections resource folder to be used in the January 2007 workshop.

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Appendices

Appendix 1: Programme for the professional learning workshop

Professional Learning Facilitators Workshop, 18 – 20 January 2006, The Shine Dome Canberra

Wednesday January 18, 2006 The Shine Dome

Registration and coffee available from 9 am

10.00 Initial data collection in the theatre (Professor Mark Hackling)
10.40am Participants hand in questionnaires and collect satchels

10.45 Welcome by Dr Jim Peacock (AAS) & Giancarlo Savaris (DEST)
Introduction of Professor John McKenzie and Professor Julie Campbell (AAS)

11.00 – 12.35 Session 1 Science, Science Teaching and *Primary Connections* (Mark Hackling)

- Introduction of the Professional Learning team
- Intended outcomes and overview of the three-day programme: ***Making Connections***
- **Engage** and elicit beliefs about the importance of science
- ***Questioning Minds*** Part 1 , The Importance of Science
- Quality teaching and learning, Principles of Teaching and Learning. The nature of scientific literacy
- Background to *Primary Connections*
- ***Questioning Minds*** Part 2, The Essence of *Primary Connections*
- Scope and sequence chart.
- The evaluation of Stage 2 and research findings

12.35 – 12.45 Introduction of the *Primary Connections* team (Shelley Peers, Managing Director, *Primary Connections*)

Lunch 12.45– 1:30

1.30 – 3.20 Session 2 The 5 Es and Cooperative Learning
Session overview Mark Hackling

Breakout into cross-jurisdictional groups led by Mark Hackling, Vaughan Prain, Russell Tytler, Denis Goodrum with 2005 trial teachers facilitating small groups
Explore Analyse the Plants in Action unit and associated work samples. Prepare poster of focus of the 5E phases. Return to theatre.

Mark Hackling leads as groups share posters, present the PC 5Es T&L model and the inquiry learning hexagon model.
Role of cooperative learning (Denis Goodrum)

- Questioning Minds, part 5: ***Cooperative Learning***

Role badges, role poster, skills poster

3.20-3.30pm Overview of PC curriculum resources – tour of the PC Web Page (Claudette Bateup)

Afternoon tea 3.30 – 3.50

3.50 – 4.30 Journaling and reflection in jurisdictional groups

6.00 – 7.30pm BBQ The Shine Dome

Thursday Jan 19, 2006 The Shine Dome
8.30 - 9.00 History of the Shine Dome (optional presentation in the lecture theatre)
9.00 – 10.20 Session 3 Focussing on Literacy (Vaughan Prain) **Explain** relationships between science and literacy teaching, literacies of science, forms of representation, literacy products map. Analyse work samples from Plants In Action unit. • Questioning Minds, part 6: ***Literacies of Science*** 10.20-10.30am Learning Objects as resources for *Primary Connections* (Nola Shoring)
Morning tea 10.30 – 11.00 *Recommended resources display (Foyer)*
11.00 – 12.45 Session 4 Focussing on Science Investigations and Assessment (Mark Hackling) Unit outcomes and the National Scientific Literacy Progress Map Investigations, investigation planners, How To's on questions, fair testing • Questioning Minds, part 4, ***Investigating***. Assessment ,embedded authentic tasks, diagnostic, formative and summative assessment, • Questioning Minds, part 7, ***Assessment*** Concept Cartoons and SEAR, assessment resources, assess plants work samples using rubrics How investigations and assessment support learning – **Elaborate** conceptualisation of the PC Teaching &Learning model • Questioning Minds, part 3: ***The Five E's***
Lunch 12.45 – 1:30
1.30 – 3.30 Session 5 Focussing on Professional Learning (Russell Tytler) Links between PC Teaching &Learning model and Principles of Learning and Teaching and the Auditing PL module **Engage** and elicit beliefs about effective professional learning, developing principles of effective professional learning and strategies of working with peers (Denis Goodrum)
Afternoon tea 3.30 – 3.50
3.50 – 4.00 The role of facilitators and the spread of *Primary Connections* into States and territories (Shelley Peers)
4.00 – 4.30 Journaling and reflection in jurisdictional groups
6.00 Assemble at the Shine Dome to catch buses to the Lobby restaurant 6.15 Buses depart **6.30** Dinner, The Lobby 10.00 Buses return delegates to their accommodation

Friday Jan 20, 2006 The Shine Dome

9.00 – 9.10 Making Connections: Working together as a team of *Primary Connections* facilitators. **(Nola Shoring)**

9.10 – 10.30 Session 6 *Primary Connections* Professional Learning Resources

Session introduction and overview Mark Hackling

Breakout into cross-jurisdictional groups facilitated by Mark Hackling, Vaughan Prain, Russell Tytler and Denis Goodrum

Exploring the professional learning resources and **explaining** to peers how to implement *The Introduction to PC* one-day PL workshop.

Groups return to Theatre and report back on emerging issues

Morning tea 10.30 – 11.00

11.00 – 12.45 Session 7 Action Planning

Planning for implementation in jurisdictional groups, tailoring the model and resources to local contexts and cultures (**Elaborate**)

Planning for School Coordinators workshop, Auditing workshop and other 90-minute workshops

Exploring how to use technologies to show the video clips

Groups facilitated by Mark Hackling (WA & SA), Vaughan Prain (VIC and TAS), Denis Goodrum (ACT and NSW) and Russell Tytler(QLD & NT)

Groups return to Theatre and report back on emerging issues

Photos (from 1.00)

Lunch (from 12.45 – 1.30)

1.30 – 1.45 Individual journaling and reflections in the Theatre

1.45 – 2.05 Workshop evaluation

2.05 – 2.15 Closing remarks (Shelley)

2.15 – 3.00 Drinks/afternoon tea

3.30pm Start loading luggage onto buses for trip to airport

3.50 pm Buses depart for airport

Appendix 2: Initial questionnaire

Australian Academy of Science: *Primary Connections* Programme

Professional Learning Facilitators Initial Questionnaire

Dear Colleague

We seek your views about professional learning for teachers of primary science and literacy. 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 and workplace details 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

For office use only

Your background

Your name: _____ Sex: Male / Female

State/Territory: _____ Sector: Government / Catholic / Independent / Other

Name of workplace for 2006: _____

Location of workplace: Metropolitan / Regional / Rural

Your professional role for 2006: _____

How long have you been in this role? _____ years

Your professional experience – please complete the table below

Professional role	Workplace (e.g., Primary School, Secondary School, Education System Office)	Number of years

Please outline your teaching experience in science and literacy

_____

_____

_____

Were you a *Primary Connections* trial teacher in 2005? Yes / No

Have you previously taught science using *Primary Investigations*? Yes / No

Qualifications
List all of your completed post-secondary qualifications e.g. Bed / BA, Dip Ed / MEd
_____

Highest level of science content/discipline studies (not science education). Tick box.

Year 10	Year 12	1 –3 undergrad sci units	Undergrad sci major	Postgrad sci e.g. MSc

List any current studies e.g. Graduate Certificate (Computer Education)

_____

Summarise your experience in facilitating professional learning for other teachers

Topic of professional learning workshops you have facilitated	Learning area and level (e.g. primary maths, secondary science)	Total number of hours of workshops

About primary science and literacy teaching

What do you believe is the main purpose of teaching science in the primary years of schooling?

What do you believe are the most important characteristics of high quality primary science teaching?

What aspects of typical primary science teaching need to be improved?

What do you believe are the most important characteristics of high quality primary literacy teaching?

What aspects of typical primary literacy teaching need to be improved?

Self-efficacy and confidence as a teacher of science

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 continually finding better ways to teach science					
2	Even when I try very hard, I don't teach science as well as I do most subjects					
3	I know the steps necessary to teach science concepts effectively					
4	I am not very effective in monitoring science experiments					
5	I generally teach science ineffectively					
6	I find it difficult to explain to students why science experiments work					
7	I am typically able to answer students' science questions					
8	Given a choice, I would not ask the Principal to evaluate my science teaching					
9	When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better					
10	When teaching science, I usually welcome student questions					

Please rate your confidence with the following aspects of science teaching

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

Item	Aspect	VC	C	OK	LC	NC
1	Engaging students' interest in science					
2	Managing hands-on group activities in science					
3	Managing discussions and interpretation of science observations					
4	Explaining science concepts					
5	Teaching science processes					
6	Developing literacy skills needed for learning science					
7	Assessing children's learning in science					
8	Using computers and ICTs in science					
9	Using an inquiry model to plan science units of work					

About professional learning

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

What aspects of typical teacher professional learning need to be improved?

Your self-efficacy and confidence as a professional learning facilitator

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					

Please rate your confidence with facilitating professional learning workshops 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	An introduction to *Primary Connections*					
2	Coordinating the science programme in a primary school					
3	Assessment of learning in primary science					
4	Conducting investigations in primary science					
5	Cooperative learning strategies					
6	Developing literacies needed for learning science					
7	Using an inquiry model to plan primary science units of work					

Primary science in your jurisdiction and sector

What factors will influence the uptake of *Primary Connections* by schools in your jurisdiction and sector?

What factors will influence how effective you can be as a *Primary Connections* professional learning facilitator?

Your goals for participating in this three-day workshop for professional learning facilitators

What are your personal goals for participating in this workshop?

Thank you for responding to this questionnaire

Appendix 3: Workshop evaluation survey

Australian Academy of Science: *Primary Connections* Programme

Professional Learning Facilitators Workshop
Workshop Evaluation Survey

Dear Colleague

We seek your views about the professional learning facilitators 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

For office use only

Your background

Your name: _____

State/Territory: _____

About professional learning

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

Your self-efficacy and confidence as a professional learning facilitator

Now that you have completed this three-day workshop, 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					

Now that you have completed this three-day workshop, please rate your confidence with facilitating professional learning workshops 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	An introduction to *Primary Connections*					
2	Coordinating the science programme in a primary school					
3	Assessment of learning in primary science					
4	Conducting investigations in primary science					
5	Cooperative learning strategies					
6	Developing literacies needed for learning science					
7	Using an inquiry model to plan primary science units of work					

Feedback on the three-day professional learning facilitators workshop

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

	Aim To develop an enhanced……..	To a limited extent		OK		To a large extent
		1	2	3	4	5
1	understanding of the *Primary Connections* project, teaching and learning model and curriculum resources					
2	understanding of the *Primary Connections* professional learning model and resources, and how it can be adapted to a wide variety of settings and jurisdictional structures and cultures					
3	understanding of principles of effective professional learning					
4	skills and confidence of facilitation professional learning workshops based on *Primary Connections* resources					
5	network of colleagues with whom you could discuss issues that arise as a *Primary Connections* facilitator					

How well prepared do you feel for facilitating *Primary Connections* professional learning workshops?
Tick one box.

Very poorly prepared	Poorly prepared	OK	Well prepared	Very well prepared

What improvements could be made to the three-day workshop for professional learning facilitators?

_____

_____

_____

_____

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

_____

_____

_____

Feedback on the *Primary Connections* professional learning resources

What is your initial evaluation of the draft *Primary Connections* professional learning resources?

_____

_____

_____

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

Totally inadequate	Poor	Satisfactory	Good	Excellent

What changes would you like made to the professional learning resources?

_____

_____

_____

Any other comments

_____

_____

_____

_____

Thank you for responding to this questionnaire