PrimaryConnections®
Linking science with literacy

Stage 3
Interim research and evaluation report 1

Case study teachers' experience of *Primary Connections*

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). This supplementary report focuses on the experiences of the cases study teachers who implemented *Primary Connections* in four case study schools in 2005.

Method and participants

Four schools opted for a whole of school implementation of *Primary Connections* in 2005. Two of these schools were small rural Government schools in Victoria and two were large metropolitan Government schools in Western Australia. These four schools were the subject of case studies that described student achievement gains, the range of forms of representations produced by the children, school organisation and changes in teachers' practice. These case studies were reported in Hackling and Prain (2005).

Two trial teachers who received eight days of professional learning worked at each of these case study schools. The trial teachers provided science learning area coordination and peer support to their colleagues, referred to here as case study teachers, who received only one day of professional learning to support them teach *Primary Connections* units.

A one-day professional learning workshop was conducted at each of the case study schools during a pupil-free day at the beginning of Term 1 of 2005. The workshops were facilitated by one of the directors of the *Primary Connections* project supported by a science policy officer employed by the state education department within that jurisdiction. An outline of the professional learning workshop is attached at Appendix 1. The intended outcomes for the workshop were:

- An enhanced understanding of the purpose for teaching primary science
- An enhanced understanding of the characteristics of effective teaching and learning of science and literacy
- Understand the philosophy and approach of *Primary Connections*
- Understand how the curriculum units support effective teaching and learning (5Es learning model, literacy practices, assessment)
- Familiarity with the unit they teach

The case study teachers at these four schools were surveyed during Term 4 of 2005. Respondents included four teachers from the small rural schools and 32 teachers from the large metropolitan schools. It should be noted that the data reported for case study teachers excludes the trial teachers teaching within the case study schools. The years of teaching experience of the respondents is summarised in Table 1.

Table 1: Years of teaching experience of case study teachers (n=35)

Teaching experience (years)	Number of teachers
1 - 5	6
6 -10	7
11 - 15	3
16 - 20	12
21 – 25	3
26 – 30	3
31 – 35	0
36 – 40	1

Note. One teacher did not indicate years of experience

Of the sample of 35 teachers who responded to this item, only six were relatively inexperienced having taught for between one and five years. Almost two thirds (63%) of the teachers had taught for more than 10 years and a little more than half (54%) had taught for more than 15 years.

The science topics taught by the case study teachers are summarised in Table 2. All of the teachers taught a *Primary Connections* unit in Terms 1 and 3. In addition to this, some (7/36) Stage 1 and 2 teachers taught a teacher-developed unit in Term 2 that had been prepared for them by trial teacher colleagues.

Table 2: Topics taught by teachers (n=36)

Stage	Term	Topic taught	Number of teachers
Early stage 1	1	Weather in our world	7
	3	On the move	7
Stage 1	1	Push-pull power	12
	3	Material matters	7
	2	Frogs (non-PC unit)	3
		Other (non-PC unit)	2
Stage 2	1	Plants in action	9
	3	Spinning in space	7
	2	Kitchen chemistry (non-PC unit)	1
		Other (non-PC unit)	1
Stage 3	1	Build it better	8
	3	Marvellous micro-organisms	8

Impact of the programme

The survey data provided information about the impact of the programme in terms of teachers' self-efficacy, confidence and the time allocated to teaching science. In addition teachers reported on benefits of participation in the programme and students' responses to the programme.

Teachers' self-efficacy and confidence

In the Stage 2 trial study, trial teachers' self-efficacy beliefs were assessed using a scale developed using items selected from Riggs and Knochs (1990) *Science Teaching Efficacy Belief Instrument.* Case study teachers also responded to this scale on the survey conducted in Term 4 of 2005. Table 3 summarises teachers' mean responses to the items comprising the self-efficacy scale. Mean responses for the trial teachers at the end of Term 2 when they had taught two units, and mean responses for case study teachers at the end of Term 3 when most had taught two units, are compared.

Table 3: Mean self-efficacy ratings for trial teachers and teachers in case study schools.

Aspect of self-efficacy	**Mean score (/5)***	
	End Term 2, trial teachers (n= 89)	End Term 3, case study teachers (n=36)
1. I am continually finding better ways to teach science	4.37	3.97
2. Even when I try very hard, I don't teach science as well as I do most subjects **	2.03	2.25
3. I know the steps necessary to teach science concepts effectively	4.09	3.56
4. I am not very effective in monitoring science experiments **	1.99	2.81
5. I generally teach science ineffectively **	1.76	2.19
6. I find it difficult to explain to students why science experiments work **	2.08	2.33
7. I am typically able to answer students' science questions	3.94	3.78
8. Given a choice, I would not ask the Principal to evaluate my science teaching **	2.54	3.17
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 **	1.92	1.92
10. When teaching science, I usually welcome student questions	4.62	4.28

Note.
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 teachers responded on a five point agreement ranging from strongly agree to strongly disagree which were scored from 1 to 5. Teachers mean agreement score was calculated for each item. The mean score for case study teachers was positive (>3 for positive items and <3 for negative items) on nine of the 10 items; the teachers responded negatively to

item 8 “Given a choice, I would not ask the Principal to evaluate my science teaching “. On nine of the 10 items, the mean score for case study teachers was less positive than the mean self-efficacy scores for the trial teachers.

Some items were stated positively while others were stated negatively. By reversing the scoring for negatively stated items and summing individual item responses, total self-efficacy scores (/50) were calculated. The frequency distribution of total self-efficacy scores, and mean total self-efficacy scores of trial teachers and case study teachers are compared in Table 4.

Table 4: Frequency of total self-efficacy scores for trial teachers at end of Term 2, 2005 and case study teachers at end of Term 3, 2005.

Total self-efficacy score**	**End Term 2, 2005 (n=89)**	**End Term 3, 2005 (n=36)**
1-10	0	0
11-20	0	0
21-30	1 (1%)	3 (8%)
31-40	49 (55%)	25 (69%)
41-50	39 (44%)	8 (22%)
Mean total self-efficacy score for all teachers	41	36.9
S.D.	4.5	5.0

Note.
**Total self-efficacy score = sum of ten self-efficacy item scores for each teacher, (/50), with the most positive response given the value of 5 and the least positive the value of 1 on a five-point agreement scale, ie, scores have been reversed for negative items.

The number of case study teachers with relatively low self-efficacy scores (<30) was 8%, with medium to high self-efficacy scores (>30 and <40) was 69%, and with very high self-efficacy scores (>40) was 22% which compares quite favourably with the trial teachers.

Teachers were also asked to respond to a nine item confidence scale comprising items about a number of important science and literacy teaching strategies. Teachers responded to each item on a five point confidence scale ranging from no confidence to very confident so that responses were scored from 1 to 5. Teachers mean responses to the item are summarised in Table 5.

The case study teachers’ mean responses were positive (>3) for all items. The trial teachers’ responses were more positive than those of the case study teachers for eight of the nine responses, and the mean total confidence score (/45) for trial teachers (36.38) was higher than the mean total confidence score for the case study teachers (33.04).

Table 5: Mean teacher ratings of their confidence with science teaching strategies for trial teachers at end of Term 2, 2005 and case study teachers at end of Term 3, 2005

Aspect of teaching	**Mean rating of confidence(/5)**	
	Trial group, end Term 2	Case study group, end Term 3
1 Engaging students' interest in science	4.45	3.97
2 Managing hands-on group activities in science	4.37	4.00
3 Developing literacy skills needed for learning science	4.27	3.46
4 Managing discussions and interpretation of science observations	4.13	3.57
5 Teaching science processes	4.02	4.09
6 Explaining science concepts	3.90	3.57
7 Using a constructivist model to plan science units of work	3.88	3.61
8 Assessing children's learning in science	3.72	3.46
9 Using computers and ICTs in science	3.64	3.31
Mean total confidence score (/45)	**36.38**	**33.04**

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

Teaching strategies with which the case study teachers were least confident were *Using computers and ICT in science*, *Assessing children's learning in science* and *Developing literacy skills needed for learning science*.

The self-efficacy and confidence data were collected after the case study teachers had participated in a one-day professional learning workshop and had taught two supplied *Primary Connections* units. The data indicate that at that time only 8% of the teachers had relatively low self-efficacy and 82% had medium to very high self-efficacy. The case study teachers' confidence with all nine key science and literacy teaching strategies was positive. To provide some form of benchmarking of the case study teachers' ratings of self-efficacy and confidence, trial teachers' data are provided for comparison. Although the trial and case study teachers' data were collected after both groups had taught two units, the trial teachers had participated in eight days of professional learning compared with the one day for the case study teachers. Taken as groups, the trial teachers had higher self-efficacy and more confidence with science and literacy teaching strategies than the case study teachers.

Self-efficacy and confidence data are not available for the case study teachers when they commenced the programme; it is therefore not possible to compare the extent of growth in

self-efficacy and confidence for the two groups. It should be noted that as the trial teachers were all volunteers and the case study teachers consented to participate rather than volunteering to participate, it is likely that the trial teachers may have had higher initial self-efficacy and confidence than the trial teachers. As there can be no claims of equivalence of groups no statistical comparisons are appropriate.

Science teaching time

Data were collected about the amount of science taught by the case study teachers and the time of day when they mainly taught science.

The minutes of science taught per week in Term 3 using a *Primary Connections* unit are reported in Table 6, and a comparison of the amount of science taught this year with *Primary Connections* with the amount of science taught last year with the previous science programme is reported in Table 7.

Table 6: Minutes of science taught per week by teachers in Term 3 of 2005 (n=36)

Minutes of science taught per week	**Per cent (number) of respondents**
60 minutes or more	75% (27)
30 to 60 minutes	11% (4)
Less than 30 minutes	14% (5)

These data indicate that three-quarters of the case study teachers taught 60 minutes or more of science per week which is far higher than the 41 minutes per week reported in Angus et al.s' (2004) study of the general population of primary teachers. The time committed to science teaching with *Primary Connections* by the case study teachers is of the same order as that reported by trial teachers (Hackling & Prain, 2005).

Table 7: Teachers' responses to the item " .. indicate how the amount of science you are teaching this year compares to what you taught last year." (n=36)

Amount of science taught	**Per cent (number) of respondents**
Much more than last year	50% (18)
A little more than last year	19% (7)
Same as last year	25% (9)
No response or didn't teach last year	6% (2)

Seventy-four percent of the teachers who had taught science in the previous year (25/34) indicated that they were teaching more science now that they were using *Primary Connections*. The teachers were also asked to report the time of day when they mainly taught science in the previous year and in 2005 when they were using *Primary Connections*. There were strong increases in the amount of science taught in the morning, and in the morning and afternoon, which was balanced by a decrease in the amount of science teaching in the afternoon (Table 8). This is consistent with the changes reported for the Stage 2 Trial involving the trial teachers (Hackling & Prain, 2005). In this study it was

apparent that the integration of science and literacy teaching was an important factor in the shift in time of teaching.

Table 8: Teachers response to the question "What time of day did you mainly teach science last year and this year?" (n=36)

Time of day	**Per cent (number) of respondents**	
	2004	2005
Morning	5.5% (2)	28% (10)
Afternoon	64% (23)	28% (10)
Morning and afternoon	30.5% (11)	44% (16)

Benefits of participation for teachers, students and the school

Teachers. The case study teachers were asked to report aspects of the programme they found particularly beneficial or caused concern or difficulty. These data are summarised in Table 9 and indicate that teachers found the greater focus on outcomes, the resources and background material and the guidance provided by the curriculum units were particularly beneficial, while time constraints for teaching science was by far the most common concern. Resources and the inappropriate selection of the right *Primary Connections* unit for the age of the children were difficulties experienced by a small number of teachers.

Table 9: Aspects of the *Primary Connections* programme that teachers found particularly beneficial or caused concern or difficulty.

Beneficial aspects (n=30 responded)		**Aspects causing difficulty (n=32 responded)**	
Aspect	Number of responses	Aspect	Number of responses
		Time issues	17
Greater focus on outcomes	12	Resources	5
Resources and background material	10	Inappropriate topic for age	5
Teacher's guide is detailed yet flexible	9	Teacher's guide	3
Students learnt more/better	5	Assessment	2
Focus on literacy	3	The balance of activities	3
5Es model	2	Fitting with other KLAs	2
		Other	5
		None	5

Teachers' perceptions of the impact of the programme on their science and literacy teaching were elicited by asking them if these aspects of their teaching had improved as a result of participating in the programme. Seventy-five percent of teachers (n=36) indicated that their science teaching had improved and 53% (n=36) indicated that their literacy teaching had improved.

Students. Teachers were also asked about the students' responses to the *Primary Connections* activities and learning approach and the amount and quality of learning with *Primary Connections*. These data are reported in Tables 10 and 11.

Table 10: Teacher perceptions of students responses to the *Primary Connections* activities and learning approach (n=36)

How students responded	**Per cent (number) with this response**	
	to activities	**to learning approach**
Very positively	52.8% (19)	52.8% (19)
Positively	30.6% (11)	30.6% (11)
OK	16.7% (6)	16.7% (6)
Negatively	0	0
Very negatively	0	0

Eighty-three percent of teachers indicated that students responded either very positively or positively to the activities and learning approach; no teacher indicated students had responded negatively.

Table 11: Teacher perceptions of the amount and quality of science learning using *Primary Connections* and contribution to literacy learning (n=36)

	Per cent (number) of teachers with this response		
Perception	Amount of learning	Quality of learning	Contribution of PC to students' literacy learning
Better than last year	55.6% (20)	66.7% (24)	61.1% (22)
Same as last year	33.3% (12)	25% (9)	30.6% (11)
Worse than last year	2.8% (1)	0% (0)	0% (0)
Can't compare	8.3% (3)	8.3% (3)	2.8% (1)
No response	0%	0%	5.6% (2)

Of the teachers who responded to these questions and were able to compare learning with *Primary Connections*, with learning in the previous year, a minimum of 60% of teachers indicated that the amount and quality of science learning, and contribution to literacy learning were better with *Primary Connections*; 73% thought the quality of science learning was better.

Schools. Every teacher indicated that *Primary Connections* had had a positive impact on their school. The most common reasons for this were greater teacher confidence, greater collegiality brought about by the whole school approach, and more science being taught.

Teachers use and evaluation of the *Primary Connections* curriculum resources

The data in Table 12 indicate a very high rate of usage of key features of the *Primary Connections* curriculum units. However, less than half of the teachers used the cooperative learning role badges, the Science Background CD-ROM, the resources CD-ROM and the *Primary Connections* web site.

Table 12: Use of key focuses of *Primary Connections* Units. (n=36)

Focus	**Number who used it**	**Usefulness**			**Number who would use it again**
		Very useful	OK	Not so good	
5Es approach	35	22	11	1	33
Include literacy in science lessons	35	32	3	0	33
Link science into literacy lessons	33	31	2	0	31
Integrate science into other KLAs	27	25	2	1	26
I used these specific literacy focuses:					
Big book science journal	25	16	7	4	22
Individual science journal	30	24	4	2	27
Word wall	34	20	10	2	30
Data charts/tables	33	25	4	3	32
Labelled diagrams	34	27	3	3	32
Flowcharts	24	17	6	1	23
Narrative texts	27	18	6	1	25
Procedural texts	27	20	6	2	25
Use of cooperative learning					
Used cooperative learning roles	25	17	4	1	22
Used the badges for these roles	15	11	2	3	14
In the teacher's guide, I used:					
Unit overview	35	25	7	1	32
Guides for each lesson	35	25	7	1	30
Resource sheets	32	22	7	3	29
Assessment tasks provided	28	20	5	1	24
Resources provided, did you use:					
Science background CD-Rom	14	5	7	2	14

Resources CD-Rom	18	5	8	3	13
Primary Connections web page	7	1	5	2	8

All of the features of the resources that were used by most teachers, were rated by the teachers as very useful and most teachers said they would use these features again. These data provide a strong endorsement of the curriculum units themselves. Digital resources such as the Science Background CD-ROM, the Resources CD-ROM and the *Primary Connections* web site are supplementary resources that support the use of the curriculum units, and as such were not essential to the implementation of the units. It might be anticipated that in a second implementation of these units teachers would be more likely to explore these supplementary resources as they become more familiar with the resources in the curriculum units.

Teachers' evaluation of the one-day professional learning workshop

The teachers also provided feedback on the one-day professional learning workshop. Almost two-thirds of the teachers indicated that they were very well or well prepared for teaching the first unit. No teacher indicated that s/he was poorly prepared for teaching the first *Primary Connections* unit, however, a little more than a third of responding teachers indicated that their preparation was OK which suggests that it did not meet all of their needs to a satisfactory level. These data are presented in Table 13.

Table 13: Teachers' responses to the question: "How well did the one day professional development learning workshop in your school at the beginning Term 1 prepare you for teaching the *Primary Connections* unit in Term 1?" (n=36)

How well prepared	**Per cent of teachers**
Very well prepared	33% (12)
Well prepared	28% (10)
OK	36% (13)
Poorly prepared	0%
Very poorly prepared	0%
No response	3% (1)

When asked how the workshop could be improved two suggestions each made by three people were increasing the time available for professional learning and conduct the workshop using smaller groups, however, it should be noted that a large majority indicated that no improvement was needed.

Table 14: Teachers' response to the question " Is there any way in which this workshop could be improved to better prepare you for teaching *Primary Connections*?" (n=36)

Suggested improvement	Per cent (number) of respondents
None needed	56% (20)
More time	8% (3)
Smaller groups	8% (3)
Other - make Teacher's guide available - more unit specific activities - do with other schools	11% (4)
No response	16% (6)

When asked about additional professional learning needs following the workshop, more than half indicated that no further professional learning was required while almost one fifth indicated that follow-up sessions would be beneficial.

Table 15: Teachers' responses to the question "Do you have any additional science teaching professional development needs at this stage? (n=36)

PD need	Per cent (number) of respondents
None needed	53% (19)
Follow-up PD later in year	16% (6)
More resources for units	6% (2)
Assessing, see other work samples	6% (2)
No response	19% (7)

General discussion, conclusions and implications

The data reported in this evaluation of the experiences of the case study teachers confirm many of the findings from the evaluation of the trial teachers' experience of *Primary Connections* reported in Hackling and Prain (2005). The provision of professional learning workshops supported with rich curriculum resources that are based on a sophisticated teaching and learning model that brings together inquiry learning scaffolded through the 5Es, open investigations, links between science and literacy, cooperative learning and assessment embedded within the teaching and learning process has had a marked impact on teachers, students and schools.

The programme has supported high levels of teacher confidence with important science and literacy teaching strategies and positive self-efficacy beliefs. The attention given to supporting teachers with the science background knowledge of the concepts and processes embedded in the units and the pedagogies needed for effective teaching and learning is likely to have enhanced teachers' pedagogical content knowledge (Gess-Newsome, 1999). This may be an important factor contributing to teachers' enhanced confidence and self-efficacy beliefs. As a consequence of the increased confidence and self-efficacy brought about through being supported with quality professional learning experiences and rich curriculum resources, the amount of time devoted to science teaching has been markedly increased. With the increased teaching time and improved pedagogy

evident in the trial teacher study, the amount and quality of science and literacy learning have increased as a consequence of the increased opportunity for learning. The whole school approach to the implementation of the programme has resulted in a more collegial approach to science teaching, increased science teaching and an enhanced status for science within the school. These relationships are represented in Figure 1.

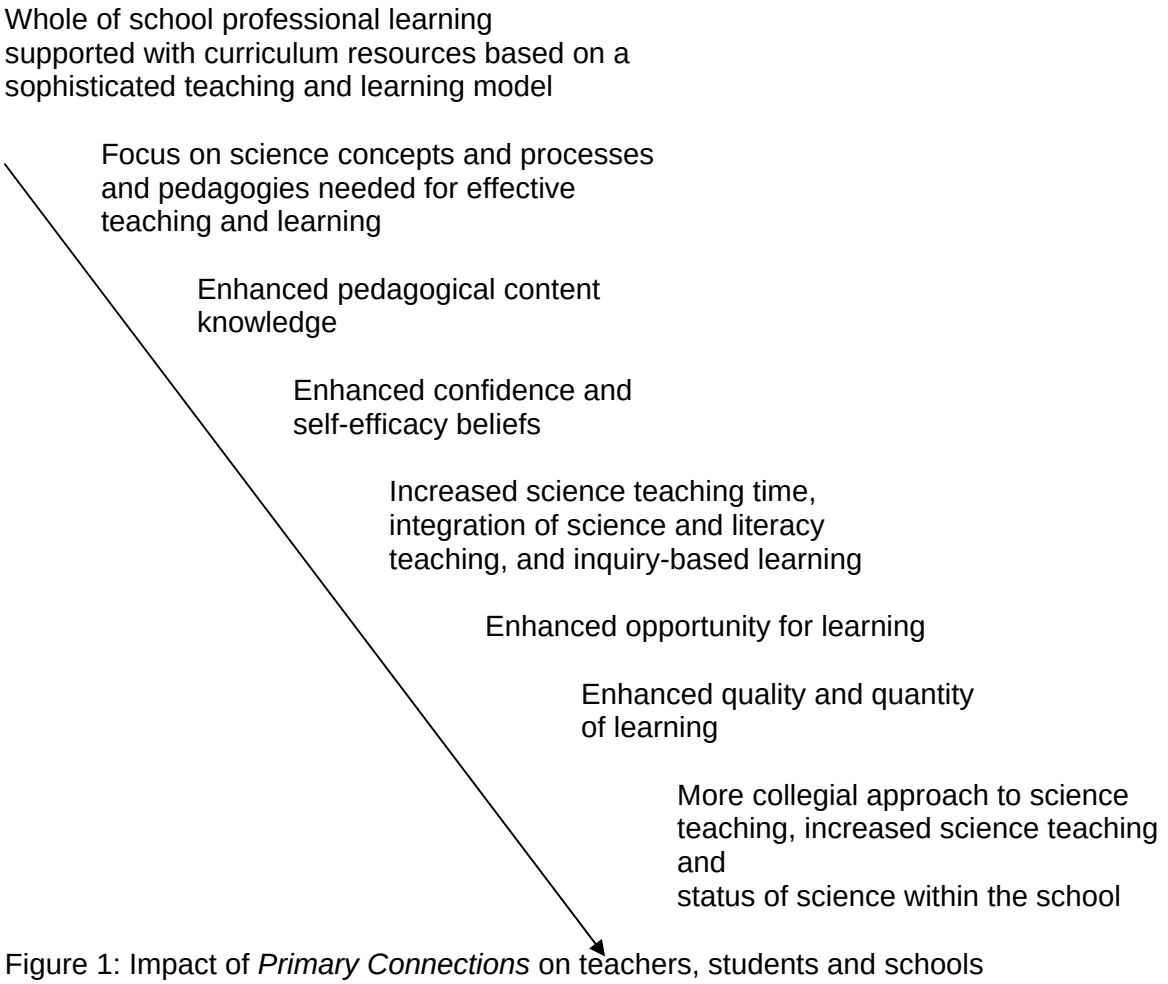

Figure 1: Impact of *Primary Connections* on teachers, students and schools

Although the findings of this evaluation of the case study teachers' experience of *Primary Connections* are similar to those from the evaluation of the impact of the programme on trial teachers, there are important differences in the professional learning experience of the two groups. The trial teachers had a total of eight days of professional learning compared to the one day provided to the case study teachers. The trial teachers not only implemented supplied curriculum units but also developed their own units in collegial teams using a *Primary Connections* unit template. Anecdotal data suggests that developing their own units required the trial teachers to unpack the *Primary Connections* teaching and learning model which led to quite deep learning about the underlying inquiry learning model. The more extensive professional learning programme provided to the trail teachers provided far greater opportunities for developing richer understandings of the science concepts and processes embedded in each unit they taught. It is therefore not surprising that the levels of confidence and self-efficacy of the trial teachers was higher than that of the case study teachers. There may also be important differences in achievement gains for case study and trial teachers which is a matter worthy of further research and evaluation in Stage 3 of the project.

The case study teachers gave very positive evaluations of the curriculum units and their key features, however, it was noticeable that the supplementary digital resources were used less extensively than the hardcopy curriculum units.

The one-day professional learning workshop was given a fairly positive evaluation by teachers although some teachers recognised a need for additional professional learning time. It is interesting to note that one of the case study schools requested a follow-up workshop to support teachers with implementing student planned investigations and assessing investigation work.

It can be concluded that the limited professional learning programme experienced by the case study teachers with the support of curriculum resources has supported fairly high levels of teacher confidence and self-efficacy, increased science teaching time and opportunity for learning. The students have responded positively to the *Primary Connections* activities and learning approach and teachers report an increased quality and quality of learning. With the whole school implementation there has been a more collegial approach to professional learning and science and literacy teaching, and an increased amount of science taught and enhanced status of science in the schools.

There are important implications from this study for the evaluation of Stage 3 of the project. It will be valuable to obtain measures of growth in confidence and self-efficacy, student achievement gains in science and literacies of science and attitudes to science with the whole-school implementations of *Primary Connections* to see to what extent they can match those obtained with the more extensive professional learning programme provided to trial teachers.

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Appendices

Appendix 1: One-day professional learning workshop programme

Intended outcomes

- Clarify the purpose for teaching primary science
- Clarify beliefs about the characteristics of effective teaching and learning of science and literacy
- Understanding the philosophy and approach of *Primary Connections*
- How the curriculum units support effective teaching and learning (5Es learning model, literacy practices, assessment)
- Familiarity with the unit they teach

Session details

8.00am to 8.30am
Arrive and coffee

8.30am to 10.00am
Session 1

Welcome and introductions
Programme for the day

Elicitation of beliefs and concerns through a think-pair-share strategy. Individual writing of responses to four questions:

- What is the purpose of teaching primary science?
- What are the characteristics of effective science teaching?
- What are your main concerns about your own teaching of science?
- What are your main concerns about the way science is organised within the school?

Responses are discussed in pairs then shared with the group.
Leader develops a summary of main points on the board. Responses to the third and fourth question used to set goals for an action plan later in the day.

Background to the *Primary Connections* programme
PowerPoint presentation of:

- History and purpose
- Curriculum and professional learning components
- Scope and sequence chart, available units, scientific literacy progress map
- Features of the curriculum units

10.00am to 10.30am
Morning tea

10.30am to 12.30pm
Session 2

Organise into year/stage based groups in larger schools. Allocate roles of Director, Manager and Speaker and hand-out role badges.

Pin-up a poster outlining the role duty statements.

Managers collect copies of the appropriate unit for the group's stage and a copy of the task instructions.
Directors organise team members to skim read sections of the unit:

- Engage
- Explore
- Elaborate
- Explain and Evaluate

If groups of four use allocations as above, if groups of five allocate two teachers to Explore. If groups of three, combine Engage, Explain and Evaluate. In small schools organise teachers in pairs and use only roles of Manager and Speaker.
Teachers read their allocated section and summarise the activities completed by students and the instructional purpose of the section. Directors organise team members to report on their sections in the order of Engage, Explore, Explain, Elaborate and Evaluate. Speaker seeks assistance from Leader or other group Speakers as required. Group prepares a poster that summarises the steps of the 5Es model.

12.30pm to 1.15pm
Lunch and gallery walk round posters

1.15pm to 2.45pm
Session 3

Groups report back on the 5Es model and leader reveals steps from prepared summary on OHP.

Groups analyse the literacy focus statements in their unit and prepare a summary of the literacy practices and forms of representation used in the unit.
Groups report back and Leader explains the relationship between science and literacy in *Primary Connections* and illustrates how to scaffold one literacy product e.g. table or graph or science journal

Groups analyse the Science unit outcomes, how they are developed in the unit and how they are assessed at the Engage, Explain and Evaluate phases.

2.45pm to 3.30pm
Session 4

Whole group development of an action plan.
What is to be the professional learning focus for Term 1? What follow-up support is required? What roles will the Consultant and the School Coordinator play?

Reflections on the day.

Appendix 2: Questionnaire for teachers in case study schools

Australian Academy of Science: *Primary Connections* Programme

Questionnaire for Teachers in Case Study Schools

This year your school has been trialling the Primary Connections programme *for science teaching.*

In this survey we are seeking your views about your teaching with Primary Connections and the professional learning programme.

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.

Please do not put your name on this survey

ID number

For office use only

Teacher background

State/Territory: _____

Years of teaching experience: _____

Name of school: _____

About your science teaching

1. What year level is the class you are teaching? _____

2. Which science topic did you teach in Term 1? _____

   Did you teach from a *Primary Connections* unit? **Yes/No**

3. Which science topic did you teach in Term 3? _____

   Did you teach from a *Primary Connections* unit? **Yes / No**

4. What time of day did you mainly teach science last year? **am / pm / am & pm**

   What time of day are you mainly teaching science this year? **am / pm / am & pm**

5. Tick **one box** to indicate how much science you taught in Term 3 this year.

Amount of science taught in Term 3	Tick
I taught science on a regular basis and averaged 60 minutes or more per week this Term	
I taught science on a regular basis and averaged between 30 and 60 minutes per week this Term	
I taught science intermittently and averaged less than 30 minutes per week this term	
I rarely taught science this Term	

6. Tick **one box** to indicate how the amount of science you are teaching this year compared to what you taught last year.

Much more	A little more	Same as last year	Less than last year

7. With regards to your science teaching this year with *Primary Connections*, 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. *Please tick within a box, not between boxes.*

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					

8. Please rate your confidence with the following aspects of science teaching when teaching from the *Primary Connections* science units, by ticking the appropriate box to the right of each statement.

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 a constructivist model to plan science units of work					

Feedback on the *Primary Connections* curriculum units

9. There were a number of key focuses in the *Primary Connections* units. Which of these did you use and how useful did you find them?

Focus	**Did you use it?** Circle one	**How useful was it? *Tick one box***			**Would you use it again?** Circle answer
		Very useful	OK	Not so good	
5Es approach	Yes/No				Yes/No
Include literacy in science lessons	Yes/No				Yes/No
Link science into literacy lessons	Yes/No				Yes/No
Integrate science into other KLAs	Yes/No				Yes/No
I used these specific literacy focuses:					
Big Book Science journal	Yes/No				Yes/No
Individual Science journal	Yes/No				Yes/No
Word wall	Yes/No				Yes/No
Data charts/tables	Yes/No				Yes/No
Labelled diagrams	Yes/No				Yes/No
Flowcharts	Yes/No				Yes/No
Narrative texts	Yes/No				Yes/No
Procedural texts	Yes/No				Yes/No
Use of cooperative learning					
Used cooperative learning roles	Yes/No				Yes/No
Used the badges for these roles	Yes/No				Yes/No
In the teacher's guide, I used:					
Unit overview	Yes/No				Yes/No
Guides for each lesson	Yes/No				Yes/No
Resource sheets	Yes/No				Yes/No
Assessment tasks provided	Yes/No				Yes/No
Resources provided, did you use:					
Science background CD-Rom	Yes/No				Yes/No
Resources CD-Rom	Yes/No				Yes/No
Primary Connections web page	Yes/No				Yes/No

Feedback on the professional learning workshop

10. How well did the one day professional development learning workshop in your school at the beginning Term 1 prepare you for teaching the *Primary Connections* unit in Term 1? Tick one box.

Very poorly prepared	Poorly prepared	OK	Well prepared	Very well prepared

11. Is there any way in which this workshop could be improved to better prepare you for teaching *Primary Connections?* Explain

_____

_____

_____

12. Do you have any additional science teaching professional development needs at this stage?

_____

_____

_____

Benefits from participating in the *Primary Connections* programme

13. Which aspects of the *Primary Connections* programme, if any, did you find particularly beneficial?

_____

_____

_____

14. Which aspects of the programme, if any, is causing you concern or difficulty?

_____

_____

_____

15. Has your **science teaching** improved as a result of participating in the *Primary Connections* programme?

Yes / No

16. Has your **literacy teaching** improved as a result of participating in the *Primary Connections* programme?

Yes / No

Students' reaction to the programme

Activities and learning approach

17. How have your students responded to the **activities** and the **learning approach**?

Activities (Tick one box)

Very positively	Positively	OK	Negatively	Very negatively

Learning approach (Tick one box)

Very positively	Positively	OK	Negatively	Very negatively

Amount and quality of learning

18. How does the amount and quality of **science learning** using *Primary Connections* compare with last year?

Amount of science learning (Tick one box)

Better than last year	Same as last year	Worse than last year

Quality of science learning (Tick one box)

Better than last year	Same as last year	Worse than last year

19. Has *Primary Connections* made a contribution to students' **literacy learning**? (Tick one box)

Better than last year	Same as last year	Worse than last year

20. Has the *Primary Connections* programme had a positive impact on science at your school?

Yes / No

Explain: _____

_____

_____

21. Are there any other comments you would like to make??

_____

_____

_____

_____

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