Australian Government

Quality Teacher Programme

Investigating the links between teacher professional development and student learning outcomes

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Volume 1

Australian Council for Educational Research

ACER

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A Note to the Reader

This report, in two volumes, describes an investigation of the links between teacher professional development and student learning outcomes. The study, funded by the Australian Government, provides a review of the research literature and of national and international initiatives linking professional development with student outcomes. It provides detailed case studies of the school-based trials of ten professional development programs in a number of different sites. It examines the repeated measures of student achievement from students in the classes of teachers in the school-based trials. Analysis and discussion of a common questionnaire completed by teachers in the school-based trials is provided. Suggestions are made for a method that could be used by the Australian Government to assess the impact of professional development programs.

Please note that pseudonyms are used for locations and named individuals to protect the privacy of all concerned.

This two-volume report comprises:

Executive Summary

Volume 1—Context and background, national and international initiatives, review of research, student achievement data, teacher survey, assessing the impact of teacher professional development, conclusions

Volume 2—Case studies of ten professional programs

Executive Summary

Purpose of the research

This research project, investigating the connection between professional development and student outcomes, was funded by the Australian Government through the Australian Government Quality Teacher Programme. The purpose of the project was to undertake an investigation of the links between teacher professional development and student learning outcomes. The project brief specified five key tasks:

1. Develop a theoretical construct to define the boundaries of the project, including the links between teacher professional development, teacher quality and student outcomes.

2. Identify and assess international practices and initiatives through which the impact of teacher professional development on teacher quality and student outcomes is assessed, and advise on how these practices and initiatives can be disseminated.

3. Identify ways Australian schools and teachers may investigate and assess the link between teacher quality, professional development and student learning outcomes. In particular, the report should identify any examples of best practice and advise on the dissemination of this information.

4. Use a framework drawn from the assessment of international and Australian practice and research to undertake, and document, extended school-based trials of whole school approaches linking teacher professional development to student learning outcomes.

5. Use a framework drawn from the assessment of international and Australian practice and research to suggest ways of developing a method that could be used to help assess the impact of professional development provided through Australian Government programs on student learning.

Scope of the research

An extensive review of the research literature established a number of key points. The research literature on educational effectiveness clearly identified the connections between quality teachers and their professional development. There was convergence in the research literature on the features of effective professional development, including the focus on subject matter learning, that are linked to improvements in students' learning. This review, which can be read in detail in Volume 1, provided the basis for the school based trials.

The school-based trials focused on whole-school approaches linking teacher professional development to student learning outcomes. Ten professional development programs were investigated in 70 schools, encompassing 42 primary schools and 28 secondary schools from all education sectors. The school-based trials were conducted during the 2002 school year, when all data, including student outcome data, was collected.

The ten professional development programs that became the focus of the school-based trials were identified following extensive national consultation, and included a wide range of professional development models. The professional development programs were provided by major educational agencies in the states and territories:

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1   Learning Improves in Networking Communities (LINC) (Monash University and Catholic Education Commission of Victoria; three secondary and six primary schools)

2   Graduate Certificate in Education (Teaching of Literacy) (Department of Education Tasmania. Tasmanian Educational Leaders' Institute. Recognition Services; two secondary and four primary schools)

3   Science in Schools (SiS) Strategy (Department of Education and Training, Victoria; four secondary and three primary schools)

4   Science Standards and Portfolios Professional Development Program (Australian Council for Educational Research; six secondary schools).

5   The Early Years Numeracy Program (Department of Education and Training, Victoria; six primary schools)

6   The Count Me In Too (CMIT) Early Numeracy Program (Department of Education and Training, NSW; seven primary schools)

7   Year 9 Exhibitions Project (ACT Department of Education and Community Services; eight secondary schools)

8   New Basics Trial, incorporating formal professional programs on Protocols, Rich Task implementation, Productive Pedagogies and Standards (Education Queensland; two secondary and six primary schools)

9   The WA Quality Teacher Program Action Research Projects (Education Department of Western Australia; seven primary schools)

10   Teaching Futures Action Research Project (Canberra-Goulburn Catholic Archdiocese; six secondary and two primary schools)

Detailed accounts of each professional development program are presented in the Volume 2 of this report.

The professional development programs were complex and multi-layered. The same program could be conducted in different ways in different schools, and the research team collected information on these variations. They also collected evidence of teachers' experience of the professional development programs, and changes in teaching practice.

Evidence of changes in student learning outcomes was collected by using a range of assessment instruments, aligned as closely as possible to the purposes of each of the professional development programs. These assessments were administered at the beginning and end of the school year. A 'value-added' analysis was used to identify the schools where it appeared that the professional development might have impacted on student outcomes. The qualitative data collected from observations, interviews, and teachers' reflective responses was scanned to help interpret the findings from the analysis of the student data.

Improvements in student learning had taken place in most schools, but the value-added analysis made it possible to focus on cases where the improvement was better than might be expected. The multi-level analysis of the repeated measures of student achievement established that in only a few cases did the data show that the students had achieved more than might have been expected and that this improvement might have been attributable to the particular professional development program. These cases were of particular interest, and provided an opportunity to develop further understanding of the links between professional development and improved student learning outcomes.

The main message from a cross-program analysis of reports from teachers in the school-based trials was that 'opportunity to learn' features in the programs had significant effects on the extent to which the programs had an impact on teacher knowledge, practice, efficacy and student learning outcomes. Reported levels of *follow up*, *content focus* and *active learning* were all directly related to the level of impact on teachers' knowledge. The level of active learning was also directly related to impact on teachers' *practice* and *efficacy*. Because these 'opportunity to learn' features had a significant direct effect on teacher knowledge—and

because it was found that teacher knowledge was, in turn, strongly related to impact on practice—it is possible to claim that opportunity to learn features have significant indirect effects on practice, student learning outcomes and teacher efficacy.

This cross-program analysis indicates some essential components that need to be built into professional development programs if they are to lead to improved opportunities for student learning.

Conclusions and implications for further research

This investigation of the links between teacher professional development and student learning outcomes provided insights into the nature of professional development and its impact on teaching. It sharpened the focus on the kinds of learning that are embraced by the term 'student learning outcomes'. The survey of national and international initiatives linking teacher professional development and student outcomes, and a review of research and other professional literature, identified the difficulties of finding evidence about how teacher learning is linked to student learning. The study generated a number of conclusions, questions and practical implications for continuing work in the field.

The study also demonstrated that there are many difficulties in researching the impact of teacher professional development on student learning outcomes.

The most significant difficulty concerned the need for research that takes place over sufficient time to capture the chain of impact linking changes to teaching practices brought about by professional development to changes in student learning outcomes.

This project conducted school-based trials over the period of a single school year. In the space of a single school year, case studies tracked changes in teachers' knowledge and practice, identifying what they were doing differently as an outcome of the professional development. During the same school year, case studies also gathered evidence of student achievement. In most cases, this was too short a time for changes in student achievement attributable to the professional development to become apparent. However, the qualitative evidence of teachers' reports of changes in their students learning provided some indicative evidence of the kinds of impact of the professional development.

The other major difficulty in conducting this research concerned the identification of assessments that aligned well with the purposes of the professional development. The multiple and varied purposes of professional development meant that some programs focussed quite directly on student outcomes, while the focus of other programs was on aspects of teaching that in more general ways contributed to the provision of improved learning opportunities for students.

These difficulties were signalled in the review of the research literature (outlined in Chapter 2 of Volume 1), which drew attention to the small body of research in this field, limited largely because of the difficulties outlined above.

The project identified a number of issues that have implications for further investigations of the links between teacher professional development and student learning outcomes

1. Student outcomes broadly defined

The professional development programs included in this study were selected because they were explicitly intended, in the long term, to lead to the improvement of student learning. The programs focused on a range of student outcomes, including quite specific student outcomes in early years numeracy, general outcomes such as improvement in students' attitudes to science, and outcomes related to enhanced levels of general engagement with learning.

The case studies of ten different professional programs indicated that it is essential, in investigating the links between teacher learning and student learning, to define student learning broadly, and to avoid narrowing outcomes to those that can be easily measured.

2. A wide range of evidence of improvement, including teachers' classroom observations

This investigation gathered both qualitative and quantitative evidence of improvements. The rigorous analysis of the repeated measures of achievement provided limited, but significant evidence of improvement. The wider range of evidence collected in the case studies, particularly from teacher's informed observations of their students over time, provided nuanced insights into the work of improving student learning.

Case studies and cross-program analysis provided information about the features of professional development activities—such as emphasis on content, follow-up support, opportunities for reflection, collaboration and the building of professional community—that contribute to the strengthening of teachers' capacity to improve their students' learning outcomes.

3. Longitudinal view of change

The school-based trials took place over a single school year. However, this was a relatively short period to allow for teachers to come to understand and to take up new practices, for these new or refined practices to impact on students' learning, and for the evidence of change in student outcomes to become apparent. The kinds of changes involved are interconnected, but required time to become embedded. If the impact of professional development is to be judged, even partially, by its impact on student learning, a longitudinal view of change is needed. This finding suggests the potential value of developing evaluation processes with the capacity to capture evidence of change over time.

4. Evidence of change in students' learning as an incentive for taking changed practice further

An interesting link between professional development and student outcomes can be seen when teachers take up a new practice, and recognise how this practice creates new learning opportunities for students. This evidence of change then becomes an incentive for further learning, suggesting that there may a symbiotic relationship between teachers' learning and students' learning. The evidence of changes in students' learning is important evidence for teachers of the efficacy of new or different pedagogical practices, and of the potential value of taking the changed practice further.

The case studies, through the interviews, provided teachers in the schools involved with opportunities for extended reflection on their practice, and on their students' learning.

5. The design of professional development

The investigation highlighted, in the literature review, in the case studies, and in the cross-program analysis, the significance of the emphasis on content in the design of professional development. Emphasis on content knowledge, knowledge of how students learn that content, and knowledge of strategies for teaching that content connect professional development to classroom programs. All of the professional development programs investigated in the school-based trials made this connection between the impact of teachers' learning on the learning of their students. This was identified in all the case studies, even though it was limited in some instances. The cross-program analysis provided further evidence of the impact of emphasis on content on teachers' learning and subsequently on students' learning.

A strong research and theoretical base for the pedagogical approaches that are the focus of the professional development validates and strengthens the content that is presented in the professional development program, and increases the likelihood that teachers incorporating this knowledge into their practice will find that it enhances their teaching.

Most of the programs were designed to allow for professional learning as ongoing, and many provided support for teachers' learning. These aspects are important design features of effective professional development.

6. School contextual factors

The school-based trials provided a considerable body of information about the impact of school contextual factors on the implementation and sustainability of the intended outcomes of professional development. The case studies captured many of the daily realities of school life that hinder a continuing focus on teaching and on improving learning. The difficulty in finding adequate time for planning, reflection and collaboration was an ongoing theme in interviews with teachers. A loss of momentum caused by staffing changes was reported in a number of cases.

Leadership support was a crucial mediating influence. Where leadership support and commitment was strong, the case studies indicate that it was possible to implement change over time.

Conclusion

These six issues reflect what has been learnt from this investigation. A broad definition of student outcomes expanded the range of the investigation of the impact of professional development on student learning. This broad definition of student outcomes required the collection of a wide range of evidence of improved learning outcomes.

Evidence of changes in teaching practices is more likely to be found in longitudinal investigations. Professional development programs that make an impact on teaching practices and student learning include several key features, including an emphasis on content and opportunities for teachers' active learning. The school context is an important element influencing the extent of the impact of the professional development.

Together, these issues highlight key considerations in designing and implementing professional development programs that lead to improved student learning outcomes. Increased understanding of these issues will assist in maximising the scope and effectiveness of the links between teachers' professional learning and improved student learning outcomes, and for strengthening these links. Further longitudinal research would illuminate the chain of logic linking professional development, teachers' learning, and students' learning.

Any methodology that is used to assess the impact of professional development programs on student learning outcomes will necessarily require a balance between what is feasible and what is ideal. The methodology suggested in this study indicates some of the complex issues to be addressed. The suggestions for focusing on the design and evaluation of professional development programs offer a basis for the development of a set of broad guidelines for future Australian Government policy on teacher professional development.

Chapter 1

Purposes and Focus of the Research

The purpose of the project was to undertake an investigation of the links between teacher professional development and student learning outcomes. The project specified five key tasks.

1   Develop a theoretical construct to define the boundaries of the project, including the links between teacher professional development, teacher quality and student outcomes.

2   Identify and assess international practices and initiatives through which the impact of teacher professional development on teacher quality and student outcomes is assessed, and advise on how these practices and initiatives can be disseminated.

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5   Use a framework drawn from the assessment of international and Australian practice and research to suggest ways of developing a method that could be used to help assess the impact of professional development provided through Australian Government programs on student learning.

The theoretical construct required by the first task was developed around the logic proposed by Supovitz (2001) that high quality professional development will produce superior teaching in classrooms, which will in turn translate into higher levels of student achievement. This logic can be extended to make explicit reference to the links between teacher professional development and enhanced teacher pedagogical and subject knowledge. The investigation was designed to examine, in a number of different settings, the nature of professional development, professional knowledge, teaching practices and student outcomes. It was also designed to probe the connections between these. Figure 1 illustrates the theoretical construct.
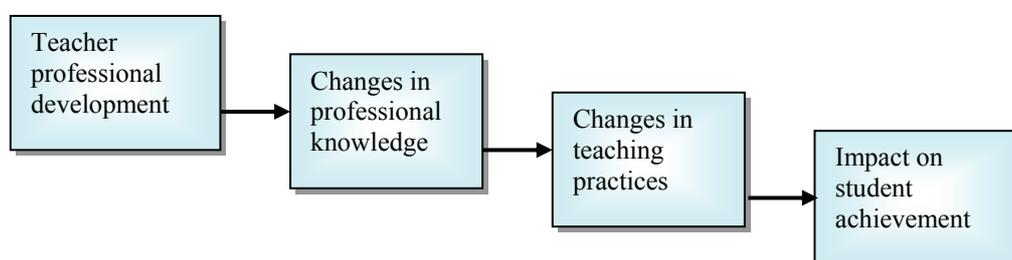
Figure 1: Theoretical construct

This model identifies the major elements in the process. Each element is complex and multi-faceted, and the links between them are also complex and recursive.

The second and third key tasks were undertaken concurrently, and the outcomes of this review are presented in Chapter 2. These tasks were a major focus of the project in the early stages, and the review was progressively updated over the life of the project.

Key task 4 was at the heart of the project. The identification of professional development programs directed to whole school approaches to linking teachers' learning to students' learning for the school-based trials involved extensive consultation. The trialling of these professional development programs in different school sites generated a considerable body of quantitative and qualitative data that provided critical insights into the actualities of the implementation of change in classroom practice. An overview of the conduct of the trials is presented in Chapter 3, and detailed case studies of the trials are presented in Volume 2 of this report. The student achievement data collected in the trials is discussed in Chapter 4 of this volume.

Data from a survey of teachers who participated in the professional development programs was used to look across the ten programs included in the study. Chapter 5 explores components of programs that might explain relative differences in the impact each had on teachers' knowledge and practice and student learning outcomes.

The school-based trials were not conducted as empirical research. No reference group of like schools who had not participated in the specific professional development programs was established. This would have presented practical difficulties, as teachers in all schools participate in many professional learning activities that impact on the nature of student outcomes. The research approach was conceptual in its design, testing out the theoretical construct developed at the beginning of the project.

Key task 5 had a practical policy focus, and required the development of a methodology that could be used to help assess the impact of professional development. Suggestions are made for such a methodology in Chapter 6.

Chapter 2

Review of the Research Literature

1. Teacher learning and improved learning opportunities for students

This review was used to determine the theoretical context for a national research project designed to investigate the links between teacher professional development and student learning outcomes.

The critical research questions for the study cluster around the relationship between teacher learning and improved opportunities for student learning. Insights into this complex relationship can be found in various fields of research, including studies of teacher professional development, teacher quality, school effectiveness, and student achievement. This review examines these diverse fields, and considers evidence-based research as well as a range of conceptual and theoretical literature.

The purpose of the review is to provide a theoretical construct for the investigation of links between teacher professional development and student learning outcomes. The DETYA (now DEST) report: *PD 2000, A National Mapping of School Teacher Professional Development* (McRae et al., 2001), provides a comprehensive account of trends and developments in teacher professional development in Australia. This review takes a more specific focus than *PD 2000*. It is concerned with literature relating to the links between professional development and student learning outcomes, and addresses the following questions.

- What is the impact of professional development on teacher quality, particularly the impact on improving specific aspects of teaching?

- What conditions promote effective professional learning for teachers?

- How do improvements in teacher quality improve student learning outcomes?

- What level and type of student outcomes can be improved through improving teacher quality?

- When does professional development lead to improved student learning outcomes?

These questions are nested within a complex network of other questions: What does research tell us about conditions likely to promote student learning and development? Where do we find documentation of what the profession considers to be best practice? How do teachers learn? Under what conditions do teachers make changes in practice that have significance for student learning? Are optimal conditions for development in skills such as literacy and numeracy much the same as they are for development in scientific, historical and moral areas of reasoning? Do teachers need to develop in much the same ways, regardless of the content of what they teach? What do teachers need to know and be able to do? What do we mean by professional development? Is professional development better described as professional learning?

Evidence of the links between teacher professional development and student learning outcomes is hard to pin down. McRae et al. (2001) note that in a national survey of schools

regarding professional development more than half the survey respondents 'referred to the demonstrated impact on student learning', capturing a view widely held by professionals. However, the authors question whether the response is indicative of the perceived 'right answer', but comment that 'it may also mean that schools are making an unprecedented effort to tie professional development to the impact of their work' (McRae et al., 2001, p. 165).

Scrutiny of the professional literature suggests that there is limited evidence-based research on the links between teacher professional development and improved student learning outcomes. The authors of a recent paper note that, in the United States, 'there is no national data that examines professional development over time, or links professional development participation to both changes in teaching practice over time and student achievement' (Olson, Desimone, Le Floch and Birman, 2002). These researchers suggest that 'to evaluate and improve our policies supporting teachers' professional growth, we need to understand how professional development translates into changes in teaching practice and improved student achievement' (Olson, Desimone, Le Floch and Birman, 2002). This paper is indicative of increased interest in investigations of these connections.

Guskey and Sparks (2002) show a similar interest, and comment on the rarity of descriptions of the impact of professional development on student learning outcomes:

> *While those responsible for professional development have generally assumed a strong and direct relationship between professional development for educators and improvements in student learning, few have been able to describe the precise nature of that relationship.*

Other researchers have also identified the challenges posed by attempts to answer questions about the links between professional development and student outcomes. Supovitz notes that while it has been demonstrated that effective, standards-based professional development can change teachers' practices, 'there is minimal evidence that the resulting changes in teaching practice translate into substantial gains in student performance' (Supovitz, 2001, p. 81).

Cohen and Hill (2000) also discuss the small amount of research evidence on the relationships between teachers' learning and students' learning:

> *It has been relatively unusual for researchers to investigate the relations between teachers' and students' learning, and when they did so it has been even more unusual to find evidence that teachers' learning influenced students' learning.*

Sykes (2002) suggests that a 'gold standard' for claims about the effectiveness of professional development would be

> *evidence that the professional development had positive effects on student learning, presumably through influences on teacher knowledge, beliefs, skills and dispositions, which in turn influenced their instruction. Yet of all the scholarship on this topic, very little meets this standard. We are just beginning a long period of discovery about how to support teacher learning that is in turn productive for student learning.*

Here, Sykes highlights the importance of understanding the links between teacher professional development and student outcomes in making judgements about the effectiveness of professional development. It is a subject for which to date there is little research evidence, but we are now in a period when research on the subject will seemingly gather momentum.

The limited body of systematic research providing evidence on the impact of professional development for teachers upon classroom practice and student learning was noted in a report from the North Carolina Education Research Council that focused on improving student performance through professional development for teachers. [There is] 'remarkably little [writing about professional development] based on real evidence about the actual impact of professional development on classroom practice and student performance' (Thompson, 2003).

The present review explores three contexts that are potentially significant for understanding the nature of links between teachers' learning and student learning. Firstly, the literature relating to the role of professional development in enhancing the quality of teaching is discussed. Secondly, the review moves to a consideration of the literature about conditions for professional learning and the scope and nature of professional development that will lead to better opportunities for teachers' learning. Thirdly, the review discusses literature on the impact of professional development on student achievement.

A guiding principle for the selection of studies for inclusion in this review was that they should be, as far as possible, evidence-based. While there is a considerable body of professional literature on the effectiveness of professional development, much of it represents widely agreed expert opinion, or hypotheses, about reasons for the effectiveness of particular programs. Some of this literature has been included in the review.

Three key studies

Three recent studies have been of particular interest and relevance to the research investigation on the links between teacher professional development and student learning outcomes. The discussion by Supovitz (2001) cited above, Translating Teaching Practice into Improved Student Achievement, provides a conceptual model for the relationships between teacher professional development and student achievement, and examines research evidence of the relationship between effective teaching practices and student achievement.

A report prepared by Gary Sykes for the Learning First Alliance, Professional Development for Teachers: Principles, Practices and Contexts addresses the question of what constitutes effective professional development and draws attention to increasing interest in 'data-based analysis of student outcomes and in uses of student work as a basis for teacher learning' (Sykes, 2002). A study by Garet et al. (2001) draws on data collected as part of a national evaluation of the Eisenhower Professional Development Program, and suggests a useful model of the relationship of features of professional development to teacher outcomes. These three studies have been especially useful for the purposes of the ACER project, and are discussed in more detail below.

2. Professional development and the enhancement of the quality of teaching

The significance of professional development in improving the quality of education is acknowledged in many educational contexts. At the policy level, connections are made between improving teacher quality and improved student learning outcomes. This is evident, for example, in *Teachers for the 21st Century—Making the Difference* (DEETYA [now DEST], 2000), the Australian Government Quality Teacher Initiative. This document states that 'it has been noted that participation in high quality teacher professional development is a key element in improving student outcomes'. This initiative also embraces the value of professional standards and related certification for teachers as a means of improving the quality of teaching.

The role of professional development in bringing about improvements in schooling is widely recognised in the context of school reform. *Phi Delta Kappan* (September, 2001) featured Furhman and Odden in a special section focused on school reform. They identified key aspects of improvement:

> We have a relatively straightforward 'theory of action' about what it takes to make better schools—schools in which more students learn to much higher levels. First, there must be clear and ambitious goals ... coherent educational standards and sound measures of student achievement. Second ... the core technology of education—instructional practice—must change dramatically. Third ... extensive

investment in continuing professional development, in strong curricula, and in leadership at the system and school levels.

This view places well funded continuing professional development firmly in a key position in school reform.

Acknowledgement of the significance of professional development as a means of improving learning opportunities for students can be identified in a variety of professional contexts. Within the context of educational research on various topics, recommendations for the implementation of research findings frequently include endorsements for professional development to enable teachers to gain the knowledge and skills identified by the research to be significant.

Two studies exemplify the frequent identification of professional development as a key strategy for improving curriculum delivery or introducing new curriculum initiatives. An Australian research study (Lankshear et al., 1997) on literacy and information communication technologies makes strong recommendations for the role of teacher professional development, citing the principle of 'teachers first' as the most effective means of supporting students' learning of skills in literacy and technology.

Another Australian study of the literacy demands of all learning areas in the senior secondary curriculum (Cumming et al., 1998) makes several recommendations for professional development focused on knowledge and understanding of literacy teaching to meet the curriculum demands of all learning areas.

The standards-based reform movement is a second context in which professional development has been linked with the improvement of learning opportunities for students. Internationally, the explication of curriculum standards gained momentum over the past 15 years.

The National Curriculum in the UK, the standards for the teaching of mathematics and English developed by the National Council of Teachers of Mathematics and the National Council for the Teaching of English in the US, and the New Standards developed in that country, have established clear expectations for student learning outcomes.

In Australia, state and territory curriculum standards were developed following the national collaborative curriculum work, which developed curriculum statements and profiles in eight key learning areas. More recently, the national benchmarks for literacy and numeracy (DEETYA [now DEST], 1998, 2000) also set expectations for student learning outcomes.

Furhman (2001) described standards-based reform as 'reforms intended to anchor key aspects of policy—curriculum, assessment, teacher education, and professional development—around policy statements of what students should know and be able to do' (Furhman 2001, p. 1). This description draws a clear link between teacher professional development and student learning outcomes. 'The concept that challenging standards for all students would lead to better instructional experiences for all students was another central component of the theory of action underlying standards reforms' (Furhman, 2001, p. 4). Furhman raises several questions about standards-based reform, including the question of whether student learning is improving. She cites some positive evidence of students learning more as a result of the standards-based reform movement, but acknowledges the difficulties in drawing conclusions about achievement. 'If the alignment that underlies the theory does not really occur—if assessments are not aligned to curriculum and standards—one can't really measure the effects of reform' (Furhman, 2001, p. 8).

A third broad context that draws strong connections between teacher professional development and student learning outcomes is work in the area of school effectiveness. Teacher quality outweighs student background factors in explaining variation in student achievement (Haycock, 1998; Darling-Hammond, 2000). Hill et al. (1996) provide evidence-based research findings demonstrating that

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*the main effects on Progress in Literacy (with adjustments for Grade Level and Prior
Achievement) for elementary students are: student Attentiveness in the classroom,
whether the teacher has participated in specialist Literacy In-Service Programs, and
whether the student is placed in a Composite Class containing students from two or
more Grade levels. Attentiveness and Literacy In-Service programs are positive in
their effect ...*

In identifying the positive effect of literacy in-service education, Hill et al. draw a clear
connection between student achievement and professional development. A key finding from
this study (the Victorian Quality Schools project) was that it is primarily through the quality of
teaching that effective schools make a difference. Initial teacher education and professional
development can have significant effects on teacher quality.

Evidence that the quality of what teachers know and can do has the greatest impact on student
learning is available from a variety of sources (Ferguson, 1991; Ferguson and Ladd, 1996;
Darling-Hammond, 2000, Wenglinsky, 2000; Muijs and Reynolds, 2000). Variation from
classroom to classroom, from school to school, in what students learn is due primarily to
variation in what their teachers know and can do. Greenwald, Hedges and Laine (1996)
examined the impact of a range of investments designed to improve student learning
outcomes. They summarised their research in terms of the relative increase in student
achievement for every $500 spent on the following strategies:

Lowering pupil-teacher ratio	0.04
Increasing teacher salaries	0.16
Increasing teacher experience	0.18
Increasing teacher education	0.22

Rowe (2001) cites evidence-based findings from Australian studies for the effects of teacher
quality on student outcomes. Darling-Hammond (2000) summarises similar evidence-based
findings:

*The effect of poor quality teaching on student outcomes is debilitating and
cumulative... The effects of quality teaching on educational outcomes are greater
than those that arise from students' backgrounds ... A reliance on curriculum
standards and state-wide assessment strategies without paying due attention to
teacher quality appears to be insufficient to gain the improvement in student
outcomes sought... The quality of teacher education and teaching appear to be more
strongly related to student achievement than class sizes, overall spending levels or
teacher salaries.*

In reviewing research on school effectiveness, Rowe notes recent studies that 'consistently
find that differences between schools, when relevant prior achievement and "intake"
characteristics of students are taken into account, are important but not especially large'
(Rowe, 2003).

In this review, Rowe highlights the significance of the focus on teacher quality:

*... those studies that have been designed to enable the estimation of class-level effects
have consistently identified larger proportions of between-class/teacher variance.
This, in turn, has prompted a renewed focus on teacher quality and instructional
effectiveness, and to some re-definition of the fundamental questions underpinning
educational effectiveness research.*

Rowe (2003) concludes that:

*the key message to be gained from the educational effectiveness research ... is that
quality teachers and their professional development do make a difference, and that
it is not so much what students bring with them that really matters, but what they*

experience on a day-to-day basis in interaction with teachers and other students in classrooms. While it may be difficult to legislate quality teaching into existence, the fact that teachers and schools make a difference should provide impetus and encouragement to those concerned with the crucial issues of educational effectiveness to at least invest in quality teacher recruitment, initial training, and their ongoing professional development.

Hattie (2003) also emphasises that the quality of teaching is the major source of variance in student's achievement, comparing the influences of what the student brings to the task, home, schools, principals, peer effects and teachers. Teachers account for 30 per cent of the variance, and he suggests that the focus of improving students' learning should be the quality of teaching. He concludes that the key to improving student achievement

lies elsewhere—it lies in the person who gently closes the classroom door and performs the teaching act—the person who puts into place the end effects of so many policies, and who is alone with students during their 15,000 hours of schooling (Hattie, 2003).

Hattie's large-scale study of excellent teachers, involving the review and synthesis of over 500,000 studies clearly indicated the impact of 'expert' teachers and has important implications for professional development:

Expert teachers do differ from experienced teachers—particularly in the way they represent their classrooms, the degree of challenge that they present to students, and most critically, in the depth of processing that their students attain. Students who are taught by expert teachers exhibit an understanding of the concepts targeted in instruction that is more integrated, more coherent, and at a higher level of abstraction than the understanding achieved by other students (Hattie 2003).

3. Conditions for professional learning

The relationships between the improvement of teacher quality and professional development as the means of achieving this improvement becomes critical in the light of the evidence of the impact of teacher quality on student outcomes. The corpus of professional literature relating to the effectiveness of professional development emphasises teacher learning, identifies characteristic features of professional development that impact on teacher learning, and espouses principles for effective professional development. Implicit in this work is the assumption that increased teacher knowledge will improve teaching practice, in turn improving student learning outcomes.

The implicit logic of focusing on professional development as a means for improving student achievement is that high quality professional development will produce superior teaching in classrooms, which will, in turn, translate into higher levels of student achievement (Supovitz, 2001).

Characteristics of effective professional development

The logic made explicit by Supovitz, and the evidence, cited by Darling-Hammond, for the impact of teacher quality on student learning highlights the value of a focus on research that identifies conditions for professional learning that will enhance teacher quality.

Supovitz proposes a model where, within the context of the school environment and the broader environment of state and district policies, effective professional development is linked to increased use of appropriate teaching practices, and improved student achievement (Supovitz, 2001).

The model represents a chain of logic linking effective professional development, increased use of appropriate teaching practices and improved student outcomes (Supovitz, 2001, p. 82). Mediating factors that influence this chain of events are state and district policies, and the school environment.

Guskey and Sparks (2002) propose a model of the relationship between professional development activities and improvements in student learning:

The premise of the model is that the quality of professional development … is influenced by a multitude of factors. Those believed to have the most immediate and direct influence, however, can be classified in three major categories: content characteristics, process variables, and context characteristics.

Cohen and Hill (2000) describe features of professional development that are likely to provide effective opportunities for teacher learning:

Teachers' opportunities to learn can be a crucial link between instructional policy and classroom practice. Many educators believe that such links exist, but research generally has not supported that belief. Our results suggest that one may expect such links when teachers' opportunities to learn are:

- *grounded in the curriculum that students study*
- *connected to several elements of instruction, i.e. not only curriculum but also assessment*
- *extended in time, possibly including follow-up during the school year.*

Cohen and Hill (2000) examined the impact of a large-scale professional development program to support implementation of new state standards and assessments for mathematics in California. They found that professional development paid off in terms of student performance on the state mathematics assessment

when teachers have significant opportunity to learn the content that their students will study, in ways that seem to enable them to learn more about teaching that material, and when assessments are linked to the student and teacher curriculum.

Thompson (2003) reviewed evidence-based research about the impact of professional development on teachers' practice and student learning, and found some points of convergence in research studies that provide evidence about the main features of professional development for teachers that contribute to improved classroom practice and student performance. The points of convergence in this research are:

- *focus on subject matter learning*
- *link professional development to curricular materials and assessments*
- *promote 'coherence' and 'active learning'*
- *extend activities to permit more active learning, and promote collective participation to enhance coherence.*

The convergence on the point about the focus on subject matter is consistent with the case argued by Sykes that 'in attending to the structural and process characteristics of formal professional development, we have overlooked the importance of content, particularly if the criterion for judging the effectiveness of staff development is its impact on student learning' (Sykes, 1999).

Recent large-scale evaluations of the impact of professional development undertaken by ACER (Ingvarson, Meiers and Beavis, 2005) investigated the effect of these features (cf. Cohen and Hill, 2000; Thompson, 2003; Supovitz, 2001) in relation to the impact of the professional development on teaching practice and student outcomes. The evaluations found that emphasis on content, active learning and collective participation were contributing factors. Supovitz (2001) reviewed several research studies examining the relationship between professional development and teaching practice and concluded:

> *Together, these studies provide a solid basis for concluding that professional development that is connected to specific standards for student performance, based upon intensive and sustained training around concrete tasks, focused on subject matter knowledge, and embedded in a systemic context is likely to be effective.*

Supovitz cites six critical components of professional development about which there is widespread agreement amongst researchers and educators.

The first component is that 'professional development must show teachers how to connect their work to specific standards for student performance' (Supovitz, 2001, p. 82). Secondly, he cites research indicating that 'effective professional development must immerse participants in questioning and experimentation and therefore model inquiry forms of teaching' (Supovitz, 2001, p. 83). The third component is intensive and sustained professional development, although the evidence for this is mixed. For example, Supovitz cites Kennedy (1998) who, in a review of science and mathematics programs that had evidence of impact on student achievement, 'found little relationship between professional development contact time and student learning'. The fourth critical component identified by Supovitz is emphasis in professional development on engaging teachers in concrete teaching tasks, and being based on teachers' experiences with students. Fifthly, 'professional development must focus on subject matter knowledge and deepen teachers' content skills'. He identifies the sixth component as being the connection of professional development to other aspects of school changes.

Discussions of effective professional development also note what is ineffective:

> *There is a much-maligned event in education called the one-shot workshop. This event has been criticised by virtually every teacher who has ever participated in it and by virtually everyone else even vaguely interested in improving teaching* (Kennedy, 1999).

Design principles for effective professional development

The perspectives cited above suggest the potential value of the articulation of design principles for effective professional development, supported by research. Hawley and Valli (1999) provide a set of research-based design principles for effective professional development.

A useful elaboration of these principles is provided in the US National Partnership for Excellence and Accountability in Teaching (available at <www.npeat.org>). These principles, shown in Table 1, reflect a synthesis of current research, and it is argued that professional development activities that have the characteristics identified in the principles are likely to be effective.

Table 1: Principles for the design of effective professional development

1 The content of professional development (PD) focuses on what students are to learn and how to address the different problems students may have in learning the material.

The content of professional development is critically important to its effectiveness. While the content varies with the goals of the school, the content of PD should deal directly with what students are expected to learn and the instructional strategies that research and experience have shown are effective.

2 Professional development should be based on analyses of the differences between actual student performance and goals and standards for student learning.

Professional development that is based on analysis of student learning helps teachers close the gap between actual student performance and goals for student learning. Goals for student learning also provide a basis for defining what teachers need to learn and a yardstick for improving PD.

3 Professional development should involve teachers in the identification of what they need to learn and in the development of the learning experiences in which they will be involved.

Adherence to this principle ensures that PD is relevant. When teachers help design their own learning, they are likely to feel a greater sense of involvement in the PD experience. Teachers are most likely to use what they learn when PD development is focused on solving problems in their particular contexts.

4 Professional development should be primarily school-based and built into the day-to-day work of teaching.

Teachers learn from their work. Learning how to teach more effectively on the basis of experience requires that such learning be planned for and evaluated. Learning needs arise and should be met in real contexts. Curriculum development, assessment, and decision-making processes are all occasions for learning. When built into these routine practices, PD powerfully addresses real needs.

5 Professional development should be organised around collaborative problem solving.

Without collaborative problem solving, individual change is possible, but school change is not. Collaborative problem-solving activities allow educators to work together to identify both problems and solutions. Activities may include interdisciplinary teaming, curriculum development and critique, collaborative action research and study groups

6 Professional development should be continuous and ongoing, involving follow-up and support for further learning—including support from sources external to the school that can provide necessary resources and new perspectives.

Adoption and implementation of effective practices requires continued learning. Therefore the design of PD must provide time to apply new ideas and, sometimes, must draw on additional outside expertise. Such follow-up and support ensures PD contributes to real change and continuous improvement.

7 Professional development should incorporate evaluation of multiple sources of information on learning outcomes for students and the instruction and other processes that are involved in implementing the lessons learned through professional development.

When done properly, evaluation of PD yields important lessons for its refinement. Without such evaluation, future opportunities for teachers to learn may not be productive. Multiple sources of information should be used, including teacher portfolios, observations of teachers, peer evaluations and student performance. Lessons are clearest when evaluators collect data during different stages of the change process.

8 Professional development should provide opportunities to gain an understanding of the theory underlying the knowledge and skills being learned.

Because beliefs filter knowledge and guide behaviour, PD must address teachers' beliefs, experiences, and habits. Furthermore, specific knowledge and skills that work in one setting, sometimes do not work in others. When teachers have a good understanding of the theory behind particular practices and programs, they can adapt the strategy they have learnt to the circumstances in which the teacher is trying to use it.

9 Professional development should be connected to a comprehensive change process focused on improving student learning.

Improving teacher capabilities without changing the conditions that influence the opportunities to use these capabilities is often counter-productive. These conditions include time and opportunities to try new practices, adequate funding, technical assistance and sustained follow through. Thus, unless professional development is designed as part of a larger change process, it is not likely to be effective.

The connections that these principles make between professional development and student learning are interesting.

The first principle asserts that the content of professional development focuses on what students are to learn and how to address the different problems students may have in learning the material. The second principle, that professional development should be based on analyses of the differences between actual student performance and goals and standards for student learning, is based on research indicating that collaborative examination by teachers of their students' work in relation to standards has significant effects on student achievement.

The third principle flows from the first two. If the first two principles are in operation, they help to define an agenda for a teacher's professional development. They imply a radical idea for the teaching profession; that professional development should be based in part on what teachers need—rather than want—to learn. The ninth principle makes a clear connection between professional development and improved student learning, highlighting the importance of the conditions in which teachers teach.

Another perspective on professional development that makes a difference comes from Darling-Hammond and Ball (1998), who offer five premises that are especially pertinent to improving teachers' learning opportunities:

- *Teachers' prior beliefs and experiences affect what they learn*
- *Learning to teach to the new standards takes time and is not easy*
- *Content knowledge is key to learning how to teach subject matter so that students understand it*
- *Knowledge of children, their ideas and their ways of thinking is crucial to teaching for understanding*
- *Opportunities for analysis and reflection are central to learning to teach* (Darling-Hammond and Ball, 1998, p. 16).

A trend in contemporary research is to identify conditions that promote teacher learning in the workplace. Many researchers have identified the existence of an active, accountable professional community within and across schools as important for effective teacher development and high quality teaching. 'The path to change in the classroom core lies within and through teachers' professional communities' (McLaughlin and Talbert, 1993, p. 18).

Newmann (2000) argues that professional development policy should not only focus on building teacher capacity but also deliberately aim to build school or organisational 'capacity'. Newman defines school capacity as 'the collective power of the school staff to improve student achievement schoolwide'.

Louis and Marks (1998) found higher levels of professional community to be associated with higher student achievement, though associations between classroom practices and achievement are much stronger. The defining elements of professional communities were shared norms and values, a collective focus on student learning, collaboration, de-privatised practice and reflective dialogue. The aim of building professional community has been at the heart of many successful professional development initiatives in Australia (Hill and Crevola, 1998; McRae et al., 2001). Professional community was found to be a significant feature affecting the impact of professional development in the ACER evaluations of professional development provided through the Australian Government Quality Teacher Programme in three jurisdictions (Ingvarson, Meiers and Beavis, 2005).

Elmore (2000) criticises those who believe recruiting, rewarding and retaining high quality teachers is enough to accomplish large-scale reform.

> *What's missing in this view is any recognition that improvement is more a function of learning to do the right things in the setting where you work than it is of what you know when you start to do the work. Improvement at scale is largely a property of organisations, not of pre-existing traits of the individuals who work in them.*

> *Organisations that improve do so because they create and nurture agreement on
> what is worth achieving, and they set in motion the internal processes by which
> people progressively learn how to do what they need to do in order to achieve what is
> worthwhile.*

For Elmore, the key to effective professional learning is to build a new professional culture
characterised by collective responsibility for teaching practice and student learning. Finding
subtle ways to de-privatise practice appears to be the key to strengthening professional
community, increasing opportunities for conversations based on concrete evidence from
classroom practice and student progress. Effective teacher learning is data-driven. Teachers
may not perceive these opportunities as professional development; nevertheless, the evidence
is that this is when some of the most effective professional learning happens.

Sykes (2002) reviewed the literature on principles for professional development. He found
four frequently occurring principles about which there appears to be some consensus. The first
of these is 'student learning', and recommendations that professional development be
organised around systematic examination of student learning. The second is that professional
development should be 'continuous, ongoing, with follow-up'. The third consensus principle
identified by Sykes is that professional development should be part of a comprehensive
approach or 'comprehensive strategy' to instructional improvement. The fourth principle,
about which there seems to be consensus, is that 'professional development should provide
teachers with learning opportunities that are meaningful, intellectually engaging, and some
would say, professionally empowering' (Sykes, 2002). This synthesis of an extensive body of
literature provides a useful framework for reviewing professional development programs.

Theory of action

Designing professional development programs built on such principles calls for attention to
the theories of action that underpin those programs. The program theory of action explicates
the design and objectives of the professional development. Examination of the theory of
action of professional development programs is a means of explicating the linkages between
processes and outcomes. Michael Quinn Patton's work (1997) provides useful insights in this
context, especially as a means of understanding the intentions of professional development,
the actualities of the professional development as it is enacted, and the links between
professional development and outcomes related to student learning.

> *The full chain of objectives that links inputs to activities, activities to immediate
> outputs, immediate outputs to immediate outcomes, and immediate outcomes to
> ultimate goals constitutes a program's theory.*

> *The espoused theory of action is a straightforward articulation of what is supposed
> to happen in the process that is intended to achieve desired outcomes. The linkages
> between processes and outcomes are made explicit. Evaluative data then reveal the
> theory-in-use, that is, what.*

Analysis of 'theory of action' is a valuable way of understanding the intentions of professional
development programs, and how they are constructed. Elmore and Burney (1998) describe
how the 'theory of action' is evident in the systemic reforms in New York City Community
District #2. The theory of action in this case largely relates to administrative leadership of
professional development. They also identified a less explicit 'theory in use' about systemic
improvement and school variability (Elmore and Burney, 1998).

Strategies for professional development

In addition to being strong design principles for effective professional development, the
strategies used in implementing programs are a significant element in teachers' opportunities
to learn. The repertoire of strategies available to the designers of professional development is
extensive and diverse. Loucks-Horsley et al. (1998) provide useful insights to strategies for

professional learning. The selection of strategies involves the planners' beliefs about teaching and teacher learning as well as access to the requirements needed to implement the chosen strategies, including time, staff and materials. Different strategies engage teachers in different kinds of professional learning, and professional development programs characteristically combine different strategies.

An important decision for any professional developer is to choose a methodology for teacher learning appropriate to the goals and context of the professional development program. Loucks-Horsley et al. (1998) provide a classification of professional learning strategies in *Designing Professional Development for Teachers of Science and Mathematics*. They define strategies as the kind of learning experiences designed to promote specific professional development goals. Each strategy is based on a set of assumptions and beliefs about teacher learning. Table 2 summarises fifteen strategies identified by Loucks-Horsley et al. Each strategy is based on a range of research studies.

'Immersion' strategies place teachers in experiential situations that deepen their understanding and knowledge of the content they are teaching their students. 'Curriculum' strategies place them in the situation of developing and implementing new curricula with colleagues for their own classes and for other teachers. These strategies can be powerful when linked to the implementation of new standards frameworks for student learning. Content knowledge can be strengthened through these strategies, but they also serve to clarify the meaning of curriculum standards and learning outcomes for students.

Loucks-Horsley et al. draw attention to the need to match the professional development strategy to the purpose of the professional development program; especially the stage participants are at in the process of change.

 Table 3 provides a classification of the strategies according to their core purposes. Some strategies focus mainly on developing awareness at the early stages when reforms are being introduced. Some focus on building knowledge and understanding of content, for example through immersion strategies. Strategies that aim to help teachers translate new knowledge into practice might, for example, concentrate on bringing teachers together to plan teaching programs. Others, such as coaching and mentoring might provide in-classroom support as teachers reach the stage of trying new ideas in their classrooms. Strategies such as action research and examining student work are suited to helping teachers analyse and reflect on the impact of their practice and generate ideas for improvement. In the context of research on educational innovation, these stages in the change process correspond to Hall and Loucks' (1977) research on 'Levels of Use' of innovations.

Table 2: Strategies for professional learning

Immersion

1 Immersion into inquiry and problem solving
   Engaging in the kinds of learning that teachers are expected to practise with their students, such as inquiry-based mathematics investigations.

2 Immersion into the world of mathematics
   Participating in an intensive experience in the day-to-day work of a mathematician, often in a laboratory, industry, or museum, with full engagement in research activities.

Curriculum

3 Curriculum implementation
   Learning, using and refining the use of a particular set of instructional materials in the classroom.

4 Curriculum replacement units
   Implementing a unit of instruction that addresses one topic in a way that illustrates effective teaching techniques.

5 Curriculum development and adaptation
   Creating new instructional materials and strategies, or tailoring existing ones, to better meet the learning needs of students.

Examining practice

6 Action research
   Examining teachers' own teaching and their students' learning by engaging in a research project in the classroom.

7 Case discussions
   Examining written narratives or videotapes of classroom events and discussing the problems and issues.

8 Examining student work and thinking, and scoring assessments
   Carefully examining students' work to understand their thinking so that appropriate instructional strategies and materials can be identified.

Collaborative work

9 Study groups
   Engaging in regular collaborative interactions around topics identified by the group, with opportunities to examine new information, reflect on classroom practice, and analyse outcome data.

10 Coaching and mentoring
   Working one-on-one with another teacher to improve teaching and learning through a variety of activities, including classroom observation and feedback, problem solving, and co-planning.

11 Partnerships with mathematicians in business, industry, and universities
   Working collaboratively with practising mathematicians with the focus on improving teacher content knowledge, instructional materials and access to facilities.

12 Professional networks
   Linking in person or through electronic means with other teachers to explore topics of interest, pursue shared goals, and address common problems.

Vehicles and mechanisms

13 Workshops, institutes, courses, and seminars
   Using structured opportunities outside the classroom to focus intensely on topics of interest, including mathematics content, and learning from others with more expertise.

14 Technology for professional development
   Using various kinds of technology, including computers, telecommunications, video and CD-ROMs, to learn.

15 Developing professional developers
   Building the skills and deep understanding of content pedagogy needed to create learning experiences.

Table 3: Strategies and purposes for professional development

	Developing awareness	Building knowledge	Using new knowledge to plan programs	Practising new approaches	Reflection on teaching and learning
1 Immersion in inquiry and problem solving	x	X			X
2 Immersion into the world of mathematics	x	X			
3 Curriculum implementation		x	x	X	
4 Curriculum replacement units		x	x	X	
5 Curriculum development and adaptation		x	X		
6 Action research		x			X
7 Case discussions	x	x			X
8 Examining student work and thinking, and scoring assessments	x	x	x		X
9 Study groups	x		x		X
10 Coaching and mentoring		x	x	X	x
11 Partnerships with mathematicians in business, industry, and universities	x	X			
12 Professional networks	x	X	x		x
13 Workshops, institutes, courses and seminars	x	X	x		x
14 Technology for professional development	x	X	x		x
15 Developing professional developers		x	x	X	x

Note: A capital 'X' indicates the primary purpose for each strategy, and a lowercase 'x' indicates one or more secondary purposes.

Professional teaching standards

If students are to achieve high standards, we can expect no less from their teachers and other educators. To help students succeed in meeting the new standards, the first priority must be reaching agreement on what teachers should know and be able to do (Darling-Hammond and Ball, 1998, pp. 14–15).

Teaching standards linked to student standards provide a means of supplying a coherent continuum of teacher development. Professional development is likely to be more effective when it is connected with well-articulated professional teaching standards. These standards will help to answer questions about professional knowledge (What range of constructions of literacy and literacy assessment can the teacher draw from?) and professional practice (Is the teacher providing all students with opportunities to participate in literacy learning that is personally culturally significant to them?). These questions are drawn from the provisional framework of standards for English and literacy teaching developed in the STELLA project (Standards for Teachers of English Language and Literacy in Australia) (AATE/ALEA, 2001).

Teaching standards can be used to guide programs for teacher education, induction and ongoing professional learning (Darling-Hammond and Sykes, 1999). This is consistent with research that emphasises that effective professional learning is more likely when teachers are active agents in their own continuing learning (Garet et al., 2001). Effective professional development engages teachers in examining where they are in relation to what they might become as teachers. Teaching standards aim to embody the deep educational values that teachers pursue.

Effective professional learning starts with induction programs where young teachers learn to evaluate their performance in relation to standards expected of entrants to the profession. In this context, effective professional learning resembles a long-term, personal quest, rather than a course or a workshop about implementing, for example, curriculum changes arising from policy changes. Standards aim to assist teachers in that personal–professional quest.

A critical question for the development and implementation of professional standards is: how can a system for learning in the teaching profession engage all teachers in effective forms of ongoing professional learning? Evidence is mounting that the best way to ensure this is to build a system of induction, registration and advanced levels of professional certification based on profession-defined teaching standards (Ingvarson, 1998).

There have been rapid advances over recent years in the ability of the teaching profession to develop standards that teachers find exciting, useful and challenging. The trend began with the professional standards developed by the National Council for Teaching Mathematics (1989) and the National Board for the Professional Teaching Standards (1989). Many other teacher associations have followed, including several Australian associations.[1]

These new profession-defined standards are distinct from the behavioural checklists and lists of generic competencies of the past. The new teaching standards reflect a major shift that took place in research on teaching during the 1980s. Following the work of people such as Shulman and Berliner, researchers began to pay more attention to understanding what highly accomplished teachers know and do.

Two important things have been learned about how standards can promote effective teacher learning:

1   They must be performance-based standards. A complete set of standards should provide answers to the following questions.

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[1] These include the Australian Association for Teachers of English, the Australian Literacy Educators' Association, the Australian Association of Mathematics Teachers and the Australian Science Teachers Association.

- What is important about what we teach, and what is quality learning of what we teach?

- What should teachers know and be able to do to promote that kind of learning?

- What tasks should teachers perform to provide evidence of what they know and can do?

- How will that evidence be judged fairly and reliably?

2   They need to be seen as one component of a standards-based professional development system, which includes:

- teaching standards that describe what teachers need to learn and what they need to improve on

- methods teachers can use to gather evidence about their work and assess their performance in relation to the standards that promote professional learning

- an infrastructure for professional learning within schools and across the profession, the primary purpose of which is to enable teachers to gain the knowledge and skill embodied in the teaching standards

- a credible, voluntary system for providing professional recognition and certification, based on valid methods for assessing when teachers have attained the standards.

One example of a standards-based professional learning system is that being generated by the National Board for Professional Teaching Standards (NBPTS) in the USA. (Others include the Interstate New Teacher Assessment Consortium (INTASC), the Praxis system developed by the Educational Testing Services (ETS) and the teacher induction schemes run by state licensing bodies in Connecticut and California.) In Australia, the Level 3 Classroom Teacher Scheme in Western Australia is the closest match to this kind of system.

Recent research studies support the validity of the NBPTS standards and methods for assessing teacher performance (Bond et al., 2000; Silver et al., 2002). For the NBPTS assessment, teachers undertake two types of task. One asks them to prepare a portfolio with four entries: one based on student work, two based on videotapes of classroom practice and one based on documented contributions to the school and professional community. The other uses an examination format to assess subject-specific pedagogical knowledge over one half day. (Ingvarson (1999) describes the certification process in some detail.)

As NBPTS certification gains credibility, governments and education authorities in the USA are creating a market for National Board Certified Teachers. Tangible forms of recognition, such as salary increases, are now given by 44 states. Many are reorganising their professional development to build an infrastructure of resource centres, teacher networks, university–school partnerships and so on to support teachers preparing for NBPTS certification and reallocating professional development funds to cover costs of certification (Anderson et al. 2001). Certification is also redefining the nature of university masters courses that US teachers routinely take for salary progression (Unrau, 2002). The NBPTS conducted a survey in 2001 of 10,000 teachers who had been through its process of certification (available at <www.nbpts.org>). In summary, teachers reported that the certification process:

- had made them better teachers (92%)

- was an effective professional development experience (96%)

- equipped them to create better curricula (89%)

- improved their ability to evaluate student learning (89%)

- enhanced their interaction with students (82%), parents (82%) and colleagues (80%).

A large-scale study conducted by Goldhaber and Anthony (2004) using a value-added model from 600,000 North Carolina elementary student test scores during a three-year period provides evidence that National Board Certified Teachers:

- are more effective at raising student achievement than teachers who pursue, but fail to obtain, NBPTS certification

- are more effective at raising student achievement—outside the year in which they apply—than teachers who do not pursue National Board certification

- have a greater impact with younger students

- have a greater impact with low-income students.

The evaluation of professional development

The links between professional development and improved student achievement are recognised as a focus for evaluating the impact of the professional development on changes in teaching practice and in student learning opportunities.

Four reasons for increasing interest in evaluating professional development are suggested by Guskey.

- *Educators now have a better understanding of the dynamic nature of professional development—a series of extended, job-embedded learning experiences.*
- *Professional development is increasingly recognised as an intentional process—a systematic effort to bring about change.*
- *There is a need for better information to guide reforms in professional development specifically and educational programs generally. There is 'increased pressure at all levels of education for greater accountability* (Guskey, 2000, p. 5).

Embedded in these reasons is better understanding of how professional development can lead to change in classrooms, to school reform and accountability, changes which in turn relate directly to improved student learning.

Guskey (2002) argues for the importance of effective evaluation of the quality of professional development. 'Using five critical levels of evaluation, you can improve your school's professional development program. But be sure to start with the desired result—improved student outcomes.' The emphasis on the importance of student outcomes in evaluation merits attention. The fifth critical level of evaluation proposed by Guskey (2002) is at the level of student learning outcomes.

> *How did the professional development activity affect students? Did it benefit them in any way? The particular student learning outcomes of interest depend, of course, on the goals of that specific professional development effort.*

This presents a clear case for the expectation that professional development will impact on student learning outcomes.

To conclude this section, it is interesting to note Sykes' (2002) summary of the evidence on effective professional development.

> *The evidence on effective PD and effective schools strongly supports the creation of professional communities among teachers anchored in consistent attention to student learning and to standards of good practice. Such a view places teacher learning*

*squarely in the center of school improvement and implicates the leadership of
schools from the superintendent's and principal's offices.*

4. The influence of professional development on student achievement

The question of what makes professional development effective inevitably leads to
considerations of teacher learning and the consequent impact on student outcomes. But Garet
et al. (2001) note that

*despite the size of the body of literature, however, relatively little systematic research
has been conducted on the effects of professional development on improvements in
teaching or on student outcomes.*

In a review of studies of professional development for mathematics and science teachers that
examined benefits to students, Kennedy (1998) found ten studies over a twenty-year period
that specifically included evidence of benefits to students. The programs in these studies
varied in terms of their impact on student learning and the permanence of the effects on
teacher practice. Kennedy teased out the presumed links between teacher and student learning
for each program (the program 'logic') and the factors that might explain why the strength of
the links varies between programs. Some programs focused on training teachers in generic
teaching behaviours, or methods such as cooperative group work. Others focused mainly on
providing teachers with research-based knowledge—for example, how student understanding
of number develops in mathematics—but left teachers to use their teaching experience to
devise their own appropriate teaching methods.

Across the ten programs Kennedy found that differences in the form of the program did not
account for differences in effects on student achievement. These forms include total contact
hours, distributed time, in-class visits, and whole-school approaches. The findings suggest that
the content of professional development should be attended to before form and structure.
What distinguished the most successful professional learning programs was the way each
engaged teachers in the content of what was to be taught and provided research-based
knowledge about how students learn that subject matter. The more successful professional
development programs focused first on influencing teacher knowledge not practice. The
effects of programs that focused first on promoting specific pedagogical practices were more
likely to fade with time, because they did not deepen teachers' understanding about content
and how students learn it.

One of the most successful programs in Kennedy's review was the Cognitively Guided
Instruction (CGI) program developed by a team from the University of Wisconsin (Carpenter
et al., 1996). Developed after extensive research in the 1980s, the CGI program enhances
teachers' understanding of research on the development of children's conception of whole
number operations involving single-digit and multi-digit numbers. The focus throughout the
program is on feedback about children's mathematical thinking. A key characteristic of the
program was that teachers listened to their students and built on what they already knew.
Instead of advocating particular teaching methods or materials, the CGI team provided issues
for teachers to consider as they planned their teaching programs.

The study carried out by Garet and colleagues examined the relationship between features of
professional development that have been identified in the literature and self-reported change in
teachers' knowledge and skills and classroom teaching practices.

In their model, they included sponsorship, structural features, core features and outcomes.
Sponsorship refers to the sponsor of the activity. Under structural features, they included time
span, contact hours, collective participation and type (traditional versus reform). The core
features included focus on content knowledge, active leaning and coherence. Outcomes had
two elements—enhanced knowledge and skill, and change in teaching practice. Their study
explored the relationship of features of professional development to teacher outcomes. The

study provided empirical confirmation in support of some of characteristics of effective professional development identified in the literature. Their results indicate

> *that sustained and intensive professional development is more likely to have an impact, as reported by teachers, than is shorter professional development [and also] that professional development that focuses on academic subject matter (content), gives teachers opportunities for 'hands on' work (active learning), and is integrated into the daily life of school (coherence), is more likely to produce enhanced knowledge and skills* (Garet et al., 2001, p. 935).

Their results also:

> *Provide support for previous speculation about the importance of collective participation and the coherence of professional development activities. Activities that are linked to teachers' other experiences, aligned with other reform efforts, and encouraging of professional communication among teachers appear to support change in teaching practice, even after the effects of enhanced knowledge and skill are taken into account* (Garet et al., 2001, p. 936).

The implicit logic of the focus on professional development as a means of improving student achievement, as identified by Supovitz (2001) is that 'high quality professional development will produce superior teaching in classrooms, which will, in turn, translate into higher levels of student achievement' (Supovitz, 2001, p. 81). Empirical evidence of the links between professional development and teaching practice can be found in several recent studies identified by Supovitz, Mayer and Kahle (2000); Cohen and Hill (1998); Supovitz and Turner (2000). Furhman (2001) cites evidence that indicates that coherent approaches to professional development, where professional development is linked directly to course content, curriculum and pedagogy, will change practice and bring about gains in student achievement (Furhman, 2001, p. 6).

Supovitz explores five possible reasons why professional development may be effective at changing teaching practices but be less successful in raising student achievement.

> *First, there are often incompatibilities between standards-based reform practices and the assessment instruments used to measure their impact. Second, there is often poor alignment between the content of what is taught and what is tested. Third, our impatience for results leads us to look for impacts too soon, rather than allowing effects to accumulate. Fourth, our models relating teaching practice to student achievement may not include crucial environmental specifications. Finally, reformers' specifications of professional development may not be precise enough to powerfully impact student achievement* (Supovitz, 2001, p. 95).

The point Supovitz makes about allowing time for effects of professional development on student achievement to accumulate is interesting. Studies investigating the links between professional development and student outcomes must take account of the time factor in looking for change.

A study by Wenglinsky (2002) of the link between teacher classroom practices and student academic performance noted that quantitative studies of school effects have generally supported the notion that the problems of US education lie outside of the school, but neglect the primary venue through which students learn, the classroom. Wenglinsky explores the link between classroom practices and student academic performance by applying multi-level modelling to the 1996 National Assessment of Educational Progress in mathematics. The study found that the effects of classroom practices, when added to those of other teacher characteristics, are comparable in size to those of student background, suggesting that teachers can contribute as much to student learning as the students themselves.

Other studies support the view that teachers and their professional development *do* make a difference, and that it is not so much what students bring with them but what they experience

on a day-to-day basis in interaction with teachers and other students in classrooms that really matters (see Darling-Hammond, 2000; Rowe and Hill, 1998).

> *While it may be difficult to legislate quality teaching into existence, the fact that teachers and schools make a difference should provide impetus and encouragement to those concerned with the crucial issues of educational effectiveness to at least invest in quality teacher recruitment, initial training, and their ongoing professional development* (Rowe, 2001).

An interesting strategy for linking student learning to teacher work is the Teacher Work Sample Methodology used at Western Oregon State College (Millman, 1997). In this evolving approach, the procedures used to assess student progress in learning 'are linked specifically to the learning outcome or outcomes a teacher is attempting to accomplish' (Millman, 1997, p. 16). Although this work is mainly concerned with assessing the effectiveness of teachers, it is worth noting that it 'yields measures of pupil learning that are close to a teachers' work and thus are meaningfully and defensibly reflective of a teacher's impact on student progress in learning' (Millman, 1997, p. 66).

A useful perspective on the links between student achievement and teachers' learning is reported in the study undertaken by Timperley in New Zealand (Timperley et al., 2003). This study sought to answer the question: 'To what extent did the professional development impact on the participants' expectations of students' achievement and their own self-efficacy in impacting on that achievement?' They concluded that the professional development program at the heart of the study

> *provided a set of conditions that led to most of the teachers changing their expectations of how well students from low-income communities could achieve and sustaining those expectations over the following year. Changes in expectations were achieved through the complex interplay of new domain knowledge in the form of redefining the reading task and how to teach it, changes in children's achievement and their own feelings of self-efficacy …* (Timperley et al., 2003).

Case discussion methods

One example illustrates how researchers are investigating the links between professional development activities, teacher learning and outcomes for students—that of case methods as developed by Barnett et al. (1994) and others (for example, Shulman, 1992). There is a long tradition of case methods in professional education and Merseth (1996) provides a comprehensive review of research on case methods as used in teacher education.

Cases are usually brief, first-hand, accounts that teachers have written about particular events or dilemmas that have arisen in teaching particular topics or ideas. They often include rough and ready evidence of what students have said, done or written in class. Barnett's teachers used 'difficult to teach' topics in elementary school mathematics, such as fractions and decimals, as a starting point for their cases. The cases usually described the context of the class, what the teacher intended to do, and what actually happened, with snippets of dialogue and student work where appropriate ('the vicissitudes of human intention'). In the final stages of a case, the case writer usually moves into a more analytic and reflective mode, using the evidence provided to identify a problem or dilemma in their practice for discussion.

Case methods provide an effective vehicle for de-privatising practice and reflective dialogue, characteristic of professional communities. Case methods groups usually consist of teachers with a shared teaching interest who meet regularly to read each other's cases, or cases that other teachers have written. These groups require a focus for their deliberations. Teaching standards can provide an appropriate focus to guide the evaluation and reflection of case method groups. Barnett shows how teachers enhanced their ability to describe, analyse and evaluate their teaching, using the standards of the National Council for the Teaching of Mathematics (NCTM) and the National Board for Professional Standards.

Heller (1995) developed a framework for conducting research on the impact of Barnett's case discussions that aims to make the links between professional development activities and student outcomes explicit. Five critical features of the case discussion strategy were identified: exploration of mathematical meanings; critical analysis of practice; focus on student thinking; experience in a learning community; and building a professional community. Table 4 spells out the links in relation to two of the five features.

Table 4: Case discussion methods

Critical features of maths case discussion method	Related teacher outcomes	Related opportunities to learn for students	Related student outcomes
Exploration of mathematical meanings Teachers discuss and think carefully about the meaning of mathematical concepts and procedures in each case	Improvements in maths content knowledge, especially with respect to meaningfulness of procedures and concepts; increase in confidence and more positive attitudes toward maths	Mathematical content areas are included that were not previously; richer exposure to mathematical meanings in classroom teaching	Students learn mathematical content they would not have otherwise, learn more sophisticated mathematical ideas and ways of thinking, and learn in more depth
Focus on student thinking Participants articulate and reflect on student thinking and understanding as well as their own and one another's thinking	Deliberate planning to support student understanding; more attention to student thinking and to solution processes	Teaching geared more to student understanding; increase in elicitation of student thinking	Students improve in quality of mathematical thinking

Barnett (1998) provides evidence that indicates that case methods have a deep impact on teachers' pedagogical content knowledge. Barnett points out that case methods do not seek to impose reforms or practices: 'Instead, we choose to demonstrate, analyse, and critique reform-oriented pedagogy, allowing teachers to form their own opinions about its value and utility' (p. 84).

Pre- and post-tests conducted by Heller (1995) showed significant gains in teacher knowledge of mathematics content, but evidence of impact on student learning is yet to come.

The impact of professional development on student achievement

The ways in which professional development programs impact on teaching practices and student learning outcomes are complex, occur over time and are difficult to identify. Professional development is a dynamic and multi-layered process, rather than a single event. Student learning, likewise, is a complex, extended process.

Therefore, evaluating the impact on student achievement of different components of students' educational experience is difficult for a variety of methodological reasons. Separating out a single component, such as the teaching practices in the classrooms in which teachers are participating in professional development program work, poses challenges.

Student achievement is influenced by a complex array of factors, and it is difficult to isolate the effects of one factor. Gathering valid evidence of changes in achievement requires a longitudinal approach as such change occurs over time, not as a single event. A related difficulty lies in identifying learning gains: some gains can be appropriately measured by standardised approaches; other significant gains may not be reflected in such standardised assessments.

Richardson and Placier (2001) argue that an important area requiring further research is the study of the effects of teacher change on students. They note the need for longitudinal assessment of students.

> *Few studies of teacher change in either the individual or organisational literature move towards examining what happens to student learning when teachers change their practices. Within a community, student learning should be assessed longitudinally to determine the effects of teacher change on student learning over a number of years. Conceptual and methodological issues would have to be worked out related to student mobility.*

Supovitz (2001) discusses the difficulties involved in linking improved student achievement to teacher professional development.

> *In contrast to the evidence of the relation between high quality professional development and changes in teachers' practices, relatively few studies have documented a link between science and mathematics teaching practices and student achievement ... The few studies that have reported a relationship between teaching practice and student achievement found the impacts to be small* (Supovitz 2001, p. 86).

Four recent initiatives provide examples of strong professional interest in investigating, from different perspectives, the linkages between aspects of education and student learning outcomes. These studies highlight the current consensus that it is important to understand these linkages, and provide insights into ways of studying improvement in student learning outcomes.

The impact of ICT on student achievement

The ImpaCT2 study, conducted within the UK National Grid for Learning (NGfL), is a major longitudinal study (1999–2002) that aimed to:

- *identify the impact of networked technologies on the school and out-of-school environment*
- *determine whether or not this impact affects the educational attainment of pupils aged 8 to 16 years (at Key Stages 2, 3 and 4)*
- *provide information that will assist in the formation of national, local and school policies on the deployment of ICT* (Department for Education and Skills, 2001).

The study examines how pupils' learning has been enhanced as a result of exposure to Information Communication Technologies (ICT) through analysis and interpretation of national test data in relation to school rating for ICT, and through the identification of any additional learning gains that may not be reflected in national tests currently used in schools. The study developed a way of representing learning using ICT, 'which places pupils' learning both within the influences of the traditional school-based environment, and in a wider social context' (DfES, 2001, p. 4).

The comprehensive model of student learning in ImpaCT2 has implications for the study being conducted for DEST by ACER to investigate the links between teacher professional development and student learning outcomes in that it indicates the significance of identifying valid and reliable ways of capturing evidence of student learning. There are also implications for the ACER study in the emerging finding from ImpaCT2, which makes the connection between learning opportunities for students and teacher quality: 'the integration of ICT into subject teaching depends upon teacher confidence and skills and varies widely within a school' (DfES, 2001, p. 11).

The effects of teachers' professional lives on student achievement in writing, reading and English

A longitudinal study (Langer, 2000) examined the effects of teachers' professional lives on student achievement in writing, reading and achievement over a five-year period. This study used a nested case design to identify characteristics in teachers' professional lives that accompany higher achievement. The professional community (the people with whom the teachers shared and gained professional ideas and knowledge, both within and apart from their workplace, both close to home and afar) was the case (Langer, 2000, p. 403).

The concept of 'professional community' is useful in that it signals that professional growth is one element within teacher quality, and that investigations of the impact of professional development need to take account the broader context in which professional growth is experienced. The study found the 'beating-the-odds teachers within beating-the-odds schools' were observed to work collegially toward professional growth and improved practice. (Langer 2000, p. 404)

The authors report that the findings of this study, which identify and describe characteristics of teachers' professional lives that seem to make a difference in student learning, provide models of implementation within the embedded contexts McLaughlin and Talbert (1993) consider a strategic site for systemic reform, simultaneously addressing their three components: content, students and teacher. (Langer, 2000). This longitudinal study provides useful evidence of the operation of the linkages between professional growth, or learning, changed practice and student outcomes, which is the subject of the ACER investigation.

The impact of Count Me In Too on student achievement

An Australian study (White and Mitchelmore, 2002) investigated trends in the NSW Year Basic Skills Test (BST) numeracy scores over the period 1996–2001 in schools that had been implementing the CMIT in all K–2 classes for at least two years. The BST data provides large-scale, standardised student achievement data. The findings are relevant to the ACER investigation, as overall, CMIT was found to have had a small but definite impact on Year 3 BST numeracy scores. Of more specific interest is the researchers' report that

> *the most positive aspect of CMIT appears to be the emphasis on professional development provided to help teachers better understand how children learn mathematics, rather than on the more traditional idea of providing a teaching package* (White and Mitchelmore, 2002).

The significance of a professional development focus was supported by two findings:

- *The main gains in BST scores occur at or soon after implementation and not when the students reach Year 3. The CMIT effect seems to be on the teaching of numeracy in the lower primary school as a whole, and not only on students exposed to CMIT.*
- *Teachers in the most successful schools tend to focus less on resource development as one of the most important parts of the program than do those teachers in less successful schools* (White and Mitchelmore, 2002).

The linking of professional development to improved student learning outcomes is a significant finding. These findings support earlier work by Bobis (2001). (Count Me In Too is one of the Australian programs being investigated in the school-based trials in the ACER study, as a major initiative of an education system that includes a professional development program with a well-developed theory of action.)

New York City Community District #2

An example of systemic improvement strategies designed to bring about significant gains in student performance by focusing on the fundamentals of teaching and learning in a sustained way over time is provided by New York City Community District #2. '… the main vehicle for improvement is heavy investment in teacher professional development focused on curriculum and pedagogy in basic academic content areas' (Elmore and Burney, 1998). The work of the superintendent, Alvarado, in using professional development as the central element in a system-wide process for improving instruction is of interest to the present study.

The initiatives designed to achieving system-wide instructional improvement in New York City Community District #2 resulted in a marked aggregate improvement in student achievement. However, there is considerable variability in school-by-school performance within the district.

The strategy of focusing professional development tightly on district-wide improvement in instruction involved every educator in the district. Principals were held accountable for the improvement of instruction in their schools. District #2's professional development program used four models:

- the professional development laboratory

- instructional consulting services

- inter-visits and peer networks

- off-site training.

However, researchers Miech, Nave and Mosteller (2001) conducted evaluations of the impact of the teacher professional development programs, and found that

the evaluations tell us that their impact on teachers' skills or student learning remains unclear. Both reported improvements in student test scores on standardised tests, but neither included a rigorous evaluation design from the outset that was tightly coupled with the two objectives of improving teacher skills and student achievement.

The variability across schools, and the lack of clarity about the impact on teacher skills and student achievement in this system-wide initiative provide useful reminders of the complexity of the linkages between teacher professional development and student outcomes. One element in this complexity is variation between schools. Elmore and Burney make clear that 'learning how to treat schools differently in the context of a common set of expectations for improvement and performance is central to systemic school reform' (Elmore and Burney, 1998).

Sykes (2002) notes that the Community District #2 case is

the best example in the literature to date of organisational practices that embody the consensus principles on PD. The case features district and school-level leadership as the critical factor, and adds to our understanding of effective PD by introducing the idea of 'theory in action' to reveal how principles and practices interact to produce results. The case is also a useful corrective to simple-minded views about practices pulled out of organisational contexts that supply necessary support. Ultimately, the case reveals how PD may be used as the main driver to scale up instructional improvement in large, urban districts.

Significant reading improvements for six-year-old students

The three-year New Zealand study cited above (Timperley et al., 2003) looked at how schools worked to lift student achievement after teachers had been trained in early literacy teaching. It is interesting to note the longitudinal nature of this study. Key findings of this study, consistent with other research cited in this review, were that:

- *The most successful schools in sustaining high levels of achievement are those whose teachers base their teaching methods on student achievement information.*
- *Professional development needs to focus on raising teachers' expectations of student achievement.*
- *Student achievement must be the touchstone for measuring teaching effectiveness.*
- *The concept of 'being professional' changes when student achievement is the touchstone. For example, professional autonomy may hinder rather than support the goal of improving student achievement.*
- *Professional development programmes need to be integrated into teachers' everyday working responsibilities.*
- *Teachers must have ongoing support if professional development is to have a long-term, positive effect on student learning.*
- *The most successful schools in raising student achievement have strong professional learning communities* (Timperley et al., 2003).

These findings come from a longitudinal research study, reinforcing the need to allow time for changes in student learning linked to teachers' professional learning to become evident.

A current Australian initiative designed to improve student learning outcomes is the Getting it Right Literacy and Numeracy Initiative of the Western Australian Department of Education, which commenced in 2001 (Cahill, 2004). The program provides extensive professional development in a collegiate setting for designated specialist teachers in literacy and numeracy. The specialist teachers work with teacher colleagues in their own schools, to improve instructional practices and improve student learning outcomes to meet specified targets. An evaluation of this initiative is being undertaken by ACER, and will be completed in mid-2005.

Rowe (2003) adds further weight to the argument about the need for longitudinal research, in particular on the impact on teaching practices, although the logistical problems of such research are noted:

> *… there have been relatively few large-scale studies capable of providing valid generalisations, and fewer still that have collected longitudinal data that are essential for the estimation of specific effects of schools over and above that which students bring with … suggest that it is necessary to be cautious in interpreting '…any study of school effectiveness that relies on measures of outcome in just a single year, or stability over time'. While the advice is apt, the logistical problems in mounting and maintaining such studies entail severe practical constrains, resulting in a virtual absence of studies conducted over long periods of time.*

The research on levels of use of teaching innovations demonstrates the stages involved in changing practice, and the time that might be required for teachers to move through these levels of use. Hall and Hord (1987) identified levels of use of an innovation.

Levels range from 'non-use', a state in which the user has little knowledge, connection or involvement with the innovation, to 'mechanical use'; a state in which effort is focused on day-to-day use of the innovation, to 'renewal', a state in which the user re-evaluates, modifies and explores new developments in relation to the innovation. Hall and Hord's research

'…implies that implementation to the point of institutionalisation … will require three to five years' (Hall and Hord, 1987).

5. Conclusions

This review has drawn on the growing body of professional discussion and research on the links between professional development and improvements in student learning outcomes, and also on literature relating to teacher quality, effective professional development and school reform.

The review of literature and international practices supports the model designed for conducting this investigation. The models described by Supovitz (2001) and Garet et al. (2001) are consistent with the model we have constructed for the investigation. For the school-based trials, we have constructed a three-stage model. The first stage is focused on the links between teacher professional development and teacher professional learning. The second stage studies the links between professional learning and changes in teaching practices. The third stage of the model investigates the links between changes in teaching practices and improvements in student achievement.

Teacher professional development

The literature provides insights into design principles and productive practices in professional development. There is an extensive body of work in this area, and as Sykes (2002) indicates, considerable consensus on significant principles. This work provides a lens through which the features of the professional development programs selected for the study can be examined.

Professional knowledge

Contextual factors such as system policies, school-wide factors, school leadership, and the supportiveness of the school community influence the development of professional knowledge. The content of the professional development program plays a role: a widely agreed principle of professional development emphasises the importance of professional development focused on the content that the teachers teach.

Teaching practices

As Loucks-Horsley et al. and others suggest, one of the purposes of professional development is to enable teachers to put new professional knowledge into practice in their classrooms. Professional development that is continuous and ongoing is more likely to do this than professional development that is less comprehensive in scope. This aspect of change was investigated through the case studies of the professional development programs.

Student learning outcomes

The research literature on educational effectiveness and that on features of effective teacher professional development provides some evidence of the impact of professional development on student learning. The research literature on educational effectiveness clearly identifies the connections between quality teachers and their professional development, and the 30 per cent of variance in student achievement that is influenced by teachers (Rowe, 2003; Hattie, 2003). There is convergence in the research literature on the features of effective professional development, including the focus on subject matter learning, that are connected with students' learning (Cohen and Hill, 2000; Thompson, 2003; Ingvarson, Meiers and Beavis, 2005; Kennedy, 1998). A small number of longitudinal studies (Langer, 2000; Timperley et al., 2003) have found that schools with strong learning communities are successful in improving student achievement.

This review indicates that there is a relatively small body of research-based evidence to draw on in relation to linking professional development to student learning. Supovitz (2001) notes

the need to ensure that assessments of student achievement are aligned with the purposes of the professional development. This poses challenges.

Some of the work that indicates positive effects of professional development on student achievement is based on measures of large-scale assessment programs. However, the nature of student achievement targeted in some professional development is not easily measured through such tests. Time is an issue for gathering real evidence of change. Substantial changes in teaching practice take time, and further time is involved when students' learning is taken into consideration.

Longitudinal research

The review of literature indicates that one reason for the limited evidence of the impact of professional development on student learning is the lack of longitudinal research, and that further longitudinal research into teacher change and student learning is required (Richardson and Placier, 2001; Supovitz, 2001).

However, this review of the literature and reported initiatives provide a solid basis for the investigation in this project of the links between teacher professional development and student learning outcomes.

Chapter 3

The School-based Trials: Case Studies

The school-based trials were focused on whole school approaches linking teacher professional development to student learning outcomes. Ten professional development programs were investigated in 70 schools, 42 primary schools and 28 secondary schools, from all education sectors. The trials were conducted during the 2002 school year, when all key data, including student outcome data, was collected.

The ten professional development programs that became the focus of the school-based trials were identified following extensive national consultation, and included a wide range of professional development models. The professional development programs were provided by major educational agencies in the states and territories:

1   Learning Improves in Networking Communities (LINC) (Monash University and Catholic Education Commission of Victoria; three secondary and six primary schools)

2   Graduate Certificate in Education (Teaching of Literacy) (Department of Education Tasmania, Tasmanian Educational Leaders' Institute. Recognition Services; two secondary and four primary schools)

3   Science in Schools (SiS) Strategy (Department of Education and Training, Victoria; four secondary and three primary schools)

4   Science Standards and Portfolios Professional Development Program (Australian Council for Educational Research; six secondary schools).

5   The Early Years Numeracy Program (Department of Education and Training, Victoria; six primary schools)

6   The Count Me In Too (CMIT) Early Numeracy Program (Department of Education and Training, NSW; seven primary schools)

7   Year 9 Exhibitions project (ACT Department of Education and Community Services, eight secondary schools)

8   New Basics Trial, incorporating formal professional programs on Protocols, Rich Task implementation, Productive Pedagogies and Standards (Education Queensland; two secondary and six primary schools)

9   The WA Australian Government Quality Teacher Program Action Research Projects (Education Department of Western Australia; seven primary schools)

10   Teaching Futures Action Research Project (Canberra-Goulburn Catholic Archdiocese; six secondary and two primary schools)

Detailed accounts of each professional development program are presented in Volume 2 of this report. Characteristic features of the professional development programs are identified in Table 5.

Table 5: Features of the professional development programs

Professional development programs	Key features
1 Using a standards-based index of inclusion for framing whole school professional development and improving outcomes for students with disabilities	School based; school teams Collaborative; builds professional community Link primary and secondary schools Embedded in context of curriculum Aim for improved outcomes for students Ongoing support from consultants and experts provided Standards-based
2 Graduate Certificate in Education Teaching of Literacy	Accredited program (RCC) Embedded in curriculum that is being taught Development of portfolio a central feature Indicators of competence Opportunities for reflection on practice Standards-based Focused on a specific learning area
3 Science in Schools (SiS) Strategy	Embedded in practice Whole school approach School and teacher action plans Follow-up processes School leadership and external support Standards-based Focused on a specific learning area
4 Science Standards and Portfolios Professional Development Program (ACER)	Examining student work Development of portfolio a central feature Standards-based Embedded in normal work of the teachers in their schools Analysis and reflection Focused on a specific learning area
5 The Early Years Numeracy Program	Train-the-trainer model Six-day spaced program for leaders Examining student work Monitoring and assessment Professional learning teams Resources Embedded in teaching context Focused on a specific learning area
6 The Count Me In Too (CMIT) Early Numeracy Program	Changing teachers' beliefs and understandings Examining student work Monitoring and assessment Range of support and resources Mentoring Embedded in teaching context Focused on a specific learning area
7 Year 9 Exhibitions project (ACT Department of Education and Community Services)	Four-day spaced program School teams Collaborative curriculum planning Examining student work Assessment of student by exhibition Ongoing work over time
8 New Basics Trial, incorporating formal professional programs on Protocols, Rich Task implementation, Productive Pedagogies and Standards	Curriculum reform Assessment Action research Examining student work Collegiate sharing and learning
9 The WA Australian Government Quality Teacher Program Action Research Projects	Action learning approach Action learning projects identified by schools Embedded in teaching context Access to targeted expertise and support Leadership support Collaborative
10 Teaching Futures Action Research Project	Action learning approach Action learning projects identified by schools Embedded in normal work of the teachers in their schools Access to support and expertise as needed Examining student work

A team of link researchers was established to work with the clusters of schools involved in the professional development programs. Each link researcher managed the development of a single case study, maintaining contact with schools, collecting data and visiting schools. During school visits, the researchers interviewed teachers, observed classes and also interviewed key school personnel, including principals.

The link researchers team met regularly as a team to share experiences, sort out practical problems and discuss methodological issues.

The main research questions for the school-based trials were:

- What links can be made between the teachers' participation in the particular professional development program and improved student learning outcomes?

- What is the nature of these links?

Data gathering

When visiting schools, and when collecting information from teachers via logbooks, questionnaires and other means, the researchers sought data to help answer the following specific research questions in relation to the professional development program that was the focus of their case study.

- What have teachers learned from undertaking this professional development program?

- How has this learning been reflected in their teaching?

- What are the connections between the changes in teaching that have resulted from teachers' learning and intended learning outcomes of students?

- What student learning outcomes have improved? How? To what extent? What is the evidence of improvement?

- Have the changes to teachers' practice that resulted from the professional development created enhanced learning opportunities for students?

- To what extent can improvements in student learning outcomes be attributed to the teachers' learning from the professional development program?

The link researchers also sought to expand their understanding of the processes and activities of the professional development program by attending some professional development activities, interviewing personnel from central and district offices worked in association with the schools or attending special events such as a full-day conference showcasing Action Learning projects. The chart on the following page presents the framework that was used to guide the collection of data from the schools participating in the school-based trials.

Table 6: Data gathering plan

Characteristics of the PD Program and sources of data	System/School context variables	Measures of teacher knowledge and beliefs	Measures of classroom/teaching practices	Outcome measures and sources of data
Design of the program Focus: coherence/soundness of plan, links to school efforts, standards Interview: Program organisers; program documents Delivery processes Focus: What is actually implemented; Learning opportunities that teachers experience Survey of participants Interviews with Program organisers Observations Content of the PD Focus: subject matter—concepts, learning of subject matter, representing content, etc. Analysis of program documentation; Interviews with Program organisers Survey of participants	Context for PD Focus: System/school level backing—financial, cultural, institutional Data sources: Interviews with System PD administrators; program organisers; school principals; teachers School level data: Measures of leadership support and pressure Professional community: Shared values Collaboration Reflective dialogue De-privatisation	Program specific measures: Focus Teacher knowledge about the content of the program Knowledge gained from the PD program Teacher beliefs/attitudes/ Assumptions about the change Data sources Interviews/questionnaire Modified portfolio/assessment centre formats Ask teachers to 'walk through' how they plan a unit of work; how they assess student progress; etc. (Aim here is to gather data about a teacher's pedagogical reasoning)	Program specific measures Question: What are teachers doing now that they weren't doing before, as a result of the PD Program? Options Identify critical indicators of use: develop LOU measures Interviews, conferencing Direct structured observation of lessons where appropriate to the change Student interviews Structured tasks where teachers are invited to provide their own examples of how they have changed their practice as a result of the PD Program Teacher implementation logs, reflective journals Questionnaire measures of teaching practice Focus groups: school staff groups	Program specific measures 1 SiS Vic 2 Early Years Numeracy Vic 3 Count Me In Too 4 Learning Improves in Networked Communities (Monash-CECV) 5 Action Research Projects (WA AGQTP) 6 New Basics; productive pedagogy (Ed Queensland) 7 Graduate Certificate in Literacy—portfolios (Tasmania and SA) 8 High schools for the new millennium (ACT) 9 Teaching Futures (Canberra-Goulburn Catholic Diocese) 10 Portfolios and standards for science teachers (ACER)

One of the purposes of the school visits was to establish a full understanding of all of the processes and activities within the professional development programs that generated opportunities for teachers' professional learning. The professional development programs were complex and multi-layered. The same program could be conducted in different ways in different schools. For example, in implementing the Early Years Numeracy Program in one school, professional development activities involved fortnightly meetings of professional learning teams, the viewing of the Schools TV broadcast on Early Years Numeracy, and the training of integration aides. In another school, the professional learning activities supporting the introduction of the Early Years Numeracy Program centred on staff meetings with an Early Years Numeracy Program focus, two 2-hour after school sessions, and incidental learning from other teachers.

The research team also sought evidence of changes in teaching practice. The following comment from a Western Australian teacher illustrates the kinds of reflection on practice prompted in an interview with a researcher:

> *The accountability aspect of the research program has made me take it [the professional development] seriously and to consciously think all the time, asking myself 'What is happening?' and trying to work out why? I find I am moving away from telling kids what to do (in science) and letting them work it out a lot more of the time. I found having the extra time [from the research project teacher relief funding] has allowed me to watch my target group of kids. They forgot I was there after a while. I was able to observe them and see their real understandings. It was very interesting and I realised how different some of my findings of their progress were as a result.*

In the interviews, teachers talked about the features of the professional development that they had found useful:

> *The main aspects of the professional development that would help a teacher to use the Early Years Numeracy Program in the classroom were the classroom management ideas, the planning and approach; the format to teach from which allows individual monitoring and teaching to strengths and weaknesses of all students, and encouraging the 'where to now' extension.*

A key research strategy in this project was directed towards gathering evidence of changes in student learning outcomes. This involved the use of a range of rigorous assessment instruments, aligned as closely as possible to the purposes of the professional development programs. These assessments were administered to students in Semester 1. A second round of assessments was conducted in October–November. Assessments were made of learning outcomes, as well as of changes in attitude and behaviour. These assessments provided repeated measures over time. However, there was a relatively short period between the two assessments, and it was anticipated that the evidence of learning gains would be modest.

A statistical process of explanatory modelling was used to determine where students had performed better than might be expected. This 'value-added' model was used to identify the schools where it appeared that the professional development might have impacted on student outcomes. The qualitative data collected from observations, interviews, and teachers' reflective responses was scanned to help interpret the findings from the analysis of the student data.

The interviews provided some anecdotal evidence of changes in student outcomes, broadly defined, as in this teacher's comment:

> *I think that the student outcomes should be able to include student attitudes and behaviour. I have two difficult boys in my class who spent most of their time last year sitting outside their class or at Admin with the deputy. The deputy asked me last week if J— had left the school because she never saw him. His academic work will not*

show a significant change but he is able to acknowledge now that his behaviour is sometimes unacceptable. This is a huge improvement!

Towards the end of the 2002 school year all teachers were interviewed, and, together with some of their colleagues, were asked to complete a written questionnaire designed to collect information on the impact of the professional development on their teaching practices, and on the learning outcomes of their students. Findings about the factors affecting the impact of professional development derived from the analysis of the questionnaire are discussed in Chapter 5.

Student outcomes

For the purposes of this investigation of the links between teacher professional development and student learning outcomes, a broad working definition of student outcomes was adopted. Student outcomes were seen to include specific improvement at the level of a key learning area, either across the stages of schooling, or at a particular stage. Student outcomes that related to engagement, motivation, enjoyment and participation were also included. Thus a variety of methods for collecting information about changes in student learning outcomes was used, including standardised tests aligned to the purposes of the professional development, measures of student behaviour and attentiveness, and teachers' observations and judgements. The questionnaire completed by teachers asked them to report on their perceptions of changes in their students' learning that had come about because of their participation in the professional development program.

The professional development programs that were the subject of the school-based trials in this research were selected because they all included a stated intention of improving student learning outcomes. The selection of the professional development programs was also guided by the variety of ways in which the improvement of student learning outcomes was addressed. An important focus of the case studies was to identify the design features of the professional development programs that were intended to impact on student learning.

In different ways, the professional development programs demonstrated the logic of focusing on professional development as a means for producing higher levels of student achievement as a consequence of its impact on producing superior teaching in classrooms. (Supovitz, 2001).

The professional development programs

There were considerable differences in the design of the ten programs, including the ways in which they linked the purposes of the professional development to the improvement of student outcomes.

One major difference lay in the breadth or specificity of the focus on student outcomes. A number of the programs focused on outcomes within key learning areas, at particular stages of schooling. Other programs addressed student outcomes from a broader perspective, such as increased participation, motivation and engagement.

Another difference was seen in the design of the professional development programs. One of the programs was designed around the provision of a particular set of learning opportunities for students, while other programs were designed to involve teachers in reflecting on their practice, with the objective of deepening their professional knowledge and teaching practices, which would in turn lead to improved learning outcomes for students.

Table 7 shows how the different professional development programs focused on student learning outcomes. In a number of cases, the main focus was on specific learning areas, while in other cases the intention of the professional development programs was to expand students' intellectual engagement and motivation across discipline areas.

**Table 7: Student outcomes and the professional development
programs**

The PD program	Focus on improvement of student learning outcomes in the PD	Student learning outcomes in key learning areas	Student learning outcomes: participation, motivation, engagement
Count Me In Too	Observation/assessment tool for teachers (SENA), identify student needs, teach	numeracy; early years	
Early Years Numeracy	Observation/assessment tool for teachers (interview), identify student needs, teach	numeracy; early years	
SiS	Whole school improvement of science learning opportunities	Science, P–12	
Portfolios and Standards.	Enhance teaching practice in science	Science, P–12	
LINC	Teachers include all students	Literacy	Inclusion, participation
Year 9 Exhibitions	The students' exhibitions, and roundtable presentation are the outcomes	Cross-disciplinary	Motivation, intellectual engagement, communication
New Basics	Aim to increase engagement and intellectual challenge	Cross-disciplinary	Motivation, intellectual engagement
WA AGQTP	Focus on pedagogy. Action research questions identify student needs.	Selected curriculum areas	
Teaching Futures	Focus on pedagogy Action research questions identify student needs	Selected curriculum areas	
Graduate Certificate in Literacy	Strengthen experienced teachers' practice, improve students' learning	Literacy, P–12	

Features of the professional development programs

In most of the professional development programs, the content was strongly connected to curriculum, assessment and classroom practices. For example, the content of the Early Years Numeracy Project included mathematical knowledge, insights into children's numeracy strategies, and the development of understanding of an interview as a means of assessing children's knowledge and skills. The Science Standards and Portfolios Professional Development was built around a set of professional standards focused on science content.

Most of the professional development programs were system-level initiatives, and received different forms of support from the system. The Science in Schools project, for example, was supported by an extensive infrastructure including central, regional and school support personnel. Most of the programs involved collaboration amongst teachers. The Learning Improves in Networking Communities (LINC) project established, in each school, a coordinating group that was set up for collaborative problem-solving, analysis and reflection. In the ACT Year 9 Exhibitions project, the intention was that Year 9 teachers would work as a team to develop teach a cross-disciplinary unit, and as a culminating activity, involving all students in round table exhibitions.

A number of the programs were based on, or linked to, sets of professional standards. The standards for science teachers developed by the Australian Science Teachers' Association

were central to the Portfolios and Standards project, and the standards-based index for inclusion provided a constant reference point for the LINC project. Two projects provided opportunities for accreditation: the Graduate Certificate in Literacy led to a qualification, and the LINC project involved some teachers in post-graduate diploma or masters' programs.

Chapter 4

The Impact on Student Performance

The collection of student achievement data at two points during the 2002 school year was a key element of the school-based trials. The assessments were administered early in the first semester and in November. The purpose of conducting the repeated measures of student achievement was to provide a means of investigating and monitoring changes in student learning outcomes as a consequence of changes in teaching practices linked to the teacher professional development programs.

For each of the ten case studies, the ACER research team investigated the properties of several assessment instruments and, where possible, consulted with the professional development providers and the schools before the instruments were finally selected. It was essential that the assessment instruments were as closely aligned as possible with the intentions of the professional development and were also rigorous and reliable. It was also necessary to select instruments where assessments made at different points in time could be validly compared.

Overall, 70 schools were involved in the trials and eight different measures of student achievement were used. Table 8 provides a summary of the repeated measures used in the study.

Table 8: Summary of the repeated measures of student achievement

Teacher Professional Development Program	Assessment instruments used for repeated measures	What was assessed
1 Using a standards-based index of inclusion for framing whole-school professional development and improving outcomes for students with disabilities	• DART (Development Assessment Resource for Teachers) Writing • DART-Reading	• DART measures students' literacy achievement. Different assessment forms, calibrated on to a common scale are available to assess growth over time.
2 Graduate Certificate in Education Teaching of Literacy	• DART-Reading • DART-Writing • Rowe Behavioural Rating Inventory	• Two equated forms of DART-Reading and Writing used on two occasions provided an appropriate literacy assessment for this PD program targeting literacy teaching. • The RBRI, completed by teachers, using the same form on two occasions, provided a measure of changes in students' behaviour.
3 Relating Professional Standards to Practice: Science Standards and Portfolios Professional Development Program	• International Benchmark Tests in Science (IBT)	• Derived from the Third International Mathematics and Science Study, for the age group 9–13, and was appropriate for this PD program.
4 Science in Schools (SiS) Strategy Research Project	• IBT Science	• The IBT assessed understanding of science concepts, skills, processes, and was an appropriate

Teacher Professional Development Program	Assessment instruments used for repeated measures	What was assessed
		measure for the SiS.
5 Early Years Numeracy Program	• Rowe BRI • LLANS (Longitudinal Literacy and Numeracy Study) Numeracy tasks	• The LLANS tasks were developed for the early years of school, as one-on-one interview tasks appropriate for the age group. LLANS assesses key aspects of numeracy learning at different points in the early years.
6 Count Me In Too	• Rowe BRI • LLANS Numeracy tasks	• The LLANS numeracy tasks provided repeated assessments designed for use with children in the early years of school.
7 ACT Year 9 Exhibitions Professional Development Program	• Student Attitude Survey	• The diversity of the curriculum focus, and the interdisciplinary emphasis of the Exhibitions project meant that a general survey of attitudes was the most appropriate measure of change.
8 New Basics	• Progressive Achievement Test in Maths (PAT Maths) • DART Reading	• PAT Maths and DART Reading provide broad measures, calibrated on common scales, of literacy and numeracy, key underpinning skills, expected to improve in the New Basics.
9 The Quality Teacher Program (QTP) in WA Department of Education and Training Schools	• DART Reading • Rowe Behavioural Rating Index (BRI) • LLANS Literacy • IBT Science	• A range of assessment instruments aligned to the school-level foci of the Action Learning projects.
10 Teaching Futures	• DART, Maths words problems, ICT skills survey.	• The action learning projects within this initiative covered many different curriculum areas, according to school need, so a range of assessments was used.

Two of the repeated measures used the assessment instruments in the same form twice, to obtain two measures of students' performance on the instrument. The Rowe Behavioural Rating Index (Rowe BRI) was used in a number of trial schools as a repeated measure. The Rowe BRI, completed by teachers, is designed to monitor changes in student attentiveness, application to schoolwork, and emotional behaviour within the school's learning environment. The Rating Index was repeated on the second occasion. Another ACER resource used in the school-based trials was the Quality of School Life Survey (Primary and Secondary versions), a survey that is completed by students. The survey is designed to provide information on student attitudes to school life. This resource was used as a repeated measure with schools in the ACT. The Rating Index and the Quality of School Life Survey measured broad aspects of students' learning.

All of the other assessment instruments that were measures of aspects of learning focused on key learning areas (mathematics, science) and skills (reading, writing). The tests provided different forms with different items in matched categories, calibrated on the same scale, for use for repeated measures. The following assessments fitted this category: the ACER

Longitudinal Literacy and Numeracy Study (LLANS), the ACER Development Assessment Resource for Teachers (DART), the Progressive Achievement Test in Mathematics (PAT Maths) and the International Benchmark Test (IBT) in Science. These are widely used and reliable tests, and were selected because they were closely aligned with the purposes of the professional development programs in relation to student learning.

Materials from the ACER Longitudinal Literacy and Numeracy Study (LLANS) were used where the professional development programs were focused on literacy or numeracy in the early years of schooling. Two linked assessment forms, with different items, were used as repeated measures to monitor student achievement in these curriculum areas. These were administered in one-to-one interview situations by the children's own teachers. These tasks have been calibrated on the same scale, and so can be used to measure growth over time.

ACER's Developmental Assessment Resource for Teachers-English (DART-English) was used with many schools as a repeated measure of student's literacy achievement. DART-English is a classroom resource intended for use as part of a teacher's assessment of student achievement in English, with an emphasis on mapping student growth over time along learning continua of described outcomes. DART-English has reading, writing, viewing, listening and speaking components. Different test forms are available across a range of year levels from middle primary to junior secondary. ACER used various DART-English Reading and Writing tests at appropriate year levels for this study. Parallel tasks that were assessed with the same marking guides were used for Writing. Equated forms of different levels of difficulty were used in Reading. In these strands, matched or equated pairs of forms were used on the two occasions.

ACER's Progressive Achievement Test in Mathematics (PAT Maths) was used as an assessment tool in a number of trial schools where numeracy or mathematics was the focus of the professional development program. PAT Maths is designed to obtain measures of change in students' numeracy performance.

ACER's International Benchmark Test (IBT) in Science was used as a repeated measure with trial schools that were involved in professional development in the area of science. The IBT, derived from the Third International Mathematics and Science Study, is used to assess understandings of science concepts, skills, processes and procedures in two populations—around 9 years of age and around 13 years of age.

Analysing the repeated measures

A 'value-added' analysis of the repeated measures of student achievement was undertaken to compare the mean change in student achievement from Semester 1 to November. The focus in this value-added analysis was on the achievement at the end of the assessment period, after taking account of the students' achievement at the beginning of the assessment period (their 'prior achievement').

Detailed technical summaries describing the steps taken in the analysis of the student data from the repeated measures for each case study are presented on the DEST website at http://www.dest.gov.au/sectors/school_education/publications_resources/. These technical summaries outline the methodology through which the background variables were investigated. The technical summaries report findings at school or teacher level, as appropriate to the particular case study.

A multi-level analysis was conducted for each professional development project, using the repeated measures. The process of analysis was the same across projects, even though the assessment instruments were different. The essential purpose of the analysis was to identify those school sites where the students' performance on the second assessment was better than might be expected, taking account of their prior achievement on the first assessment.

The multi-level analysis of the repeated measures of student achievement established that in only a few cases did the data show that the students had achieved more than might have been

expected and, as a corollary, that this achievement might have been attributable to the particular professional development program. See the DEST website for the *Research data: analyses of repeated measures of student achievement*, which is available at http://www.dest.gov.au/sectors/school_education/publications_resources/.

Using the analysis of project #1 Reading as an example (see Table 9), the adjusted mean point estimate is shown as a triangle located within a vertical error band, which shows the 95 per cent 'uncertainly' intervals marked at each end with a horizontal band displayed for each of the nine schools. The zero dotted horizontal line represents the 'population mean' (set at 0.0 on the vertical scale on the left side). This line shows the amount of growth expected between the two assessments

When the 'uncertainly' intervals for the group of students from the school do not overlap and are above the population mean (school 9), the students in that school have achieved better than expected on the assessments, given their prior achievement in the first assessment.

When the 'uncertainly' intervals for the group of students from the school do not overlap and are below the population mean (schools 1 and 2), the students in that school have achieved less well than expected on the assessments, given their prior achievement in the first assessment.

The 95 per cent 'uncertainty' intervals of the other schools (3–8) overlap the population mean and these students have therefore achieved the expected levels of growth.

For River Gum High School, the lower bar of the confidence interval is clearly above the population mean zero. This would suggest that the students at River Gum High School have performed better than might have been expected, relative to the other eight schools. Potentially, the impact of the professional development program on teacher's practice could account for this better-than-expected performance.

Table 9: Ranked Residuals for Reading for Project 1 Schools (LINC)
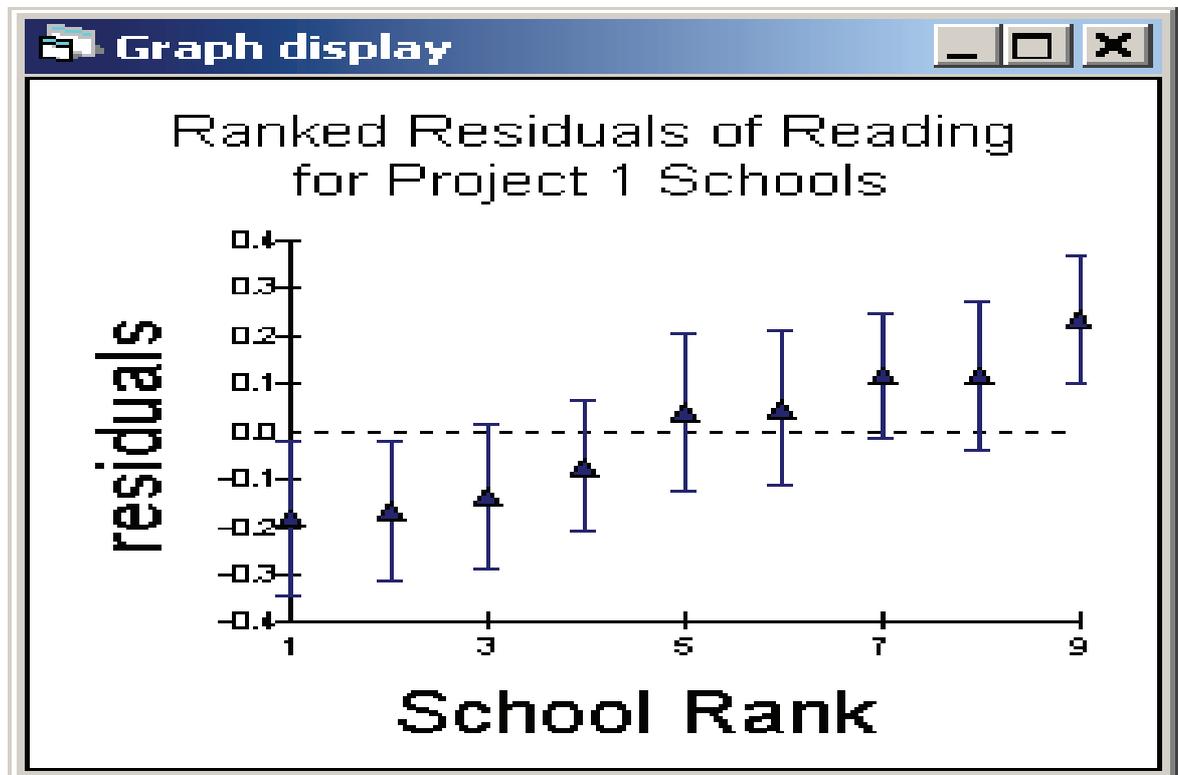
Summary of findings

Across all ten professional development programs investigated in the school-based trials, performances better than might have been expected were found in four cases.

Project #1	DART-Reading	River Gum High School
Project #1	DART-Writing	Plover Primary School
Project #4	IBT Science	Styphelia College
Project #6	Rowe Behavioural Rating Inventory	Dove Street Primary School

Improvements in student learning had taken place in all schools, but the value-added analysis makes it possible to focus on cases where the improvement is better than might be expected. These four cases are of particular interest, as they suggest that the professional development program has led to more effective teaching. They provide an opportunity to develop further understanding of the links between professional development and improved student learning outcomes. Examination of the qualitative information from the case studies for these schools reveals that in each case, conditions in the school contributed to the difference.

Connections

In the case of River Gum High School, in Project 1 (LINC), the school had participated in specific professional development activities related to reading, in addition to the professional development activities in which the other schools had been involved. In other words, connections had been made between the professional learning gained from LINC and other professional learning opportunities. The additional professional development opportunities, and the specific focus of these on reading may explain why this school's reading results were better than might be expected.

Conditions for professional learning in schools

The case of Plover Primary School, Project 1, is interesting. The better than expected results for the DART-Writing assessment could be explained by the attention to teaching argumentative writing provided by the professional development program. The literacy analysis and the scaffolding strategy developed to support writing in various genres in this case appear to have strengthened students' writing of argument.

In this school, the LINC professional development led, in turn, to an increased focus on teaching students how to write arguments. The DART-Writing results show better than expected results for writing. The trained assessors had, during the marking process, drawn attention to the unusually high quality of argument writing demonstrated by these students, commenting on the groups' high level of understanding of argument. Unusually, they found classes, from Year 5 to Year 9, where almost all students knew how to structure an argument. Even where the substance of the argument was weak, students had understood the purposes of argument and could use a framework for setting out a case.

In the professional development program, certain genres or text types, such as report writing and argument writing, were identified as spanning several key learning areas, for example, Science, Social Studies and English. It was suggested that students might benefit from specific teaching about the structures and features of the genre, so that they could apply them to tasks in different curriculum areas. The strategy of providing students with 'scaffolding' for an argument, for example, was described to the teachers. The students could then use this framework whenever that genre was called for. This scaffolding strategy was taken up enthusiastically in all nine schools and was felt by the participating teachers to be a valuable concrete learning from the LINC program. The professional development program

emphasised the content that teachers teach (how to write in different genres), and strategies for teaching the content.

However, in the case of Plover Primary School where the student achievement data identified a specific situation, it is reasonable to attribute the improvement in student learning outcomes to changes in teaching practice resulting directly from the professional development made available to the teachers of these students. The difference in impact lies in differences at the school level. The situational context varies from school to school, according to the conditions that influence context, including follow-up, opportunities to receive feedback on teaching, support from the school leadership team, opportunities for collaboration and opportunities for shared examination of student work.

The message from this example is that while professional development may be positively received by teachers and enhance their professional knowledge, the impact of that professional development on student learning is dependent on school level factors. Changes in student learning may take longer to become evident in one school than another, given the nature of local conditions. This suggests the need to maximise conditions for teachers' professional learning in schools, by providing follow-up and support for professional development, and by strengthening professional collaboration in schools.

Conditions at the school level also provided an explanation for between school differences in the Science in Schools case study. The results of the assessment using the IBT in Science with students from Styphelia College (Project 4, Science in Schools) were in the range of 'better than might be expected'. The case study data indicted that science teachers at this school were members of a strong and cohesive team, with strong leadership. More time was devoted to the teaching of science as an independent subject, rather than integrating it with other studies. Mentoring arrangements were in place to support new staff. The school was in the second year of involvement in the Science in Schools project, teachers were committed to the SiS Action Plan, and it had been followed up. In this case, it appears that a number of factors within the school context in which the SiS professional development program was implemented contributed to the better than expected outcomes.

Teachers' prior experience

The results of the repeated measures on the Rowe Behavioural Rating Inventory for students of one teacher at Dove Street Primary School show better than might be expected behavioural outcomes This can be explained by the evidence gathered in the case study that from previous experience with the Count Me In Too professional development in another school, this teacher had developed strong beliefs in the value of the teaching approaches, which underpinned her work in the new school.

Teachers' professional learning and student learning

In each of these four cases specific conditions applied in the schools, or applied to particular teachers. These cases help us to recognise the complexity of finding evidence of the link between professional development and improved student learning outcomes.

One case seems to be explained by the school's overall priority focus on literacy, and the connections between this work and the LINC project. An explanation for the case of Plover Street Primary School relates to the direct linking of the assessment instruments with specific emphases in the professional development experienced by the teachers (the connections between the LINC program and the teaching of argumentative writing), and the better-than might-be-expected results for DART-Writing. The other cases are explained either by mediating factors within the school, or by the teachers' prior experience.

These four cases suggest three significant aspects that contribute to the impact of professional development on student outcomes:

- close alignment between the purposes and professional learning opportunities
  provided by the professional development and the measures of student
  achievement

- mediating factors at the school level, such as school contexts characterised by
  effective and sustained collaboration amongst teaching colleagues, and strong
  leadership support

- teachers' previous experience of the teaching approaches advocated by the
  professional development program and belief in the efficacy of the approaches.

While these factors were observed in other schools, they help to explain, in the four cases
identified, the better-than-expected performance of the students.

The extent of the impact of school variables, and variables associated with the structure and
design of the professional development programs are further explored in Chapter 5. The
significance of mediating factors at the school level, and of the importance of teachers' prior
professional learning experience point to the need for teacher professional development to be
perceived as a central element in the improvement of student learning, involving both school
contextual factors and factors relating to individual teachers.

The repeated measures of student achievement in the school-based trials were used to test the
links between professional development and student outcomes by gathering quantifiable data
on changes in student outcomes, and using a rigorous value-added methodology to analyse the
results. In relation to the links between professional development and student learning
outcomes, the following conclusions can be drawn from the value-added analysis.

- Assessments of the kind used for the repeated measures in the short term may
  not show the kinds of changes in the broad range of student outcomes targeted
  by the professional development programs.

- The assessments used, although carefully selected, may not have been
  sufficiently closely aligned with the purposes of the professional development
  programs, suggesting that the alignment of student assessment instruments with
  the purposes of teacher professional development is difficult and has limited
  application.

- The relatively short time between the repeated measures possibly did not allow
  for the changes in teaching practices promoted by professional development
  programs to have impacted on student learning; a much longer time span may be
  needed to allow for change to become embedded in practice.

- Conditions in schools influence teachers' professional learning, and these vary
  from school to school.

These findings indicate that the use of testing instruments alone to measure the impact of
professional development on student outcomes has significant limitations, especially over a
short time.

Student outcomes, broadly defined

In this project, a broad definition of student outcomes was used. To assess the impact of
professional development on such outcomes requires qualitative as well as quantitative data.
Qualitative data from teacher (and student) feedback and interviews, and from structured
observation of classroom activities at different points in time during the implementation of the
professional development program are essential. Complementary components of any data
collection need to be marshalled for the purposes of evaluating the impact of a professional
development program on student learning outcomes.

The case studies in Volume 2 tease out some of the detail about professional development programs, what teachers did, what they learned and what happened to their students.

Evidence of changes in student achievement can be found from a range of evidence, including teachers' classroom observations and students' performance in formal assessment tasks. The evidence from the formal assessments is discussed above.

In this project, the case studies provide further evidence of change in student learning outcomes. The case studies provide accounts from teachers of changes in students' levels of engagement and motivation, in their behaviour and in their self-esteem. They also report students' capacity to successfully undertake tasks that they have not previously attempted. Several examples are illustrative of this evidence.

For example, teachers in the Science in Schools project commented that their students 'were talking and explaining better … they participate more in activities … more creative, more effort … and they are learning more about communication skills and working together'.

Teachers in Count Me In Too noted changes in students learning, such as how questions about the 'number before' often elicited an automatic 'number after' response, but by the end of the year most students had learned to self-correct. The case study of Count Me In Too provided some telling examples of how strategies learned from the professional development provided teachers with tools to reshape their teaching approaches:

> *You get surprises. There was one child who was such a shock. I didn't realise what he could do … I'm surprised how many children have difficulty with the backwards number sequences, they can do 10, 9, 8 and so on but they can't do the others. I'm sure language problems are the cause. They always need to be reminded what the number before means. When I do this as a whole class I now realise that lots of kids are tuned out, what looks like the whole class chanting can just be led by a few. I need to think of activities that focus these children.*

Strategies that enable teachers to enhance their understanding of what students know and can do lead to changes in practice; but it takes time for these changes in practice to impact on students' learning.

Evidence of changes in students' classroom behaviour and in their performance on assessment tasks provides different but equally important insights into improvements in students' learning. Both kinds of evidence show significant outcomes related to learning, and indicate that the evidence of changes in student learning is to be found in teachers' observations, students' performance, as well as in test data.

Evidence of how changes in students' learning might be an outcome of teachers' implementation of the practices advocated by the professional development programs is more elusive. Conditions in schools need to be taken into consideration. The time taken for professional learning to become embedded in teachers' practice varies amongst teachers, and must be counted as a significant factor.

The next chapter discusses some of the links between teachers' learning and their experience of the professional development programs studied in the school-based trials.

Chapter 5

Cross-program Analysis

Introduction

The ten professional development programs in this study were chosen in the main because state and territory system authorities recommended them. Many were well tried and most were based on clearly articulated design principles, and this was reflected in the positive ratings they received from teachers. The case studies in Volume 2 of this report provide rich details about the designs of each program and the complexity of changes they required at school and classroom levels.

While our research focused mainly on case studies of each of these programs, this chapter looks across the ten programs included in the study. It explores components of programs that might explain relative differences in the impact each had on teachers' knowledge and practice and student learning outcomes.

To facilitate this cross-program analysis, participants in each of the ten programs were invited to complete a common questionnaire consisting of two main parts:

  a) questions about the design of the program; both its structure and the processes of learning used in the program

  b) questions about the impact of the program on their knowledge, practice, sense of efficacy, and their students' learning.

The survey also asked participants about the impact of the program on their professional community: the nature and extent of collaborative work amongst colleagues in their schools.

This chapter provides an analysis of the survey, specifically in terms of relationships between program design and program impact and a summary of the findings. While teachers who responded to the survey generally rated the ten programs highly in terms of impact, there were significant differences across the ten programs in the extent to which teachers reported that they had influenced their teaching and benefited their students. There were also marked differences in the strategies and learning processes used in these programs. These differences provided a valuable opportunity for cross-program analyses of the linkages between design features of professional development and learning outcomes.

Background

The ten programs in this study were selected carefully to ensure they differed in their design and the nature of the learning opportunities they provided to teachers. These differences would enhance the capacity of the study to identify links between professional development strategies and student learning outcomes.

One dimension along which programs differed, for example, was in the relationship between teachers and research. Some programs placed the teacher in the role of learning about and applying existing research to their practice; others aimed to place the teacher in the role of researchers themselves, conducting research into their own practice. Programs such as Count Me In Too and the Early Years Numeracy Project focused on assisting teachers to understand and make use of recent research about how students learn the content they are being taught. These programs aimed to deepen teachers' knowledge about the content they taught and help them to adopt specific teaching strategies based on that research. In this sense, they were structured training programs with clear goals. The designers of these programs could specify

the knowledge that teachers were expected to gain and the practices it was hoped they would use.

Structured programs of this nature are especially appropriate when the purpose of the program is to assist teachers to learn new pedagogical skills grounded in clear theory and research. The work of Joyce and Showers (1982) summarises the essential components of such training in 'teaching models': a clear theoretical rationale for the model based on research, modelling, and practice with feedback and coaching.

Others, such as the WA Australian Government Quality Teaching Program and the ACT Teaching Futures Program were based on action research or action learning principles. One aspiration behind these programs was to place greater responsibility in the hands of teachers for determining their professional development needs and developing plans to meet those needs. These programs also aimed to place the teacher in the role of generating rather than applying knowledge about teaching and learning. Emphasis was placed on assisting teachers to collaborate in developing tentative solutions to identified problems of practice, trialling them and evaluating their effects, thereby placing teachers in the position of making their own practice a site for research and professional development.

These two broad types of programs represent a common distinction in the professional development literature: between structured training models to assist teachers to add to their knowledge and skill and action research models that encourage learning from analysis and evaluation of existing assumptions and practice. In practice, however, the significance of the distinction tends to dissolve. Providers of structured professional development programs know that their programs will not be effective if they do not engage teachers, at least initially, in analysis and reflection on their current practice. Action research models that operate without a clear set of professional norms or standards, risk celebrating the idiosyncratic, under-utilising existing evidence-based research and re-inventing the wheel.

With this background in mind, we developed a method for describing the design of professional development programs that relied on participants' descriptions of what they had actually done, rather than what the designers themselves said about their programs. This approach is described in the conceptual framework below.

Method of data gathering

The principal means for gathering data relevant to the analysis in this chapter was a questionnaire distributed to teachers who were participating in one of the professional development programs chosen for this study. The link researchers distributed copies of questionnaires to teachers in the schools where they were conducting case studies, as part of the larger investigation. Distribution took place as late as possible in the year so that teachers would have had an opportunity to gauge the impact of the program and implement recommended practices. There were 70 schools involved in the professional development programs and 293 teachers from these schools completed questionnaires.

It is important to point out that the results of this survey should be treated with caution. Questionnaires were distributed to teachers only in the case study schools, and, for most of the programs in the study, these teachers represent a small, non-random proportion of the total population of teachers who participated in the programs.

Conceptual framework

The review of research conducted for this study was examined closely, looking especially for features that might be included in the cross-program analysis. The most relevant papers were those by Kennedy (1998), Loucks-Horsley et al. (1998), Hawleyand Valli (1999), Cohen and Hill (2000), Garet et al. (2001), Supovitz (2001), Sykes (2002), and Guskey (2002). This research has become increasingly sophisticated over recent years (Ingvarson, 2002) and provides a firmer foundation on which to identify program features and develop models that might account for the relative differences in the effectiveness of professional development
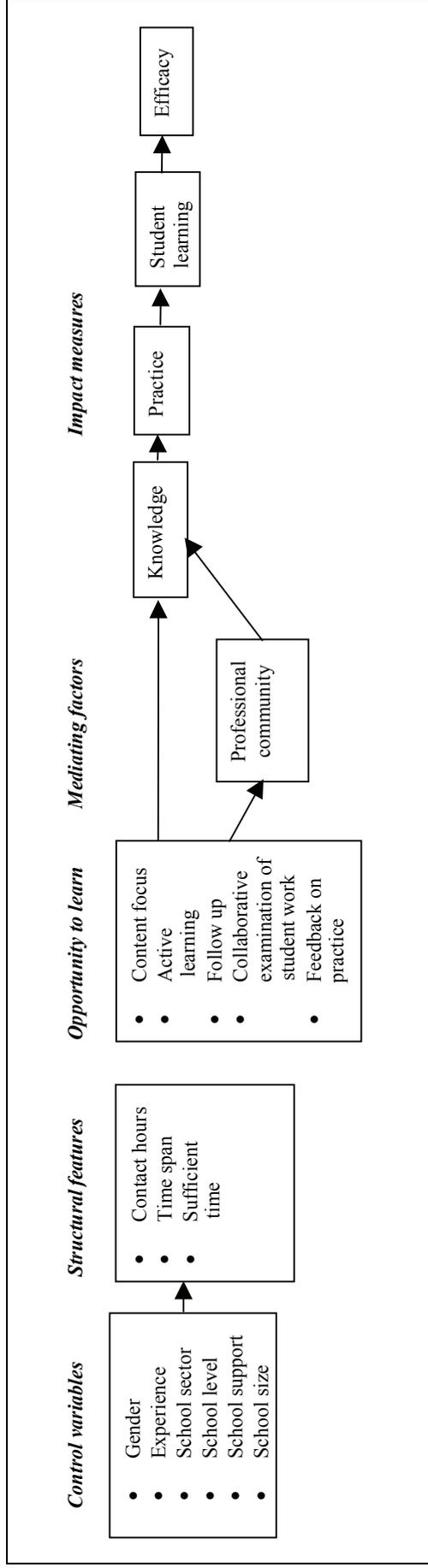
programs. The evaluation team used this research to create an instrument for measuring the extent to which teachers actually experienced certain types of learning opportunities during the professional development program. In developing this instrument (The Quality of Professional Learning Index) we used our review of the research literature to identify a number of characteristics of effective professional development. These included:

- content focus

- follow-up

- active learning

- feedback

- collaborative examination of student work.

The model is based on this literature review. It presents a model of the main program features that might explain differences in impact across the ten programs. The model reflects the primary focus of this research. It provides a framework for examining relationships between key features of programs, such as structural features, opportunity-to-learn features, teachers' knowledge and practice, student learning and teacher efficacy. The model includes: control variables; structural features, such as the duration of the program; opportunity to learn features of programs, such as 'active learning'; and four measures of program impact (knowledge, practice, student learning and teacher efficacy. (Details of how these variables were measured are provided below.)

An important objective for the designers of several programs selected for this study was to strengthen professional community in the target schools—the nature and quality of professional interaction and collegiality among teachers—in order to enhance the impact of their programs on classroom practice. Therefore, professional community has been included in the model as a mediating variable.

Figure 2: Representation of relations between key variables associated with teacher efficacy and professional development Figure 2: Representation of relations between key variables associated with teacher efficacy and professional development

Control variables
- Gender
- Experience
- School sector
- School level
- School support
- School size

Structural features
- Contact hours
- Time span
- Sufficient time

Opportunity to learn
- Content focus
- Active learning
- Follow up
- Collaborative examination of student work
- Feedback on practice

Mediating factors

Professional community

Impact measures

Knowledge → Practice → Student learning → Efficacy

55

An important feature of the model is that it makes a distinction between design and implementation features of professional development programs. Rather than relying on what the providers of the program say about its design features and learning processes, this model relies on what teachers report about their experience in the program—their actual opportunities to learn. A program may be advertised as 'action research', for example, but teachers' actual experience may be quite different. Program designers may claim to have provided follow-up support, but teachers may not have received it. For this study, we needed accurate data about the opportunities for learning that teachers experienced.

In working with program designers and developing this instrument, ACER staff drew extensively from recent research on the critical features of effective professional development programs (Hawley and Valli, 1999). Use was made of other researchers (for example, Loucks-Horsley et al., 1998; Sykes, 2002) who provide useful guides to the major types of strategies used to promote professional learning. Heller et al. (2003) and Killion (2003) provide approaches that help to identify the logic underlying programs and how the pieces fit together to promote effective teacher learning.

Measures used in the cross-program analysis

Control variables

These variables are pre-existing characteristics of the teachers who participated in the programs, or the schools in which they worked, that might influence the type of professional development that teachers experienced. They include: teacher gender; teacher experience, measured as number of years teaching; school sector; and school support for professional development. The gender of the teacher and the sector in which they were teaching were included to ensure that they had no confounding relationships with other variables.

Professional development programs are usually designed to change teachers' knowledge and classroom practice, but research has indicated that the impact of these programs is often strongly influenced by factors at the school level, such as administrative support and staff culture. (These school level factors may undermine the impact of a professional development program, or they may act in such a way as to reinforce or enhance its effects. The model indicates that several teacher and school level factors were incorporated into our model.)

School support was measured by asking teachers about the extent to which they agreed or disagreed with the following statements.

- The leadership team at my school actively support and encourage all staff to take part in professional development.

- Insufficient time is available in my school to support teachers' professional learning

- Follow-up support for professional development is available within my school.

- Teachers at my school work collaboratively to resolve teaching and learning issues.

Teachers responded to these items on a four-point scale from 'strongly agree' through to 'strongly disagree'. On the survey form, a response of 'strongly disagree' was scored as 4, through to 'strongly disagree' which was scored as 1. These scores were reversed for the analyses reported here so that the higher the score, the higher the level of agreement. The index was created by averaging the scores on each of these four items. This meant that this variable had a range of values from 1 to 4.

Structural features

A long-standing criticism of professional development programs has been that they typically consist of brief one-shot workshops; brief encounters that focus on information giving and reducing teachers' role to that of an audience. Programs of longer duration, at least in theory, give teachers the opportunity to play more active roles in learning and to receive more follow-up assistance as they implement change.

Duration includes two slightly different, but related, aspects: contact hour and time span. The programs in this study varied in contact hours and time span for participants, but none could be characterised as one-shot workshops. To measure contact hours, teachers were asked to indicate the total number of hours they spent in activities related to the program (1 = less than 10 hours; 2 = 10–20 hours; 3 = 20+ hours; 4 = 50+ hours.) The data from the completed questionnaires indicates that the LINC and Graduate Certificate in Literacy Programs were the longest (these were tertiary courses), and Count Me In Too the shortest.

Table 10: Contact hours for each program as reported by survey participants

Program	n	Mean
LINC	22	3.77
EYNP	51	2.61
CMIT	25	2.00
WA AGQTP	30	3.07
New Basics	26	3.15
Graduate Certificate in Literacy	9	3.56
ACT Exhibitions	11	3.36
Science Standards and Portfolios	5	3.20
SiS Vic	27	2.59
Teaching Futures	20	2.35

To measure time span, teachers were asked to indicate the total time the professional development activity covered. The data from the questionnaires indicates that most of the programs in this study took place over an extended period of several months (1 = 1 week or less; 2 = 1 month or less; 3 = 6 months or less; 4 = more than 6 months). Several, such as LINC, EYNP, WA AGQTP and SiS were over six months according to most respondents.

Table 11: Span in months of each program as reported by participants

Program	n	Mean
LINC	22	3.68
EYNP	51	3.76
CMIT	25	3.00
WA AGQTP	30	3.67
New Basics	26	3.46
Graduate Certificate in Literacy	9	3.33
ACT Exhibitions	11	2.73
Science Standards & Portfolios	5	3.60
SiS Vic	27	3.41
Teaching Futures	20	3.10

Learning processes

The literature review for this study identified that several key features of effective professional development programs have emerged from recent research. As mentioned above, we decided to rely on participants' experience in identifying the nature of the learning opportunities provided in each program, rather than the program designers' descriptions of the strategies they used to promote teacher learning.

Recent research was used to identify the types of opportunity to learn that were likely to explain the variation in impact across the ten programs. Sykes (1999), Kennedy (1998), Wilson and Berne (1999), for example, provide valuable reviews of this literature. From this literature we identified five different aspects of teachers' opportunity to learn during a professional development program: content focus; active learning; feedback; collaborative examination of student work; and follow-up.

Content focus

Recent research has indicated the importance of what teachers have the opportunity to learn during professional development programs (Borko and Putnam, 1995; Kennedy, 1998; Cohen and Hill, 2000).

In summary, this research (see Chapter 2) indicates that professional learning is most likely to improve student learning outcomes if it increases teachers' understanding of: the content they teach; how students learn that content; how to represent and convey that content in meaningful ways; and how well their students are doing in relation to how well they should be doing.

To measure the content focus of professional development programs we developed an index based on the following four questionnaire items.

What emphasis did this professional development activity give to:

- knowledge of the content that you teach?

- knowledge about how students learn?

- knowledge about how students learn the specific content that you teach?

- the methods used to teach the required content?

Teachers were asked to respond to these items on a four-point scale from 'no emphasis' through to 'major emphasis' (no emphasis' = 1, minor emphasis = 2, moderate emphasis = 3, major emphasis = 4.) The index was created by averaging the scores on each of these four items.

As Figure 3 shows, the programs included in this study varied considerably in terms of this measure of content focus. For example, the mean rating on a four-point scale for the Graduate Certificate in Literacy was 3.75. Figure 3 indicates that teachers reported that programs such as the Graduate Certificate in Literacy, EYNP, CMIT and LINC placed more emphasis on content than programs like New Basics, ACT Exhibitions and Teaching Futures. Although the WA AGQTP program had an action-learning orientation, teachers rated it high on content emphasis.

Figure 3: The extent to which the program was reported to have
a focus on content showing mean emphasis level and 95%
confidence intervals
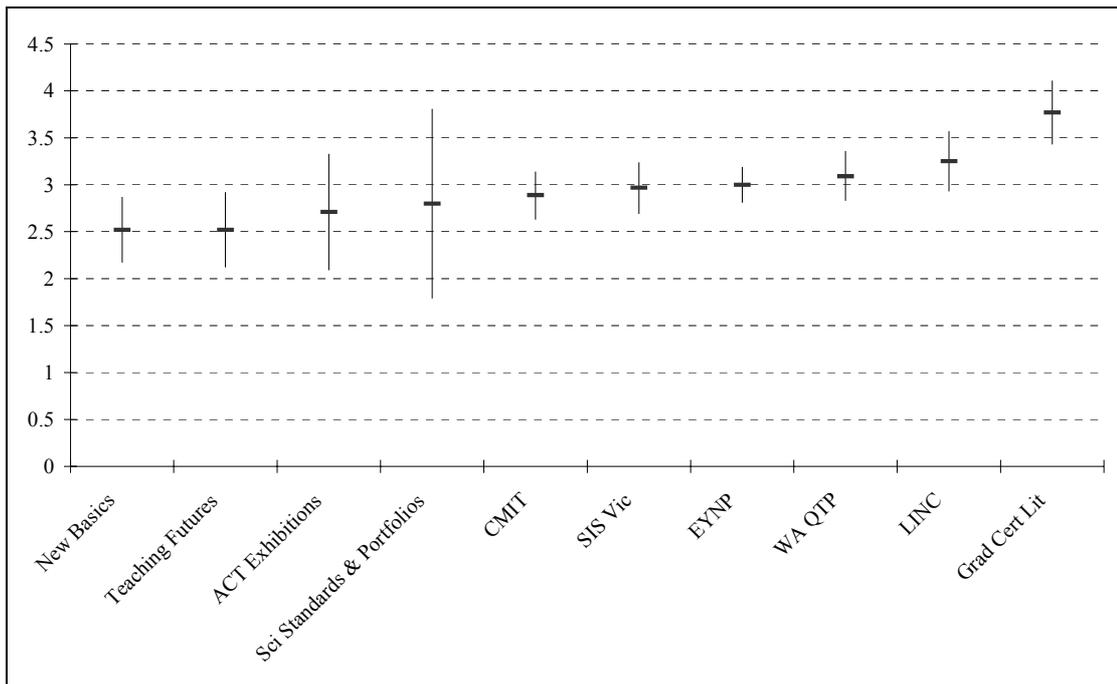
Active learning

Recent research confirms the importance of teachers being actively engaged in their own learning, but it is the nature of this engagement that seems to matter as much, if not more, than the level. Effective professional development programs draw teachers into an analysis of their current practice in relation to professional standards for good practice. They also draw teachers into close comparison of what their students are learning in relation to what students of that age and circumstance are capable of learning. Hawley and Valli's (1999) list of research-based principles for effective professional development captures these features well. Effective professional development programs lead teachers to examine their practices closely as well as their students' outcomes in relation to external reference points or standards.

To measure the extent to which programs engaged teachers in active learning, we developed an index based on the following three questionnaire items.

To what extent did the program:

- engage you in actively reflecting on your practice?

- engage you in identifying specific areas of your practice that you needed to develop?

- give you opportunities to test new teaching practices?

Teachers were asked to respond to these items on a four-point scale from 'not at all' through to 'a major extent' (a response of 'not at all' was scored as 1, 'to a minor extent' as 2, 'to a moderate extent' as 3 and 'to a major extent' as 4). Averaging the scores on each of these three items created the index.

While all program managers in this study placed importance on engaging participants in processes that led them to play an active role in analysing and reflecting on their practice, Figure 4 indicates that the programs differed significantly in the opportunities they provided for teachers to engage in active learning as defined here. Programs rated high in terms of active learning included the WA AGQTP and LINC. These were significantly higher statistically than the CMIT, New Basics Programs, SiS and EYNP.

Figure 4: The extent to which the program was reported to
require active learning showing mean extent and 95% confidence
intervals
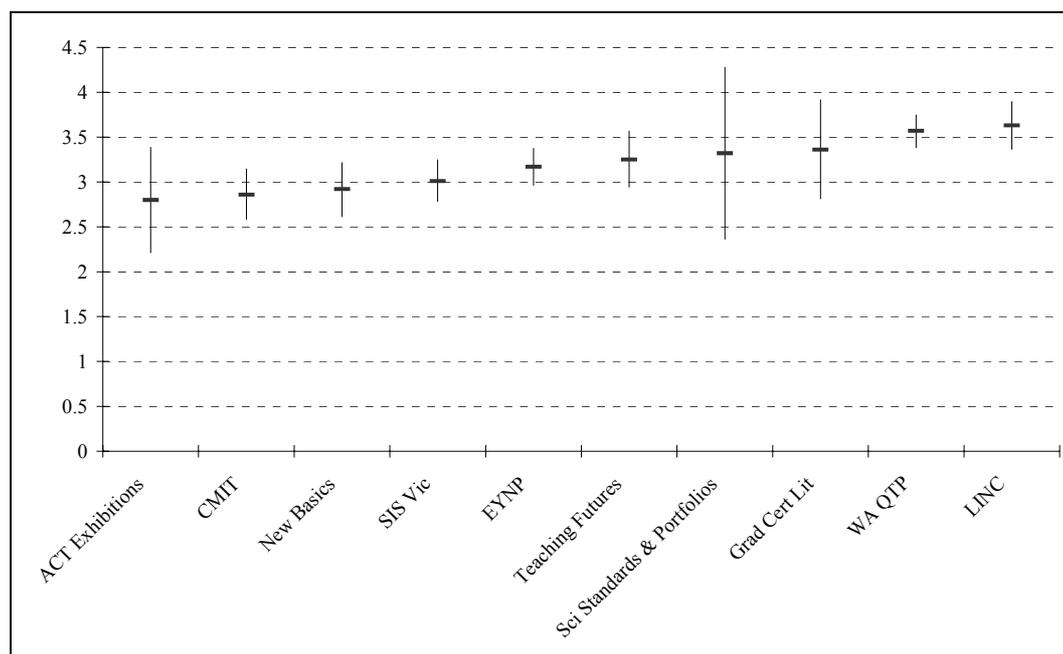
Feedback

Feedback on practice and coaching during the implementation phase have long been recognised as essential for professional development programs that aim to help teachers develop new skills (Joyce and Showers, 1982). Although most of the programs in this study aimed to help teachers learn new skills, Figure 4 indicates that relatively small numbers of participants actually received 'at the elbow' assistance and feedback in their classrooms during the critical and difficult implementation phase when they were trying out new practices.

To measure the extent to which programs provided feedback as an opportunity to learn, an index based on the following two questionnaire items was developed.

During the course of this professional development activity how many times:

- was your teaching observed by others involved in the program (for example, a mentor, or in a team teaching situation)?

- did you receive feedback on your teaching from other teachers or people involved in the program?

Teachers were asked to respond to these items on a four-point scale ('never'= 1, 'once or twice' = 2, 'three or four times' = 3, 'often' = 4). The index feedback was created by averaging the scores on each of these two items.

As Figure 5 shows, there were differences in the programs in terms of the extent to which they built opportunities for feedback into their designs, but as a generalisation, these opportunities were rare. The WA AGQTP program scored statistically significantly higher than the Science Standards and Portfolios program.

Figure 5: The extent to which teachers received feedback during the course of the professional development activity showing mean extent and 95% confidence intervals
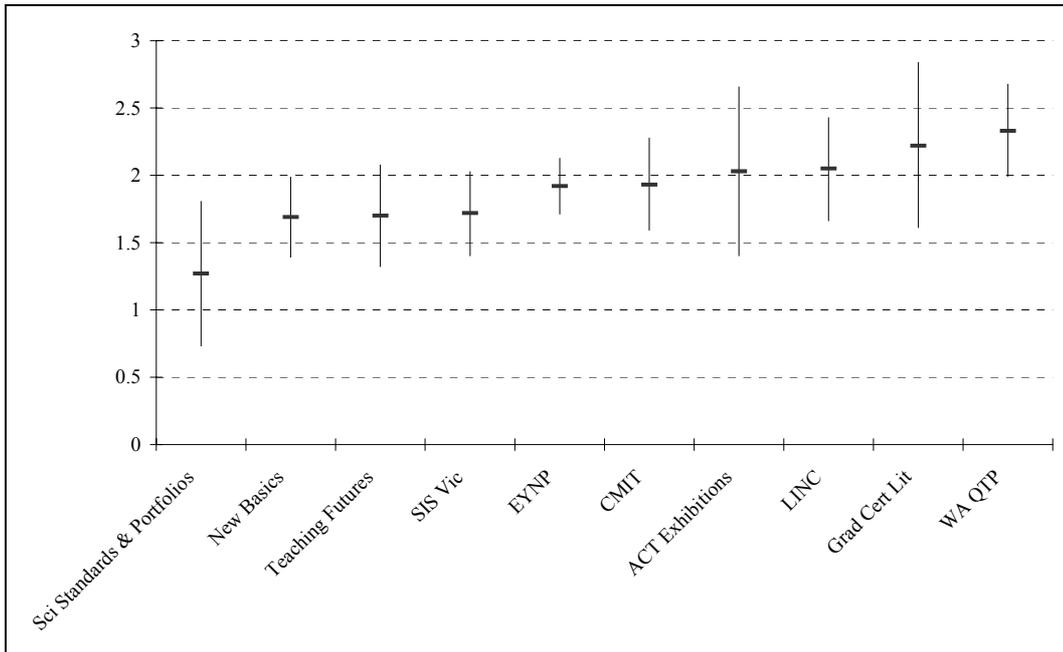
Collaborative examination of student work

Over recent years, it has become clear that teachers gain a great deal of valuable learning from opportunities to examine student work in collaboration with colleagues—especially their own students' work, and in relation to standards for what students should know and be able to do. Collaborative analyses of student work opens up many avenues for teachers to de-privatise their practice and learn from each other. It also leads to deeper understanding of student learning outcomes and greater discrimination about what counts as meeting those objectives. Hawley and Valli's (1999) review of research rates this feature as a critical component of effective professional learning programs.

To measure the extent to which programs provided opportunity for collaborative examination of student work, we developed an index based on the following five questionnaire items.

To what extent did the program:

a) provide opportunities to share ideas with colleagues in your school who were not directly involved in the professional development activity?

b) give you opportunities to collaborate with colleagues in examining students' work?

c) give you opportunities to collaborate with colleagues in examining your own students' work?

d) engage you in analysing your students' achievement in relation to learning outcomes?

e) engage you in analysing other students' achievement in relation to learning outcomes?

Teachers were asked to respond to these items on a four-point scale from 'not at all' through to 'a major extent'. A response of 'not at all' scored as 1, through to 'to a major extent', which scored as 4. An index was created by averaging the scores on each of these five items.

Figure 6 indicates that few programs in this study gave special emphasis to including collaborative examination of student work in their design. The mean rating on the four-point scale is between 2 and 2.5 for most programs, which means teachers generally said that this happened to a minor extent in the programs in which they participated.

Figure 6: The extent to which teachers engaged in collaborative examination of student work, showing mean extent and 95% confidence intervals
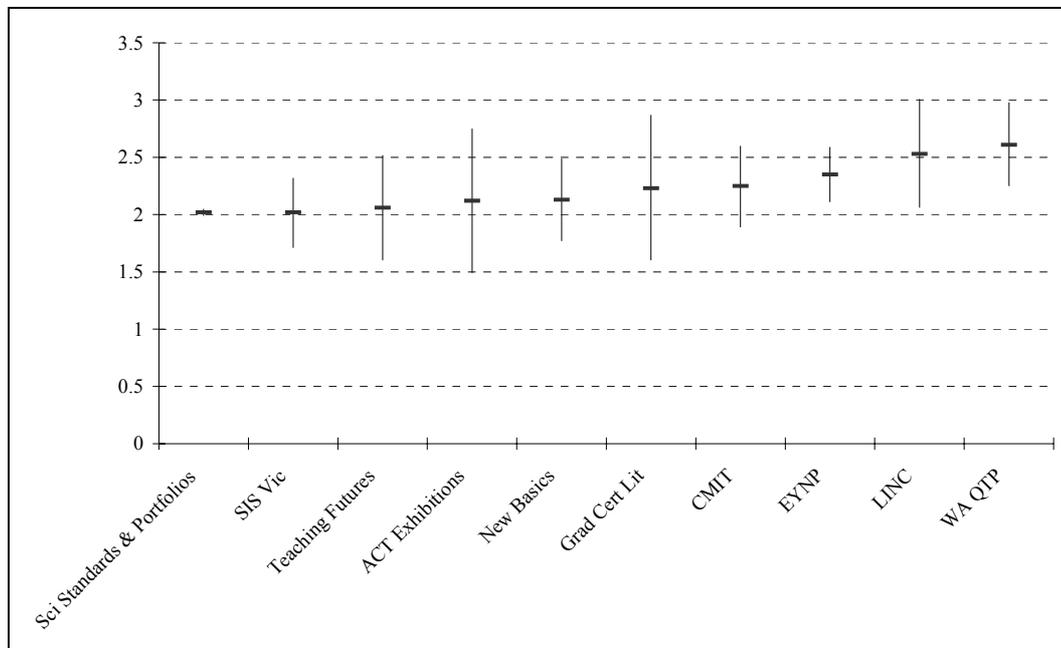
Follow-up

Follow-up support to teachers during the implementation phase of change has long been identified as an important feature of more effective programs (Fullan, 1982). Perhaps the strongest criticism of many professional development programs over the years has been the lack of built-in provision for 'at the elbow' support for teachers back in their classrooms as they apply new ideas and skills.

To measure the extent to which programs provided follow-up to support teachers, we developed an index based on the following three questionnaire items.

To what extent did this professional development activity:

a) provide time for you to practise your new learning?

b) make provision for follow-up/ongoing assistance in your school or classroom to help you implement changes advocated in the program?

c) relate to other programs designed to improve learning in your school?

Teachers responded to these items on a four-point scale from 'not at all' through to 'a major extent'. A response of 'not at all' scored as 1, through to 'to a major extent', which scored as 4. An index was created by averaging the scores on each of these three items.

Figure 7 shows that teachers who participated in the WA AGQTP and the LINC programs indicated that follow-up had been provided to a 'moderate' extent, whereas teachers involved in the New Basics, Graduate Certificate in Literacy programs and EYNP were statistically significantly more likely to report higher levels of follow-up than those attending Science Standards and Portfolios.

Figure 7: The extent to which teachers received follow-up
support to the professional development program, showing mean
extent and 95% confidence intervals
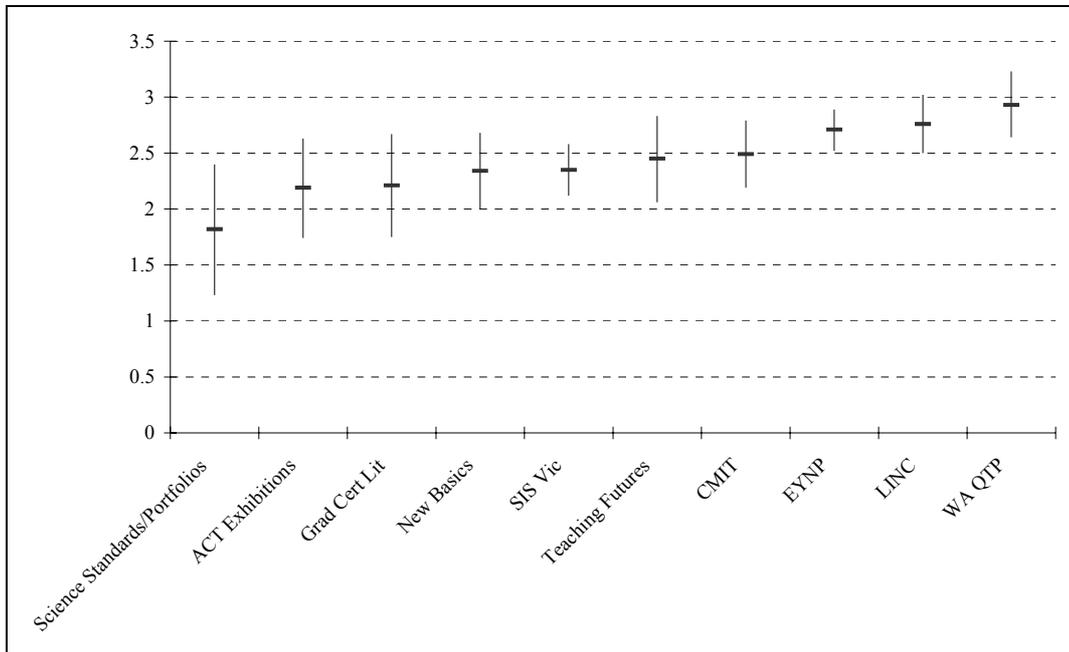
Mediating factors in the school

One of most important mediating factors affecting the impact of professional development programs is the extent to which the program enhances the level of professional community activity among teachers involved. One of the criteria for selecting programs for this study was whether the designers of those programs had adopted a whole school approach. So most programs included features that were designed to strengthen the level of collegial interaction and collaboration, related to their programs, in schools. This was seen as a means of increasing the likelihood that their programs would have an impact at the level of classroom practice.

To measure the extent to which the programs had an impact on professional community, we developed an index based on the following questions.

As a result of the professional development activity, in my school there is:

    a)   greater collaboration and sharing of resources

    b)   more joint planning of programs

    c)   more discussion about teaching methods

    d)   greater openness about the practices we use

    e)   more shared discussion and analysis of students' work

    f)   greater cooperative effort among staff members

    g)   more interest in new ideas for teaching

    h)   more experimentation with new teaching methods

    i)   better evaluation of teaching programs and their effects.

Teachers were asked to respond to these items on a four-point scale from 'not at all' through to 'a major extent'. A response of 'not at all' was scored as 1, 'to a limited extent' as 2, 'to a

moderate extent' as 3, 'to a major extent' as 4. Averaging the scores on each of these items created an index for professional community.

The ten programs included in this study varied considerably in the extent to which they aimed to strengthen the level of professional community in the schools with which they worked. Some such as the Graduate Certificate in Literacy Program and the Science Standards and Portfolio programs did not aim directly at bringing teachers together in 'joint work' situations within schools. Other programs, such as the Early Years Numeracy and Learning in Networking Communities (LINC) gave special emphasis to this aspect.

Measures of program impact

To provide a common basis for evaluating the impact of programs with ostensibly different objectives we developed an approach based on standards for effective teaching (Ingvarson, 1998; 2002). We argued that the quality of impact of a program should be measured not only in terms of whether it meets the developers' objectives, but also in terms of the extent to which the program moves teachers' practices towards those associated with research-based standards for effective teaching (Ingvarson, 1998; 2002). (For some programs, the objectives and standards may be much the same, but this was not always the case).

The programs were assessed in terms of their impact on teacher knowledge, practice, student learning and teacher efficacy. Descriptions of these measures follow.

Knowledge

Teachers were asked to indicate the extent to which their participation in the professional development program had led to an increase in their knowledge in a variety of areas and contexts. Specifically, they were asked to what extent they agreed that the following outcomes had been achieved.

As a result of my participation in the professional development program, I now have:

a) increased knowledge of the content of the key learning area/s in which I teach

b) increased knowledge of teaching and learning strategies appropriate to the content of the key learning area/s that I teach

c) increased knowledge about how students learn the content of the key learning area/s in which I teach

d) increased understanding of individual differences amongst students and how I can cater for their needs

e) increased understanding about linking assessment into the teaching and learning cycle

f) increased knowledge of classroom organisation and management

g) increased knowledge of materials and resources available in the key learning area in which I teach.

Teachers were asked to respond to these items on a four-point scale from 'strongly disagree' through to 'strongly agree'. A response of 'strongly disagree' was scored as 1, through to 'strongly agree', which was scored as 4. Averaging the scores on each of these items created the index for impact on knowledge.

Figure 8: The extent to which teachers agree that there was an increase in their professional knowledge, showing mean agreement and 95% confidence intervals

Overall, Figure 8 indicates that teachers thought these ten programs had a positive impact on their professional knowledge. For some programs the differences were statistically significant. The EYNP and LINC programs had statistically higher average levels of impact on knowledge than the New Basics program.
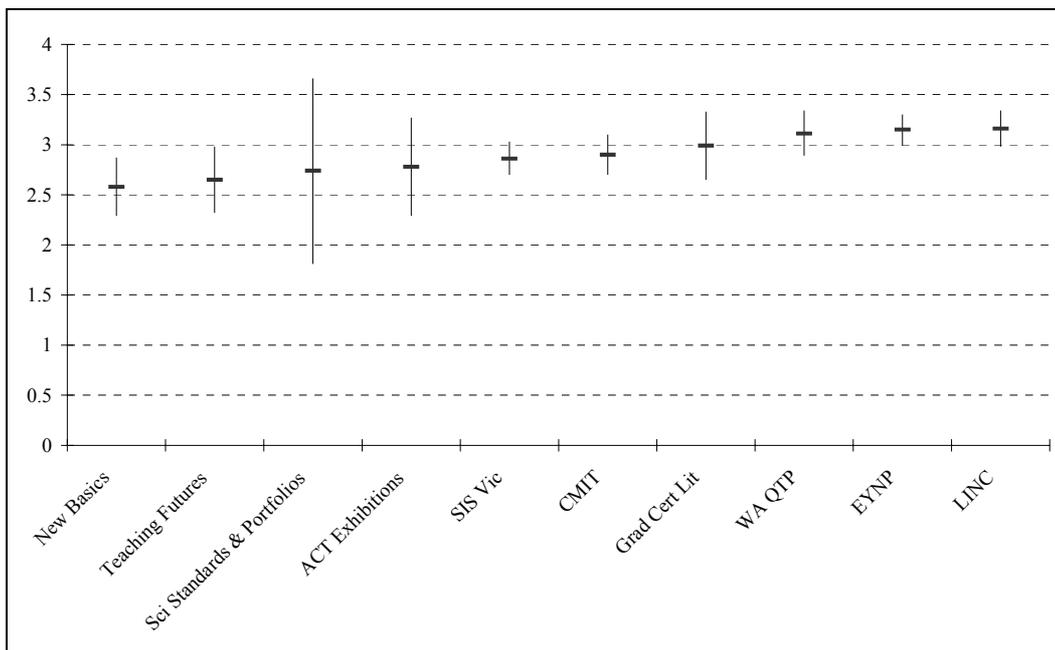
Practice

Teachers were asked to indicate the extent to which their participation in the professional development programs had led to change in their practice in a variety of areas and contexts. Specifically, they were asked to what extent they agreed that the following outcomes had been achieved.

a) make clearer links between my teaching goals and classroom activities

b) manage classroom structures and activities more effectively

c) use more effective teaching and learning strategies appropriate to the content that I teach

d) use more effective teaching and learning strategies appropriate to the classroom context

e) use teaching and learning strategies that are more challenging and engaging

f) am better able to meet the individual learning needs of my students

g) link assessment into the teaching and learning cycle more effectively

h) provide more effective feedback to my students to support their learning

i) engage students in higher order thinking

j) access and use materials and resources more effectively.

Teachers responded to these items on a four-point scale from 'strongly disagree' through to 'strongly agree'. A response of 'strongly disagree' scored as 1, through to 'strongly agree', which scored as 4. An index was created by averaging the scores on each of these items.

Figure 9: The extent to which teachers agree that there was a
positive change in their professional practice, showing mean
agreement and 95% confidence intervals

Overall, teachers responding to the questionnaire agreed that the program in which they had
participated had led to positive changes in their practice. Figure 9 indicates that teachers
reported that the WA AGQTP, EYNP and LINC programs had statistically higher average
levels of impact on practice than the ACT Exhibitions and the New Basics programs.
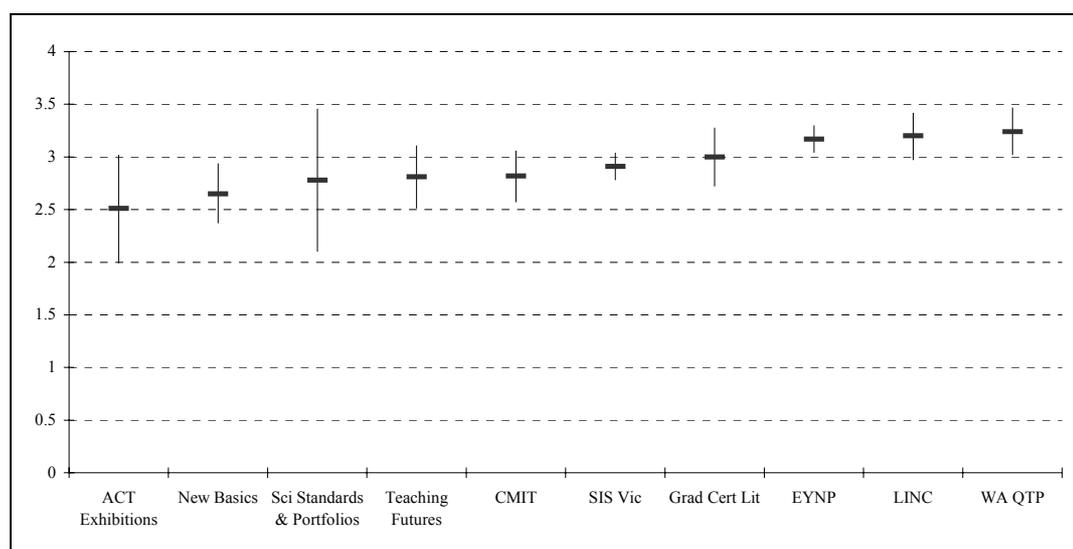
Student learning outcomes

Teachers were asked to indicate the extent to which their participation in the professional
development program had led to an improvement in their students' learning outcomes.
Specifically, they were asked to what extent they agreed that the following outcomes had been
achieved by their students:

     a)   have fewer difficulties in understanding what they are being taught

     b)   are learning more purposefully

     c)   are more actively engaged in learning activities

     d)   demonstrate enhanced learning outcomes

     e)   access and use materials and resources more effectively.

Teachers responded to these items on a four-point scale from 'strongly disagree' through to
'strongly agree'. A response of 'strongly disagree' scored as 1, through to 'strongly agree',
which scored as 4. Averaging the scores on each of these items created the index.

Figure 10: The extent to which teachers agree that there was a positive change in student learning outcomes, showing mean agreement and 95% confidence intervals

Overall, teachers agreed that the program in which they had participated had led to improvement in student learning outcomes. However, there were significant differences between the programs in this respect. Figure 10 indicates that the EYNP and WA AGQTP had statistically higher average levels of impact on student learning outcomes than the ACT Exhibitions and the New Basics programs.

Teacher efficacy
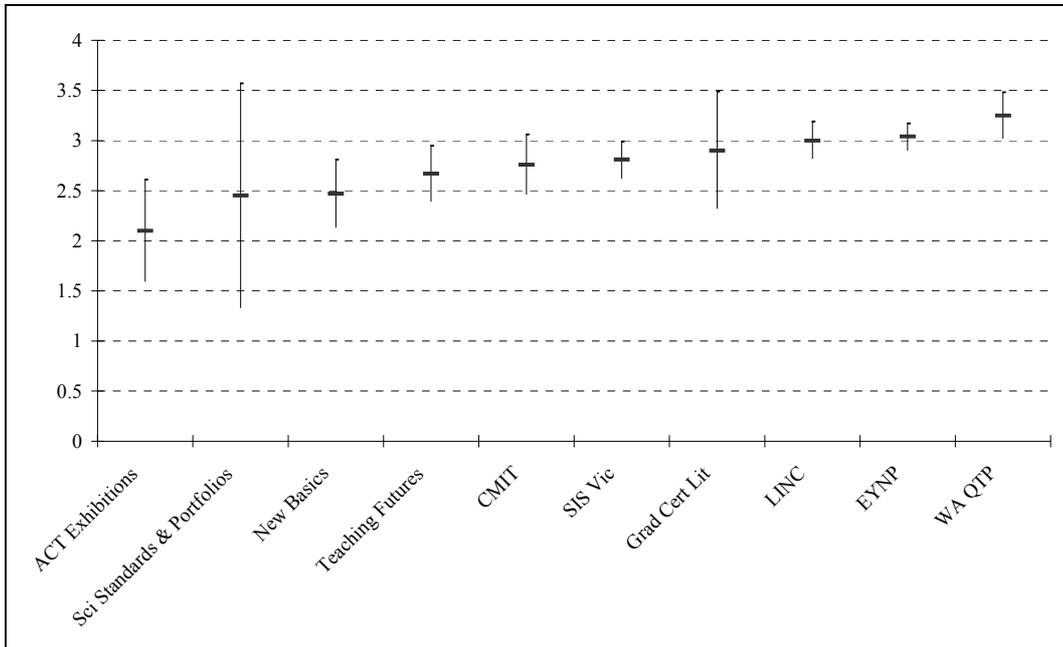
Teachers were asked to indicate the extent to which their participation in the professional development program had led to an improvement in their efficacy as teachers. Specifically, they were asked to what extent they agreed that the following outcomes had been achieved, as a result of their participation in the program.

    a) My ability to meet the learning needs of my students has expanded.

    b) My confidence as a teacher has increased.

Teachers responded to these items on a four-point scale from 'strongly disagree' through to 'strongly agree'. A response of 'strongly disagree' scored as 1, through to 'strongly agree', which scored as 4. An index was created by averaging the scores on each of these items.

Figure 11: The extent to which teachers agree that there was a
positive change efficacy, showing mean agreement and 95%
confidence intervals
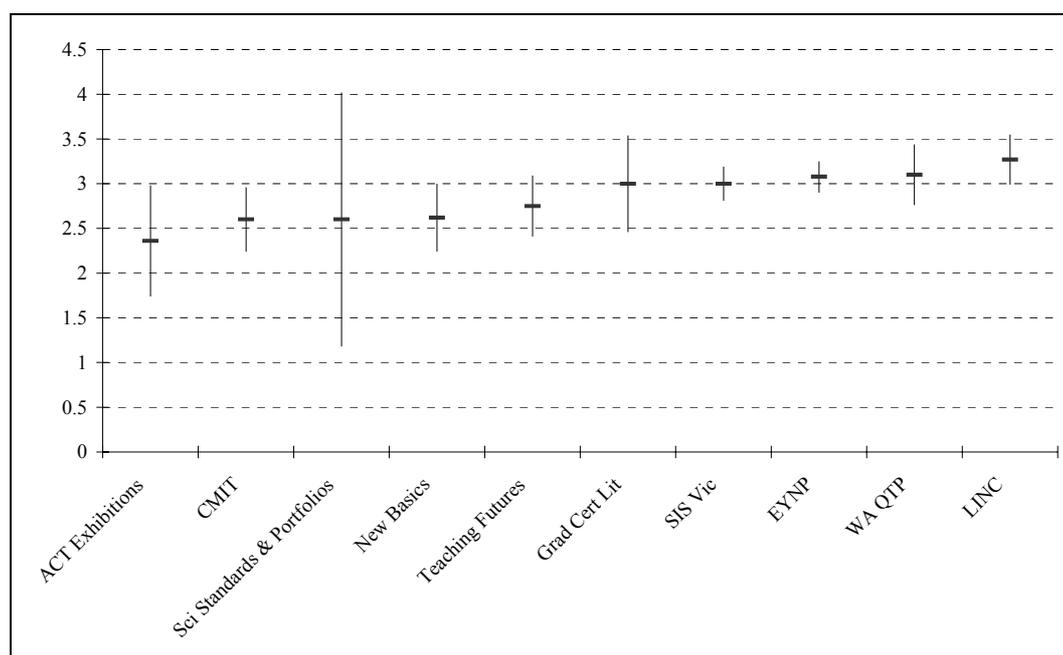
Overall, teachers responding to the questionnaire agreed that the program in which they had
participated had led to a greater sense of efficacy—a belief that they had the capacity to make
a significant difference to their students' learning. Figure11 indicates that the LINC program
was rated highest by teachers in terms of impact on efficacy, significantly higher that the ACT
Exhibitions and CMIT programs.

Regression analysis

As indicated earlier, the purpose of the cross-program analysis was to look across the ten
programs to identify:

- features of the professional development programs that might explain variation
  in impact

- school level factors that influence or mediate the outcome of the programs.

The focus of interest in this analysis is on patterns of responses and relationships between
variables in the model across the ten programs. The designers of some programs deliberately
did not emphasise, for example, 'collaborative examination of student work', or 'feedback',
for a variety of reasons. Rather than comparative questions between programs, we were
interested in questions such as 'Is time span related to the level of reported impact?' or 'Are
teachers who participate in collaborative examination of student work more likely to say that
that program had a strong impact on their practice than those who do not?'

As a first step in the analysis, a blockwise regression analysis was conducted using the SPSS
PC procedure regression. This procedure is based upon a least-squares algorithm to estimate
the strength of the linear relationship between the dependent variable and a set of independent
variables. The results are summarised in Table 12. It shows the standardised regression
coefficients and significance levels for each of the predictors in the model. The use of
standardised coefficients permits easy comparison of the strength of associations within the
model. For example, a standardised beta coefficient of 0.27 is three times as strong in its effect
as one of 0.09. When examining these effects it is important to remember that they are net of

the effects of other variables in the model. The regression analysis thus shows the unique contribution that each variable makes to changes in the dependent variable. Table 12 also shows the proportion of variance explained by the models (R^2). A negative coefficient indicates an inverse relationship between variables. The order in which these variables were entered into the equation was determined by the theory underlying the research (as summarised in Figure 2).

There were six control, or background (exogenous), variables in this model, and three blocks of intervening (endogenous) variables: structural feature, learning process and professional community. The full model accounted for around 73 per cent of the variance in the dependent variable (teacher efficacy)—which meant that several features in our model were reasonably good predictors of whether teachers would rate a professional development program as effective.

Table 12: Relationship between background variables, structural features, opportunity to learn, professional community in the school, and teacher knowledge, teacher practice, student learning and teacher efficacy

	Content Focus	Active Learning	Follow-up	Collaboration	Feedback	Professional Community	Knowledge	Practice	Student Learning	Teacher Efficacy
Sector (Govt =1, Other=0)	-0.03	**-0.20**	0.00	0.08	**0.12**	**0.15**	-0.02	-0.04	-0.05	0.01
Primary = 1 Others = 0	0.16	0.07	**0.16**	-0.04	-0.08	0.01	**0.16**	**0.19**	0.04	-0.11
Size of School	0.06	0.05	-0.07	-0.02	0.03	-0.06	0.11	0.09	-0.04	-0.06
Sex (F = 0 M = 1)	-0.08	0.04	0.00	0.11	0.00	**0.13**	**0.11**	0.05	**0.11**	0.02
Years Teaching	-0.07	-0.03	-0.04	-0.02	-0.06	0.01	-0.07	0.01	**0.10**	**0.11**
School Support	0.13	**0.13**	**0.13**	0.07	**0.14**	**0.16**	0.11	**0.10**	0.05	0.02
Duration–hours	**0.19**	**0.16**	0.05	**0.23**	**0.18**	0.11	-0.03	0.06	0.01	0.02
Span–months	0.11	0.08	0.01	0.01	0.03	**0.17**	0.03	-0.04	0.01	0.01
Sufficient time	**0.22**	**0.08**	**0.22**	0.07	**0.13**	0.02	0.02	-0.01	0.07	**0.10**
Content Focus		**0.38**	**0.29**	0.01	0.06	-0.10	**0.21**	0.03	-0.04	-0.07
Active Learning			**0.28**	0.16	0.09	0.12	**0.15**	**0.13**	-0.03	**0.12**
Follow-up				**0.20**	**0.48**	**0.43**	**0.33**	0.01	0.00	0.05
Collab. Exam. of Student Work					0.10	**0.15**	0.03	-0.01	0.01	**0.12**
Feedback						0.09	0.09	0.03	0.06	0.03
Professional Community							**0.15**	**0.16**	0.02	0.05
Knowledge								**0.64**	0.02	0.12
Practice									**0.73**	**0.32**
Student Learning										**0.48**
R-squared (adjusted)	0.17	0.34	0.57	0.21	0.47	0.48	0.58	0.77	0.65	0.73

Bold text indicates statistically significant ($P<0.05$)

Findings

The following findings from the cross-program analysis should be considered exploratory only. As mentioned above, data was gathered in the main only from teachers who worked in the case study schools, and the number of returns for some programs, such as Science Standards and Portfolios, was very small. However, the findings from this study turned out to be generally consistent with three similar studies based on larger samples of teachers who had participated in the Australian Government Quality Teaching Programs in NSW, Catholic Education Commission, Victoria (CECV) and the Northern Territory (reported in Ingvarson, Meiers and Beavis, 2005).

One of the main findings from this study is that the conceptual model for the cross-program study, as set out in Figure 2, captures the main factors that account for the variation in reported impact across the ten programs. Among all the variables in Table 12, the block of variables measuring opportunity to learn explained most of the variation in reported levels of program impact.

By way of illustration, participants in the WA AGQTP, EYNP and LINC professional development programs, for example, consistently rated these programs high on the impact measures. As Figures 3–7 indicate, they also rated them high in terms of opportunity-to-learn measures such as follow-up, collaborative examination of student work and feedback.

In summary, the main message from Table 12 is that several of the opportunity-to-learn features in the model had significant effects on the extent to which the programs studied have an impact on teacher knowledge, practice, efficacy and student learning outcomes. Significant relationships are indicated in bold type. Reported levels of follow-up (0.33), content focus (0.21) and active learning (0.15) were all directly related to the level of impact on teachers' knowledge. The level of active learning was also directly related to impact on teachers' practice (0.13) and efficacy (0.12). Because these opportunity-to-learn features have a significant direct effect on teacher knowledge—and because we found that teacher knowledge is, in turn, strongly related to impact on practice—it is possible to claim that opportunity-to-learn features have significant indirect effects on practice, student learning outcomes and teacher efficacy.

The following explanation of the results of the regression analysis, shown in Table 12, moves from the left to the right of the table. The focus is first on the influence of background (control) factors and structural features of programs on the various components of opportunity to learn.

The level of school support is associated with the extent to which participants' report that they had opportunities for active learning (0.13), follow-up (0.13) and feedback (0.14). Table 12 also indicates that school support is related to the level of professional community activity resulting from programs (0.16). As these components of opportunity to learn are related significantly to the reported level of impact on knowledge, this therefore means that the level of school support, as defined above, has substantial, though indirect effects on the extent to which program outcomes are achieved. Though not a design feature of professional development programs in the conceptual model for this study, the level of school support comes through the analysis as an important enabling condition with a significant shaping influence on the opportunities to learn experienced by teachers.

Of the other background variables, primary teachers were more likely than secondary teachers to report that the professional development program had had an impact on their knowledge (0.16) and practice (0.19). Teachers with more experience were slightly more likely to report that a professional development program had made an impact on their students' learning outcomes (0.10) and their sense of efficacy (0.11).

Some programs in this study, such as the Graduate Certificate in Literacy, were targeted specifically at experienced teachers. We can only conjecture why experienced teachers in this study were more likely to report that programs had an impact. It may be that their experience

and confidence gives them a better basis on which to make use of and capitalise on new ideas, such as those in the EYNP and CMIT.

Table 12 indicates that, while the duration of programs (contact hours) does not have direct effects on the impact measures, it is related significantly to the level of content focus (0.19), active learning (0.16), collaboration (0.23) and feedback (0.18). As these opportunity-to-learn features were found to have significant direct effects on reported impact levels, duration is an important structural feature. This study indicates the importance of giving program designers the time and resources that will enable them to incorporate these components of learning into their programs.

This study indicates that time span enabled programs to strengthen professional community activity (0.17), which, in turn, increased the likelihood that programs would have significant effects on teacher knowledge and practice. The time span of programs had a significant effect on the amount of time program participants reported spending meeting informally with other participants in related activities, such as joint lesson planning and developing curriculum materials. These structural features of contact hours and time span both have substantial, though indirect, effects on program outcomes.

Teachers were asked whether the program in which they participated provided sufficient time to learn what needed to be learned. Longer programs in this study were more likely to have a content focus, such as the Graduate Certificate in Literacy. Sufficient time was strongly associated to the reported level of follow-up support (0.22), which, in turn, had a strong impact on teacher knowledge and practice.

The strong relationships between content focus and active learning (0.38) and follow-up (0.29) should be noted. These results suggest that programs with an emphasis on the subject matter that is being taught, how it is learned and how to teach it, tend to facilitate more active school-based professional learning processes. The low levels of follow-up and opportunities for feedback in these ten programs has already been noted. However, as might be expected, this study found that programs that did build opportunities for follow-up support into their design were more likely to provide opportunities for teachers to receive feedback (0.48) as they tried out new skills.

Table 12 indicates that the extent to which a professional development program influences knowledge and practice, as reported by teachers, is enhanced by the extent to which that program also strengthens the level of activities associated with professional community (0.15; 0.16)—that is, the extent to which it increases opportunities for teachers to talk about the specifics of their teaching practice and student learning, share ideas and support each other as they attempt to implement ideas from the professional development program. The extent to which programs influenced the level of professional community activity was enhanced to the extent that their designers built in active learning processes (0.12) follow-up (0.43) and opportunities for collaborative examination of student work (0.15).

As mentioned above, the main message from Table 3 is that among all the variables in the model, the block of opportunity to learn or process variables had the largest effect on program outcomes. Of this set of variables, the ones with strongest effects were active learning, follow-up and content focus (especially those that focused on how students learn the content and on methods to teach the content). The fact that the influence of active learning carries through to influence teacher practices (0.13) and teacher efficacy (0.12), net of the effects of other variables in the model, is particularly noteworthy. It suggests that this feature is having a pervasive and generative influence on factors that increase teachers' confidence and ability to meet student needs rather than making specific changes in practice alone.

The strong relationship between impact on knowledge and reported impact on practice is noteworthy. This supports findings from Joyce and Showers (1982) and Hawley and Valli (1999); that a strong knowledge base and a clear theoretical rationale grounded in research are necessary conditions for effective programs, as with EYNP and CMIT. An increased sense of teacher efficacy is, not surprisingly, dependent on the extent to which teachers think their

practises have improved (increased competence) and evidence that student learning outcomes have improved as a result. The strongest influence on teachers' reported levels of impact on efficacy was the extent to which teachers saw that a program had had an impact on their students' learning outcomes (0.48). This finding echoes earlier research by Guskey (2000), which found that the more effective strategy is to ask teachers to try out new practices and see the effects on their students, rather than trying to change attitudes first in the hope that this will automatically lead to change in practice. Programs that model effective practice and invite teachers to try them out tend to be more successful than programs that devote resources primarily to changing attitudes first.

Table 12 shows a very strong relationship between impact on practice and reported positive outcomes for students (0.73). As might be expected, teachers who report significant changes in their practice are more likely to report improved learning opportunities for students. As reported in Figure 10, teachers who responded to the questionnaire generally agreed that the program in which they had participated had led to improvement in student learning outcomes. However, teachers reported that some programs such as the EYNP and WA AGQTP had statistically higher average levels of impact on student learning outcomes than the ACT Exhibitions and the New Basics programs.

Discussion

This cross-program analysis indicates some essential components that need to be built into professional development programs if they are to lead to improved opportunities for student learning. The analysis of impact across the programs indicates that the most successful, such as EYNP, LINC and WA AGQTP, had profiles consistent with research on effective learning processes. They were rated highly by teachers across all five opportunity-to-learn measures in the conceptual model (Figure 2). They provided opportunities for teachers to focus on what students were to learn and how to deal with the problems students may have in learning that subject matter. They focused on research-based knowledge about student learning of content. They included opportunities for teachers to examine student work collaboratively—and in relation to standards for what the students in question should know and be able to do. They led teachers to actively reflect on their practice and compare it with high standards for professional practice. They engaged them in identifying what they needed to learn, and in planning the learning experiences that would help them meet those needs. They provided time for teachers to test new teaching methods and to receive follow-up support and coaching in their classrooms as they faced problems of implementing changes. They included activities that led teachers to de-privatise their practice and gain feedback about their teaching from colleagues.

This study is similar in methodology to the study by Garet et al. (2001). There are some differences in our model, reflecting the different context for the professional development programs included in the study. In the Australian Government Quality Teacher Programme, studies had to target, for example, experienced primary and secondary school teachers (10+ years) and areas such as literacy, numeracy, science and technology. Individual professional development programs within these target areas generally had to go through an extensive period of development and quality control mechanisms and, consequently, were generally rated highly by teachers in terms of the impact measures. Our analysis was restricted to programs for which we had responses from at least ten teachers—and teachers were not surveyed until at least three months had elapsed since the program.

Garet's study draws on their evaluation of the Eisenhower Professional Development Program—directed specifically at mathematics and science teachers. In selecting programs, they drew on a national probability sample of school districts and others that had received Eisenhower funds. Their survey is based on a nationally representative sample of about 1500 teachers who had attended these activities. They sub-sampled two teachers from each activity.

By and large, the findings from the two studies are similar as well. Content focus and active learning have a significant impact on knowledge in both studies. The ACER study includes

separate measures for follow-up, feedback and collaborative examination of student work, but the Garet study includes these in its overall index of active learning. We did not include a measure like Garet's coherence, as it did not seem applicable to the Australian context where programs would not receive funding unless they were consistent with Australian Government objectives and state-level curriculum standards. However, we did include a measure of the extent to which a professional development program facilitated the development of professional community at the school level as part of its strategy. This turned out to be a significant mediating variable in the ACER study.

The opportunity to learn variables that appeared to have had the least influence in this study are feedback and collaborative examination of student work, despite strong evidence for their importance in other research studies. However, as reported above, few program designers in this study built opportunities for feedback about practice into their strategies. Teachers indicated that opportunities to receive feedback as they tried new practices in the classroom were rare. Consequently there was little variation across programs in this variable and the study was not able to provide a fair test of the effect that feedback could have on teachers' practice. Similarly, few programs provided opportunities for collaborative examination of student work. Although this study does not provide a convincing case, it would not be appropriate to assume these two features were not important, given other research (Hawley and Valli, 1999). This study does indicate that program designers may not be incorporating these features to the extent that is needed to support implementation and sustained change in practice.

The relative success of programs also depended on the extent to which programs were extended in time, and planned so that they included activities that strengthened interaction and collaboration in the school—the level of professional community activities. They linked to other programs in the participants' schools that were designed to improve learning. The fact that both span of time and contact hours show significant, though independent, effects in this analysis indicates that both aspects of duration are important in the design of effective professional learning activities. This finding is consistent with the research of Garet et al. (2001) who claim that, 'Professional development is likely to be of higher quality if it is both sustained over time and involves a substantial number of hours' (p. 933).

Other clear messages come through this analysis across the programs. The role of follow-up is especially noteworthy. The level of follow-up was found to increase significantly the extent to which teachers reported a sense of increased knowledge (0.33), perhaps reflecting the critical role that 'at the elbow' coaching and support in classrooms plays in learning new skills and putting them into practice. This kind of support was built into the more effective programs such as the WA AGQTP Action Learning Program, the LINC program in CECV schools and the Victorian Early Years Numeracy Program.

The findings from this study are also consistent with long-standing research findings about the importance of school context. The pre-existing level of support for professional development in a school has a significant indirect effect on the outcomes of programs. It follows from this research that is not enough to provide well-designed professional development programs from outside the school. Policy makers and school administrators need to give equal attention to building the conditions that will enable schools to provide fertile ground for professional learning on an ongoing basis and as a routine part of the job. This study indicates that a substantial level of professional community is vital to significant change. The key ingredients here are time to think, analyse and talk about the specifics of what is going on in classrooms and what students are doing and learning. Effective school administrators in strong professional communities expect evidence of professional development and act in ways that demonstrate they value teacher learning.

The findings from this cross-program analysis reflect findings from other research on professional development and challenges that policy makers have faced for many years. These studies often find a considerable gap between the conditions that research indicates are optimal for professional learning and those that are provided. The capacity of policy makers to provide funding sufficient to ensure their incorporation into most professional development

programs can be constrained depending on the level of available funding for professional development. While the research has long indicated that there are no short cuts to significant and sustainable change at the classroom level, short cuts often have to be taken. However, money spread thinly, when it comes to professional development, is unlikely to produce significant change. Where significant change is sought, it may be wiser to involve fewer teachers than produce less significant change among many.

Not only policy makers, but also professional development providers face a challenge in designing programs consistent with research in this field. This cross-program study reinforces the central importance of building follow-up support into the design of professional development programs. However, this feature of professional development is labour intensive and time consuming and, consequently, expensive.

The same applies to feedback. Perhaps one of the most significant findings in this study across the ten programs was how rarely designers built in opportunities for feedback and coaching, despite research on their centrality to learning new skills. Reflection on practice and the development of understanding about the change is unlikely to be optimal without sources of timely and insightful feedback on what one is doing. Ensuring opportunities for every teacher to receive 'at the elbow' support and coaching during the difficult phase of implementing significant change in the classroom is a feature of effective programs. This study reinforces the central importance of building follow-up support into program design. Though this feature of professional development is labour-intensive and time-consuming, without it money may be wasted.

Similarly, time to bring teachers together in the workplace to examine student work and to provide opportunities for feedback needs to be built into current conceptions of teachers' work. These studies indicate that teachers' work needs to be organised on the assumption that it is professional work; that is, work that requires an appropriate balance between up-front practice and back room collegial analysis and reflection on practice in the light of standards for student learning and professional practice.

Limitations

The research described above is based primarily on teacher self-reported data. Given the time frame and the level of resources usually allocated to evaluations of professional development programs, there is often little opportunity to gather first-hand evidence about changes in teacher knowledge, practice, efficacy and students' learning outcomes. However, recent studies (for example, Mayer, 2001) indicate that it is reasonable to place a certain level of confidence in surveys that rely on teachers' reports about their practice. Reliability of these self-report data increases with more specific measures, as used in the ACER approach. Also, teachers are not reluctant to speak their minds frankly when it comes to assessing the value of professional development programs. There is little reason to think that their responses might be biased one way or another, or prompted by any desire to please, especially when, in studies such as the above, they are contacted several months at least after the programs have finished.

Chapter 6

Towards a Methodology for Assessing the Impact of Professional Development on Student Learning

The fifth key task in this project was directed towards the development of a methodology to assess the impact of professional development provided through Australian Government programs on student learning. The extensive literature review, and the school-based trials contributed in different but significant ways to the development of a possible methodology that could be used in Australian Government programs.

The research project was built on a model linking professional development to changes in teachers' professional knowledge that are, in turn, linked to changes in teaching practices. In this causal chain, the last link is between changes in teaching practices and improved student learning outcomes. This model is consistent with current research on the impact of professional development on student learning outcomes, arising from increasing recognition of quality teaching as a key to better student performance (NPEAT, 2001, Supovitz, 2002, Garet et al. 2001, Cohen and Hill, 2001, Guskey and Sparks, 2002, Wenglinsky, 2002, Rowe, 2003, Hattie 2003). Within the extensive body of research on professional development, research about the impact of professional development on classroom practice and student achievement has been limited (Cohen and Hill, 1998; Thompson, 2003).

Through the school-based trials, the model allowed for the exploration of critical features of professional development programs, and how professional learning contributed to changes in teachers' knowledge and skills, changes in classroom practices and, ultimately, to changes in student learning outcomes.

The professional development programs that were the subject of the school-based trials highlighted many of the features of effective professional development identified in the literature review (Chapter 2). Research on professional development that makes a difference indicated key features, such as content knowledge, professional community, opportunities for active learning, continuous, providing feedback (for example, Darling-Hammond and Ball, 1998, Thompson, 2003, Cohen and Hill, 2000).

The detailed case studies (see Volume 2) and the cross-program analysis of the questionnaires completed by teachers (Chapter 5) identified many of the ways in which these key features were evident in the professional development programs.

Student learning outcomes in the school-based trials

The scope and nature of student learning outcomes required clarification at the commencement of the project. For the purposes of the investigation of the links between teacher professional development and student learning outcomes, a broad working definition of student outcomes was adopted. Student outcomes were seen to include specific improvement at the level of a key learning area, either across the stages of schooling or at a particular stage. Student outcomes that related to other matters with a major influence on learning, such as engagement, motivation, enjoyment and participation were also included.

The professional development programs that were the subject of the school-based trials in this research were selected because of their stated intention of improving student learning outcomes. The variety in emphasis given to the improvement of student learning outcomes also guided the selection of the professional development programs for the case studies.

In different ways, the professional development programs demonstrated the logic of focusing on professional development as a means of improving student achievement as described by Supovitz (2001):

> ... that high quality professional development will produce superior teaching in classrooms, which will, in turn, translate into higher levels of student achievement.

There were considerable differences in the designs of the ten programs, and in the ways in which they linked the purposes of the professional development to the improvement of student outcomes.

A marked difference was seen in the design of the professional development programs. They ranged from programs designed to focus on a specific area of learning to other programs designed around the provision of a particular set of learning opportunities for students, to further programs intended to involve teachers in reflecting on their practice. The objective was to enhance teachers' professional knowledge and practices, leading in turn to improved learning outcomes for students.

Another major difference lay in the breadth or specificity of the focus on student outcomes. A number of the programs addressed student outcomes from a broad perspective, focusing on increased participation, motivation and engagement. Other programs focused on outcomes specifically within key learning areas, such as subject content knowledge, skill acquisition and development, at particular stages of schooling.

Insights into changes in this wide range of student learning outcomes were derived from the detailed qualitative evidence of the case studies, and to a significantly lesser extent, from the analysis of repeated assessments of student achievement. The value-added analysis of student achievement data provided limited evidence of the impact of the professional development on student learning outcomes. Further evidence of the impact on student learning was found in the qualitative data from the case studies. The cross-program analysis of the teacher questionnaires also identified how the self-reported data from teachers showed changes in student learning outcomes.

The trials reflected the difficulty of obtaining evidence of the impact of professional development on student learning outcomes that had been identified in the literature review (Garet et al., 2001; Supovitz, 2001; Cohen and Hill, 1998). The limited evidence of impact of the professional development programs on student learning, despite the rigour of the value-added analyses, reinforces the recognition in the research literature of the need for longitudinal approaches to finding evidence of the link (Rowe, 2003; Supovitz, 2001; Richardson and Placier, 2001).

Assessments of student achievement data

At the outset of the project, it was recognised that student achievement data, linked to professional development, would be difficult to obtain on a large scale, and that this represented a major methodological challenge in the research project.

While State and Territory data on literacy and numeracy achievement against national benchmarks at Years 3, 5 and 7 provided a potential source of data on broad changes in student achievement in some of the aspects addressed in the professional development programs, it was recognised that these assessments would not be directly aligned with the purposes of other professional development programs being investigated, and so would not provide an appropriate measure.

In order to gain insights into changes in student learning outcomes, a significant strategy used in the case studies was the collection of student achievement data at two points in time, so that a value-added analysis could be undertaken. It was clear that it was essential to use assessments aligned with the purposes of the professional development programs. Well-established assessment instruments, such as the Developmental Assessment Resource for Teachers (DART) and the International Benchmark Tests in Science (IBT), were used. However, a broad range of student outcomes was addressed in the professional development programs, and some of the assessments tasks addressed a relatively narrow range of outcomes. These assessments were conducted in the first semester and at the end of the school year.

The repeated measures provided the opportunity to undertake a value-added analysis that took account of background variables such as gender, year of schooling, language background other than English and students' prior achievement. The analysis was undertaken to determine if any schools amongst those studied in the school-based trials showed student achievement that was better than might have been expected, and that might therefore be attributed to the impact of the professional development in which the teacher had engaged.

The outcome of this analysis was that only a very small number of schools showed student achievement that was better than might have been expected, and it proved to be difficult to identify, from the qualitative data of the case studies, aspects of the professional development programs that might have contributed to the changes.

A significant limitation of the approach was the relatively short period of time between the repeated assessments. Although this component of the research project used rigorous assessment strategies and methods of analysis, it suggested that collecting evidence of changes in student achievement only from standard assessments would not provide a useful methodology for assessing the impact of professional development programs.

In the context of some professional development programs, standardised assessments closely aligned to the purposes of the professional development could, over time, reveal the changes in student achievement targeted by the professional development. The collection of longitudinal data over three or more years would allow for the changes promoted by the professional development to become embedded in teachers' classroom practice, and subsequently to create better learning opportunities for students.

Qualitative data from the case studies

The case studies provided some qualitative evidence of changes in student outcomes that could reasonably be linked to the professional development programs. In interviews with the link researchers, teachers reported their observations of changes in a broad range of student outcomes, including motivation, engagement, and in some cases, specific aspects of achievement such as improvements in writing. The evidence from the case studies suggests that the fine-grained observations of teachers in the classroom identify signs of changes in student outcomes earlier than standard assessment tasks. In some cases, the professional development activities undertaken by the teachers had alerted them to the kinds of changes in students' learning that they might expect to see, and they were able to describe these changes.

The common questionnaire sent to all teachers in the school-based trials, and to some of their colleagues, included a question that invited them to report on changes in student outcomes. The responses to this question provided further evidence of observed changes, and suggest the potential value of such a questionnaire for use on a larger scale. Analysis of the responses to the questionnaire (Chapter 5) showed that some features of professional development programs, including follow-up, content focus and active learning, were directly related to the level of impact on teachers' knowledge. The level of active learning was found to have a direct relationship to changes in teachers' knowledge and efficacy.

A methodology for Australian Government programs

The understandings of the links between professional development and student outcomes that have been derived from the review of the professional literature and national and international initiatives, and from the school-based trials in this investigation, have provided useful insights for the development of a methodology for assessing the impact of professional development. The findings of the research project suggest that a feasible methodology for the Australian Government would involve a focus on the design of professional development programs, and also on the evaluative processes to be used in such programs. The findings from this research project suggest some guidelines for the design and evaluation of Australian Government programs.

A significant consideration concerns the multiple purposes of professional development: some focus quite directly on student outcomes, while other programs focus on aspects of teaching that in more general ways contribute to the provision of improved learning opportunities for students. The methodology would therefore need to be used at different levels according to the particular purposes of the professional development programs.

The model that underpins this research project also provides a robust model for the methodology that could be used to assess the impact of professional development programs on student learning outcomes. The logic of linking professional development to changes in teachers' knowledge, then in teaching practice, and finally to changes in student outcomes, matches the requirements of the methodology.

The design of professional programs

Professional development programs can be designed explicitly to bring about improvement in student learning. If Australian Government programs are to lead to improved learning, they should be deliberately designed to do this. Professional development programs funded by the Australian Government could encourage the provision of design briefs that clearly indicate the ways in which the program pays attention to all elements of the model. Key questions that could be addressed in design briefs include:

- What improvements in student learning outcomes, general or specific, are targeted in the program?

- What are the teaching practices promoted by the professional development program? How might these practices provide better learning opportunities for students?

- What new knowledge and skills is it expected that teachers will acquire from the professional development activities? How will this knowledge and these skills lead, over time, to changes in teacher practice, and, in turn, affect student learning?

These questions are critical in articulating the theory of action for a professional development program.

Evidence from the school-based trials (see the detailed case studies in Volume 2) and the cross-program analysis (Chapter 5) suggest some ways in which professional development programs can be designed to improve student outcomes. The design briefs should include clear descriptions of the ways in which the particular professional development program includes features that have been identified in recent research and were evident in the case studies as contributing to improved classroom practice and student learning outcomes. These characteristics of effective professional development that affect teachers' knowledge and practice, their general efficacy, and then student learning, include:

- a focus on the content that teachers present (on specific subject matter), on the ways in which student learn that content, and on how to teach the content

- direct connections to the curriculum and assessment requirements relevant to the educational context in which teachers work

- the provision of opportunities for teachers' active learning, including access to models of effective teaching, opportunities to reflect on practice, opportunities to engage in collaborative examination of students' work and to practice new teaching approaches

- the provision of ongoing support and follow-up for professional development

- professional development programs that are sustained and extended in duration, rather than brief single workshops.

The evaluation of teacher professional development

Changes in teaching practice take time to become embedded in ongoing practice. Consequently, there is a time lag between teachers' involvement in professional development programs and the availability of evidence of impact on student learning outcomes. Therefore, the methodology for assessing the impact of professional development on improvements in students' learning should include evaluation processes that allow time for changes to become integrated into teachers' practice. Such delayed evaluation processes could focus on gathering data on changes in teachers' knowledge, in their teaching practices, and in the learning outcomes of their students.

The evaluation questionnaire used in this project provides an example that can be used some months after the completion of a professional development program to gather evidence about the impact of the professional development. The questionnaire is an example of a way of prompting teachers to reflect on changes in their own teaching and in the learning achievements of their students. Feedback from teachers about the changes they perceive in student learning, especially when it is sought after a reasonable period of time, could be gathered from selected samples of program participants.

This research project provided evidence that improved student outcomes are difficult to measure over a short time. If the methodology required, for evaluative purposes, the collection of specific evidence of changes in student achievement for specified professional development programs, a rigorous value-added approach should be used, with the repeated measures assessments occurring at intervals of at least one year. If specific evidence of student achievement is collected, student outcomes should be broadly defined, and the assessment instruments used should relate closely to the purposes of the particular professional development programs. In many cases, assessments of students' learning, in particular key learning areas, and of specific skills and knowledge can be assessed by well-designed assessment instruments. Such instruments can be used to assess broader outcomes, such as significant changes in behaviour of engagement.

Through the case studies, the project also demonstrated the value of teachers' judgements of their students' learning and, through the questionnaires, the value of teachers' self-reported data on improved learning.

Conclusion

Any methodology that is used to assess the impact of professional development programs on student learning outcomes will necessarily require a balance between what is feasible and what is ideal. The methodology suggested indicates some of the complex issues to be addressed. The suggestions for focusing on the design and evaluation of professional development programs offer a basis for the development of a set of broad guidelines for future Australian Government policy on teacher professional development.

Chapter 7

Conclusions and Implications for Further Research

Introduction

This investigation of the links between teacher professional development and student learning outcomes has provided insights into the nature of professional development and its impact on teaching. It sharpened the focus on the kinds of learning that are embraced by the term 'student learning outcomes'. The survey of national and international initiatives linking teacher professional development and student outcomes, and the review of research and other professional literature, identified the difficulties of finding evidence about how teacher learning is linked to student learning. The study generated a number of conclusions, questions and practical implications for continuing work in the field.

In some cases, achievement data and qualitative evidence indicated that improved student learning could be linked to teacher professional learning but there was insufficient evidence to provide a direct relationship to a specific professional development program in a majority of cases. However, the review of research literature identified some studies that provide evidence of a clear link between student learning and overall teacher quality.

Features of professional development that impact on teachers' knowledge were identified in the school-based trials. The incorporation of these features into the design of future professional development programs will contribute to their effectiveness in improving the quality of teaching.

The study demonstrated that while the connection between quality of teaching and students' learning is well established, connecting changes in students' learning directly to their teachers' learning from particular professional development programs is a complex matter. There are significant challenges in gathering evidence of the impact of teacher professional development on student learning outcomes. The most significant difficulty lies in the need for research that takes place over a sufficient period to capture the chain of impact from teachers' professional learning, to changes to teaching practices and eventually to changes in student learning outcomes.

This project conducted school-based trials over the period of one school year. In the event, this was a short period of time in which to collect repeated measures of student achievement to identify more change than might be expected, given students' prior achievement. In the space of a single school year, the case studies tracked changes in teachers' knowledge and practice, identifying what they were doing differently as an outcome of the professional development. In the same school year, the case studies also gathered evidence of student achievement. This was, in most cases, too short a time span for change in student achievement attributable to the professional development to become apparent. However, the qualitative evidence of teachers' reports of changes in their students learning provides some important insights into the impact of the professional development programs.

The other methodological problem in conducting this research concerned the difficulty of identifying assessments that aligned with the purposes of the professional development. Professional development programs serve multiple purposes: some programs focus quite specifically on strategies for improving student learning outcomes, while others focus on

aspects of teaching that in more general ways contribute to the provision of improved learning opportunities for students.

Both of these difficulties were signalled in the research literature, which drew attention to the small body of research in this field, largely because of the difficulties outlined above.

Conclusions

1. Student outcomes broadly defined

The professional development programs included in this study were selected because it was clear that they were explicitly intended, in the long term, to lead to the improvement of student learning. However, within the ten programs investigated, there was considerable diversity in the student outcomes that were the focus of the professional development. The programs included quite specific student outcomes in early years numeracy, general outcomes such as improvement in students' attitudes to science, and outcomes related to enhanced levels of general engagement with learning.

Providing high quality learning opportunities that will enable students to achieve this broad range of outcomes is central to teachers' work, and therefore will always, in different ways, be the subject of teachers' professional learning. The case studies of ten different professional programs indicate that it is essential, in investigating the links between teacher learning and student learning, to define student learning broadly, and to avoid narrowing outcomes only to those that can be easily measured. The case studies provide information about the features of professional development activities, such as emphasis on content, follow-up support, opportunities for reflection, collaboration and the building of professional community, that contribute to the strengthening of teachers' capacity to improve their students' learning outcomes.

2. A wide range of evidence of improvement, including teachers' classroom observations

This investigation gathered both qualitative and quantitative evidence of improvements in students' learning. The rigorous approach to collecting and analysing repeated measures of achievement over time provided limited but significant evidence of improvement. The wider range of evidence collected in the case studies, particularly from teachers' informed observation of their students over time, provided nuanced insights into ways of improving student learning.

Teachers interviewed for the school-based case studies frequently referred to their observations of improvements in their students' learning. A teacher who undertook the Graduate Certificate in Literacy noted how she could see her students

> *really using their literacy skills, making them see why it's important to be able to make up a good argument, not just talk off the top of your head. They were so excited when people sat up and took notice of what they had to say.*

A participant in a Western Australian AGQTP Action Learning project reported how her students' reading had improved, and the evidence for these improvements:

> *I can confidently say that my class has progressed from being basically very good technical readers to very capable text users and integrate their reading skills into other learning areas by being text users. This is evident by the progress noticeable in their workbooks and their ability to use their reading skills to prepare presentations on given topics, writing reports and demonstrated reading behaviours characteristic for Level 2 and 3 readers.*

Changes in students' learning in the ACT Year 9 Exhibitions project were, in this case, seen as a long-term process:

Change for students is a very gradual thing. The capacity to self-evaluate is very hard to develop. It is difficult for Year 9, but it helps them to improve. Students can negotiate their work and make choices. Since they can talk easily about their work the reflecting will come.

These three examples exemplify the wide range of qualitative evidence of improved student learning provided by the case studies.

3. Longitudinal view of change

The school-based trials took place over a whole school year. However, this was a relatively short period to allow for teachers to understand and take up new practices, for these new or refined practices to impact on students' learning, and for the evidence of change in student outcomes to become apparent. The kinds of changes involved are interconnected, but required time to become embedded. If the impact of professional development is to be judged in part by its impact on student learning, a longitudinal view of change is needed. A teacher taking up new practices may see evidence of improvement in her students from an early stage, but it may be two or three years until the new practices are firmly embedded in her teaching, and before evidence can be collected that shows sustained difference in students' learning.

The research literature and the evidence from the case studies highlight the importance of evaluations of the impact of teacher professional development on student learning outcomes being timed to allow for improved instructional practices to become embedded in teachers' everyday practice. A teacher in the Science in Schools professional development project noted that, 'In many ways the real business of changing science teaching and learning practice begins with the second year of the project'.

This finding suggests the potential value of developing evaluation processes with the capacity to capture evidence of change over time.

4. Evidence of change in students' learning as an incentive for changing practice

Connections between professional development and student outcomes can be seen when teachers take up a new practice, and recognise how this practice creates new learning opportunities for students. This evidence of change then becomes an incentive for further learning, suggesting that there may be a symbiotic relationship between teachers' learning and students' learning. The evidence of changes in students' learning is important evidence for teachers of the efficacy of new or different pedagogical practices, and of the potential value of taking the changed practice further.

The case studies, through the interviews, provided teachers in the schools involved with opportunities for extended reflection on their practice, and on their students' learning. This reflective process reinforced their valuing of the professional development.

5. The design of professional development

This investigation has highlighted in the literature review, in the data collected in the case studies and in the cross-program analysis, the significance of the emphasis on content in the design of professional development. Emphasis on content knowledge, knowledge of how students learn that content, and knowledge of strategies for teaching that content connect professional development to classroom programs. All of the professional development programs investigated in the school-based trials made this connection, and evidence, even though it was preliminary in some cases, of the impact of teachers' learning on the learning of their students was found in all the case studies. Thus it can be concluded that the evidence suggests that professional learning programs with a strong content focus, as well as an emphasis on other features such as follow-up, active learning, feedback and professional community are likely to show evidence of improved student learning. The cross-program analysis (Chapter 5) reported evidence of the impact of emphasis on content on teachers' learning and subsequently on students' learning.

A strong research and theoretical base for the pedagogical approaches that are the focus of the professional development validates and strengthens the content that is presented in the professional development program, and increases the likelihood that teachers incorporating this knowledge into their practice will find that it enhances their teaching.

Most of the programs were designed to allow for professional learning as a continuing and ongoing process, and many provided support for teachers' learning. These aspects are important design features of effective professional development.

Some of the professional development programs were explicitly designed to bring about a change in the learning opportunities available to students. For example, the ACT Year 9 Exhibition program provides a striking example of a professional development program designed to change student outcomes. This is described in the case study (see Volume 2) as follows:

> *It is established in the design of the professional development program itself. Year 9 Exhibitions professional development program was designed from the premise that the purpose of a professional development program is to change student learning outcomes. Therefore, the structure and organisation of the program explicitly linked student learning to the initial professional development meetings. Even though it is very difficult to determine a set of causal links between the professional development meetings and the various steps in changing teacher knowledge and pedagogy, the intentions of the program were clear. It set out directly to change student outcomes.*

This finding suggests that emphasising content in the design of professional development programs will strengthen its impact.

6. School contextual factors

The school-based trials provided a considerable body of information about the impact of school contextual factors on the implementation and sustainability of the intended outcomes of the professional development. The level of school support was associated with the extent to which participants in the professional development programs found that they had opportunities for active learning. Active learning within professional development programs was a strong influence on teaching practices, and teaching practices in turn had a strong influence of students' learning.

The case studies capture many of the daily realities of school life that hinder a continuing focus on teaching and on improving learning. The difficulty in finding adequate time for planning, reflection and collaboration was an ongoing theme in interviews with teachers. A loss of momentum caused by staffing changes was reported in a number of cases. Some schools planned for the sustainability of the changes they had implemented by providing mentoring programs for new staff. Leadership support was a crucial mediating influence. Where leadership support and commitment was strong, the case studies indicate that it was possible to implement change over time.

Designing professional development programs that improve student learning

This investigation highlighted the importance of keeping improved student learning in mind when designing professional development programs and when evaluating those programs. There is a chain of logic that links teachers' professional learning and improved student learning outcomes, and there is growing convergence about the features of effective professional development that have the potential for strengthening these links. Further longitudinal research will deepen our understanding of that chain of logic.

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Glossary of Acronyms

ACER	Australian Council for Educational Research
AGQTP	Australian Government Quality Teacher Programme
BST	[the NSW Year] Basic Skills Test
CBI	Cognitively Guided Instruction [program]
CECV	Catholic Education Commission, Victoria
CMIT	The Count Me In Too [Early Numeracy Program]
DART	Development Assessment Resource for Teachers
DEETYA	Department of Employment, Education, Training and Youth Affairs
DEST	Department of Education, Science and Training
DETYA	Department of Education, Training and Youth Affairs
ETS	Educational Testing Services
EYNP	Early Years Numeracy Program
IBT	International Benchmark Tests
ICT	Information and Communications Technology
INTASC	Interstate New Teacher Assessment Consortium
LINC	Learning Improves in Networking Communities
LLANS	Longitudinal Literacy and Numeracy Study
LOU	Level of Use
NBPTS	National Board for Professional Teaching Standards
NCTM	National Council for the Teaching of Mathematics
NGfL	[UK] National Grid for Learning
NPEAT	National Partnership for Excellence and Accountability in Teaching
PAT	Progressive Achievement Test
PD	Professional Development
QTP	Quality Teacher Program
RBRI	Rowe Behavioural Rating Inventory
RCC	Recognition of Current Competency
SiS	Science in Schools
STELLA	Standards for Teachers of English Language and Literacy in Australia
WA AGQTP	West Australia Australian Government Quality Teacher Program