MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

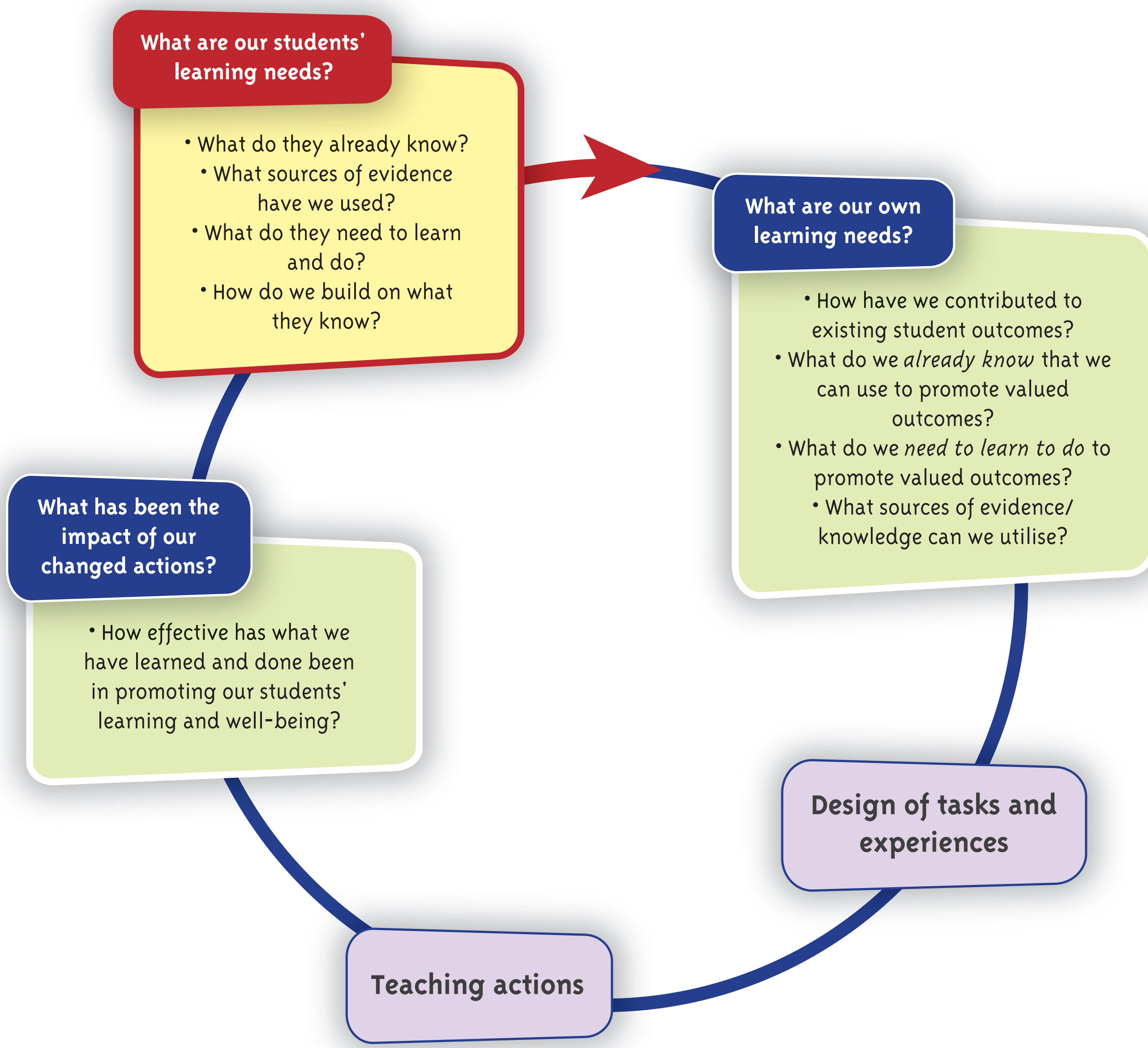
Teacher Professional Learning and Development

Best Evidence Synthesis Iteration [BES]

Helen Timperley, Aaron Wilson, Heather Barrar, and Irene Fung,
University of Auckland

BES
ITERATIVE BEST EVIDENCE SYNTHESIS PROGRAMME
http://educationcounts.edcentre.govt.nz/goto/BES
New Zealand

Teacher inquiry and knowledge-building cycle to promote valued student outcomes.



H. Timperley, A. Wilson, H. Barrar & I. Fung (2007)
Teacher Professional Learning and Development: Best Evidence Synthesis Iteration
Wellington, New Zealand: Ministry of Education
http://educationcounts.edcentre.govt.nz/goto/BES

Teacher Professional Learning and Development

Best Evidence Synthesis Iteration [BES]

Helen Timperley, Aaron Wilson, Heather Barrar, and Irene Fung,
University of Auckland

New Zealand Ministry of Education

This report is one of a series of best evidence synthesis iterations (BESs) commissioned by the Ministry of Education. The Iterative Best Evidence Synthesis Programme is seeking to support collaborative knowledge building and use across policy, research and practice in education. BES draws together bodies of research evidence to explain what works and why to improve education outcomes and to make a bigger difference for the education of all our children and young people.

Each BES is part of an iterative process that anticipates future research and development informing educational practice. This BES is fundamental to the effective use of all the schooling BESs because it illuminates the kind of professional learning for teachers that strengthens valued outcomes for diverse learners. New BESs will progressively become available at http://educationcounts.edcentre.govt.nz/goto/BES

Feedback is welcome at best.evidence@minedu.govt.nz

Note: The references printed in bold refer to the list of URLs found in Appendix 3. These are a selection of useful sources for teachers and teacher educators who want to engage more deeply with the issues raised in this best evidence synthesis iteration.

Published by the Ministry of Education, Box 1666, Wellington, New Zealand 6140.
www.minedu.govt.nz

Dewey number 371.102
ISBN 978 0 7903 2628 3
Item number 32628
PDF ISBN 978 0 7903 2629 0
PDF Item number 32629

Contents

Acknowledgments ... vi

Forewords ... vii

International ... vii
Secondary Principals' Association of New Zealand ... x
NZEI Te Riu Roa ... xi
Post Primary Teachers' Association ... xii
New Zealand Teachers Council ... xiii
Pasifika ... xiv
Teacher education ... xiv
Māori education ... xvi
Chief Education Adviser, BES ... xx
Summary of Findings ... xxiii
Theoretical and methodological frameworks ... xxiii
Findings ... xxv
1. The context of professional learning and development ... xxvi
2. The content of professional learning and development ... xxxi
3. Activities constructed to promote professional learning ... xxxv
4. Learning processes ... xl
Consistency with findings from other syntheses ... xlv
Gaps in the evidence ... xlv
Summary ... xlv

1. Context ... 1
1.1 New Zealand context ... 1
1.2 Issues of audience ... 3
1.3 Organisation of the synthesis ... 3

2. Processes and Outcomes of Teacher Learning ... 6
2.1 Black boxes ... 7
2.2 Professional learning processes ... 7
2.3 Responses of diverse teacher learners ... 13
2.4 Implications of the professional learning framework ... 15

3. Student Outcomes and Responsiveness to Diversity ... 18
3.1 Determining student outcomes ... 18
3.2 Determining teacher outcomes ... 19
3.3 Responsiveness to diversity ... 20

4. The Framework for Analysis and Synthesis: Methods and Procedures ... 22
4.1 Identifying and retrieving the studies ... 23
4.2 Development of the theoretical framework ... 24
4.3 Mapping the studies on the framework ... 25
4.4 Putting the mapping framework together ... 29
4.5 Identifying broad categories ... 31

5. Outcomes for Students ... 33
5.1 Effect sizes for quantitative outcomes ... 33
5.2 Summary of findings ... 56
5.3 Measuring qualitative outcomes ... 60

6. Professional Learning and Mathematics ... 65
6.1 Studies considered ... 65
6.2 What works for whom in changing teaching of mathematics ... 71
6.3 Bringing it all together ... 91

7. Professional Learning and Science 99
7.1 Studies considered 99
7.2 What works for whom in changing student outcomes in science 103
7.3 Bringing it all together 122

8. Professional Learning and Literacy 130
8.1 Studies considered 130
8.2 What works for whom in literacy? 137
8.3 Bringing it all together 153

9. Reframing Teachers' Social Constructions of Students 160
9.1 Studies considered 160
9.2 What works for whom in reframing teachers' social construction of students 164
9.3 Bringing it all together 177

10. What the Evidence Tells Us about Some Topical Issues 183
10.1 Issue 1: Multiple roles of assessment in promoting teacher learning 183
10.2 Issue 2: The role of school leaders in promoting professional development 192
10.3 Issue 3: Teachers' existing theories 196
10.4 Issue 4: Professional learning communities 201
10.5 Issue 5: Professional learning in secondary school contexts 205

11. Sustainability 218
11.1 Methodological approach 219
11.2 What works for whom to sustain improved student outcomes 220
11.3 Bringing it all together 224

12. Gaps in the Evidence 228

Appendix 1. Case Studies 232

Appendix 2. Methods and Procedures 269
2.1 Locating the studies 269
2.2 Mapping the studies into the framework 273

Appendix 3. URLs of citations 280

Appendix 4. Glossary 282

Table of Tables

Table 1. Positive and negative examples of activities xxxvii
Table 5.1. A list of studies with effect sizes (ES) of student outcomes 35
Table 5.2. The range and mean effect sizes of student outcomes averaged for each study 57
Table 5.3. The range and mean effect sizes for all effects 58
Table 6.1. Mathematics: core studies 65
Table 6.2. Mathematics: supplementary studies 69
Table 7.1. Science: core studies 100
Table 7.2. Science: supplementary studies 102
Table 8.1. Literacy: core studies 130
Table 8.2. Literacy: supplementary studies 134
Table 9.1. Reframing teachers' social constructions of students: core studies 160
Table 9.2. Reframing teachers' social constructions of students: supplementary studies 163
Table 10.1. Assessment use: core studies 184
Table 10.2. Teacher professional learning in a secondary school context: core studies 206
Table 10.3. Teacher professional learning in a secondary school context: supplementary studies 207
Table A 2.1. Combinations of keywords for database searches for studies 269
Table A 2.2. A list of studies included for analysis and synthesis 270
Table A 2.3. Main categories and subcategories of the framework 274

Table of Figures

Figure 4.2. Framework for analysing the effectiveness of professional learning experiences. xxiv
Figure 4.1. Flow chart for the analysis xxv
Figure 6.2. Typical sequence of professional learning opportunities xxxviii
Figure S.1. Developing teacher knowledge and inquiry to promote student learning xliii
Figure 2.1. The black boxes of teacher and student learning 7
Figure 2.2. Teacher learning processes and outcomes 8
Figure 2.3. Responses of diverse teacher learners/communities 14
Figure 4.1. Flow chart for the analysis 23
Figure 4.2. Framework for analysing the effectiveness of professional learning experiences... 24
Figure 4.3. Types of professional learning content mapped on to the framework 28
Figure 4.4. Professional learning activities mapped onto the framework 29
Figure 4.5. A framework for mapping the studies 30
Figure 6.1. Assessment and teacher commitment 82
Figure 6.2. Typical sequence of professional learning opportunities 85
Figure 4.2. Framework for analysing the effectiveness of professional learning experiences ... 232
Figure A 2.1. Rubric for assessing methodological adequacy in documenting student outcomes 278

Table of Overviews

Overview 1. Effective contexts for promoting professional learning opportunities that impacted on a range of student outcomes xxvii
Overview 2. The content of professional learning and development in the core studies xxxii
Overview 3. Activities in the core studies that were constructed to promote professional learning xxxvi
Overview 4. Learning processes and teachers' responses xl
Overview 6.1. The context of the professional learning opportunities 72
Overview 6.2. The content of the professional learning opportunities 78
Overview 6.3. Activities constructed to promote the professional learning 84
Overview 6.4. Learning processes 89
Overview 7.1. The context of the professional learning opportunities 104
Overview 7.2. The content of the professional learning opportunities 109
Overview 7.3. Activities constructed to promote the professional learning 115
Overview 7.4. Learning processes 121
Overview 8.1. Key features of the context for literacy 138
Overview 8.2. Key features of the content of the professional learning opportunities 143
Overview 8.3. Activities constructed to promote professional learning 148
Overview 8.4. The learning processes 152
Overview 9.1. The context of the professional learning opportunities 164
Overview 9.2. The content of the professional learning opportunities 169
Overview 9.3. Activities constructed to promote the professional learning 173
Overview 9.4. Learning processes 176
Overview 10.1. Multiple roles of assessment in the core studies 183
Overview 10.2. Leadership roles found in studies with substantive positive outcomes for students.. 193
Overview 10.3. Qualities of professional communities that promoted teacher and student learning. 203
Overview 11.1. Conditions found in studies that demonstrated sustainability 220

Acknowledgments

It would not have been possible to complete this synthesis without the support of many people. To acknowledge some runs the risk of omitting others. Our apologies in advance to those we have left out. Our first acknowledgment must go to Dr Adrienne Alton-Lee, Chief Education Adviser, Iterative Best Evidence Synthesis Programme in the Ministry of Education, for her continued support and challenge throughout the process. Indeed, the courage of the Ministry of Education to embark on this whole programme must be acknowledged.

We have also had the ongoing support of Dr Lorna Earl from Aporia Consulting who has acted as an international quality assurer and critical friend throughout various iterations of the synthesis. Members of our Advisory Committee, Professor John Hattie, Associate Professor Judy Parr, Dr Margie Hohepa, Nicky Knight, and Tanya Samu, together with Professor Viviane Robinson, have also provided extensive and helpful comments.

Completion of the cases in the final section of the synthesis would not have been possible without the time the authors of the original studies spent with us in describing in detail what happened and how they engaged with teachers in the learning process. These people included Professors Russell Bishop and Stuart McNaughton, Drs Mei Lai, Joanna Higgins and Gillian Tasker, Michael Absolum, and Jude Moxon. Drs Claire Sinnema and Graeme Aitken's contribution to the inquiry cycles, the theory underpinning the cases, and their comments on the format were much appreciated.

Extensive work was involved in checking (and rechecking) the calculation of the effect sizes for the different studies. We are very grateful to Dr Gavin Brown and Junjun Chen for their careful work in this regard and to Ngaire Hulsbosch for working through the detailed analysis of the counter-factuals and making sure it all made sense in the text.

Ian Reid from Learning Media Limited has extensively edited the text to make it more readable for multiple audiences. His expertise in this regard is most appreciated.

At various stages of its development, this synthesis has been discussed extensively by numerous groups comprising teachers, researchers, consultants, and Ministry officials who were directly or indirectly involved in professional development. Officials from the two teacher unions have also provided useful comment throughout the process.

We are grateful for the patience of our work colleagues, managers, and families, who tolerated our neglect of other tasks and our absences, knowing that we were 'working on the BES'.

Helen Timperley

Aaron Wilson

Heather Barrar

Irene Fung

Forewords

International

Over the past several decades the focus on educational change has been pervasive and unrelenting as education systems everywhere have struggled to meet the needs of the times. For those of us who have a long history of involvement in education, it is sometimes hard to imagine that there could be anything new under the educational reform sun, as old ideas are recycled and the pace of change often seems painfully slow. But periodically, something surfaces that has the power to fundamentally reshape how we work. The Iterative Best Evidence Synthesis Programme, of which this BES is part, has this potential.

The Iterative BES Programme is at the forefront of a wave of activity that is dramatically altering the reform landscape by linking research to policy and practice. This interest in evidence-informed policy and practice is driven by a growing awareness of the need for a better understanding of the complex problems confronting us and the need to fully utilise available knowledge to develop better solutions. Many jurisdictions and organisations are undertaking systematic reviews of educational research with the aim of disseminating the knowledge gained to policy makers and practitioners. None are so well established or systematic as the New Zealand Ministry of Education's Iterative BES Programme.

I have had the privilege of being a critical friend to the development of this *Teacher Professional Learning and Development BES*. My insider–outsider vantage point has allowed me to witness the evolution of the Iterative BES Programme as a powerful force able to accelerate the transformation of knowledge into use in New Zealand and beyond. As others have observed, the programme is the most ambitious and rigorous of its kind to be found anywhere. It is also the only one to so comprehensively emphasise student learning and engage stakeholders in interpreting and sharing the findings, with the result that the knowledge from these reviews is accessible and practical for both policy makers and practitioners.

In the final analysis, education is a human, societal, and political process. Evidence is not the only factor taken into account when making educational decisions, but it is much more likely to play a role when the available research has been synthesised and presented with the clarity, accessibility, and rigour that is apparent in this programme. As with the earlier syntheses in the programme, this BES adds to the landscape of knowledge at the same time as it contributes to the refining of the methodology.

The *Teacher Professional Learning and Development BES* is an extraordinary synthesis. It moves the discourse about what we know about learning for teachers onto a different plane, offering a rich and detailed theory supported by highly defensible evidence and logical arguments. Its authors have extended the research methodology, explicating a process for determining effect sizes for both qualitative and quantitative studies so that no data are lost, and establishing a means for categorising and organising widely different studies so that they can be considered in relation to a standard framework. This approach should have wide applicability for researchers in New Zealand and elsewhere who wish to conduct reviews of other areas.

Although the methodological advances are important, it is on the content of the *Teacher Professional Learning and Development BES* that I want to focus my comments. Many factors influence student learning, but it is increasingly clear that what teachers know and are able to do is one of the most important of all. Teachers are the ones who work directly with students, who translate and shape curricular goals and theoretical ideas into classroom practice and who shape the environment for learning. Teachers' knowledge, skills, attitudes, and dispositions have direct and serious implications for the success of the students they teach. From this standpoint, professional learning represents an enormous investment in the development of human capital, directed at ensuring that the teaching and learning in our schools is up to date and effective.

If teachers, school leaders, and governments are going to expend energy and resources on professional learning, an understanding is needed about the kinds of learning that help teachers develop and grow in ways that will serve all their students well, even as expectations of students and schools are constantly changing. This was the remit for the *Teacher Professional Learning and Development BES* team—a daunting task.

The authors began by formulating a theory of how professional learning works to influence student learning. Their conceptualisation of twin 'black boxes' of teacher and student learning is a powerful addition to the field. Their theoretical framework offers a comprehensive picture of the complexity of adult learning in the service of student learning and demonstrates the challenges involved in linking one to the other. In their eagerness to get to the key findings, policy makers and practitioners typically skip the theoretical material in documents such as this, but I highly recommend that everyone read this section of the document. It provides a framework on which to hang the ideas and helps the reader integrate the findings.

Timperley, Wilson, Barrar, and Fung have painstakingly searched the literature to find studies that provide evidence of the nature of the relationship between teacher learning and student learning. The matrix of categories selected for investigation includes numerous attributes of the professional learning context, the content of the professional learning, the activities that were included in professional development programmes, the learning processes, teacher responses, and the impact on learners. In all, the analysis took account of 84 different dimensions. Based on their careful analysis of the studies they located, the authors make some powerful statements about what matters in professional learning.

Professional learning can ask a lot of teachers in the interest of their students. Even those who are confident in their professional role can feel profoundly uncomfortable when what they hold to be true is challenged and they have to rethink their beliefs and practices. This is particularly so because teachers are adults who have well-defined and defended schema about the way the world works. But the findings and case studies in this BES contain vivid examples of what teachers, school leaders, and policy makers can do, individually and collectively, to create the conditions for teachers to engage in this kind of learning.

I was particularly struck by how consistent the BES findings are with the three principles of learning identified by a blue ribbon panel organised by the National Research Council in the US:

- People come to learning with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught or may learn them superficially and revert to their preconceptions in real situations.
- To develop competence in an area of inquiry, people must:
  - have a deep foundation of factual knowledge;
  - understand facts and ideas in the context of a conceptual framework;
  - organise knowledge in ways that facilitate retrieval and application.
- A metacognitive approach to instruction can help people to take control of their own learning by defining goals and then monitoring their progress toward achieving them.

(*How People Learn*, Bransford et al., 2001) [1]

Taken together, these two sources provide a powerful framework for thinking about how best to occasion professional learning and development.

[1] Bransford, J., Brown, A., & Cocking, R. (2001). *How people learn: Brain, mind, experience, and school.* Washington, D.C.: National Academy Press.

This BES, like the others before it, is firmly anchored in the New Zealand context. The literature for the synthesis came from a broad-based search of sources but the interpretation is embedded in the social, economic, and cultural contexts for which it was written. Nowhere is this seen more clearly than in its attention to the needs of diverse students and communities. The chapter devoted to teachers' social constructions of students provides important insights into the additional dimensions that a diversity agenda requires of teachers in New Zealand schools—insights that have wider relevance, too.

I want to comment on the significance of this BES for the planning and implemention of professional learning programmes and to put it in the larger context of the responsibilities that fall to policy makers and practitioners to turn its findings into reality. Professional learning/development is both costly and important. The BES surfaces significant understandings about the nature of the learning that occurs in the 'black box' associated with teacher learning. Most importantly, it suggests that effective professional learning is a powerful lever for getting the kinds of change that can enhance student learning. But this may not happen if the process is purely voluntary, left to teachers to take up or not take up. The kind of professional learning that makes a difference for students is hard work and demands strong policy support and professional determination.

Acting on this BES will be challenging and, at times, unpopular. Not everyone will agree with its conclusions. But for the first time, it will be difficult to mount arguments based on a challenge to the evidence base. Conversations and decision making can now begin with what is known or not known thanks to the thorough work behind this BES. The debate then becomes, as it should, a debate about values, politics, and interests—not tacit knowledge, opinions, and histories masquerading as fact.

I'd like to remind the reader, especially researchers, that the BES process is an iterative one. This document by Timperley et al. is a first synthesis of research into the processes by which professional learning comes to impact on student learning. It is a strong beginning. It both sets the stage and issues a challenge to researchers around the world—a challenge to iteratively fill the gaps, extend the knowledge base, and anchor the findings in local contexts everywhere.

The world is teeming with activities variously referred to as knowledge utilisation, knowledge dissemination, knowledge brokering, knowledge transfer, knowledge exchange, knowledge mobilisation, and knowledge translation. Whatever the term used, the idea is to gather together what the research tells us about a topic of interest and then to synthesise it into practical, usable knowledge. The Iterative Best Evidence Synthesis Programme sets a high standard, and has generously shared its model for others to use and to enhance. A worthy challenge.

Lorna Earl

Dr. Lorna Earl is Director of Aporia Consulting Ltd and a recently retired Head of the International Centre for Educational Change at the Ontario Institute for Studies in Education. She has been Researcher In Residence to the Ministry of Education in Ontario, and was one of the lead evaluators of the Literacy and Numeracy Strategies in England.

Secondary Principals' Association of New Zealand

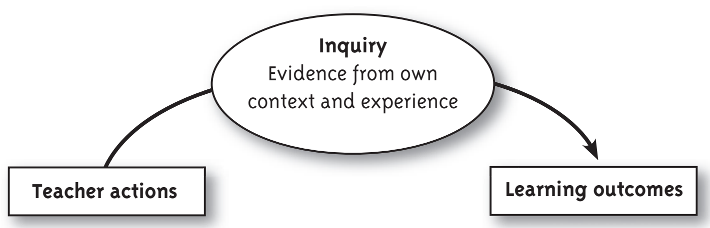
Professional development has generally been recognised as having an important role in ensuring that teachers are part of a skilled and up-to-date profession. This recognition has, however, always been tempered by the strong, mostly anecdotal, evidence that much professional development has not been effective in terms of achieving change in teacher practice.

The authors of the *Teacher Professional Learning and Development BES* have done us an invaluable service by surveying the relevant research literature, uncovering what is known, and identifying where further research is urgently needed. It will take the reader some time to fully digest the synthesis, but it won't take them long to confirm that effective professional development involves more than a quick fix.

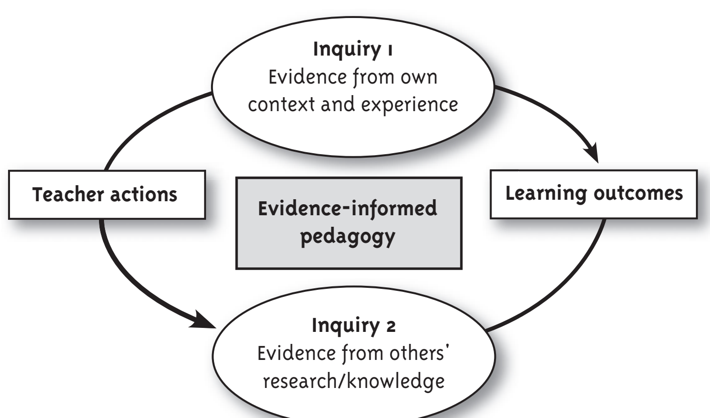
Teacher professional development is not unlike peeling an onion: there are multiple layers to be uncovered. Each layer represents specific needs that have been identified by data. This multiple layering means that the connections between cause and effect are complex, and the authors frankly acknowledge this. They use a 'black box' as their metaphor for the relationship between teacher learning and student learning.

Not surprisingly, the BES finds that effective professional development recognises (rather than ignores) the theories that teachers bring with them, and that teachers need a good reason to do things differently. The writers show how specific student needs, identified from local data, can be used to challenge existing theories and open the way for new teacher practice that is underpinned by research pedagogy.

Every teacher I have met is the best teacher they know how to be. But unless we support our teachers with professional learning opportunities, they will act in isolation of the wider knowledge that research is making available and which could enhance their effectiveness. The first diagram suggests this situation:



The *Teacher Professional Learning and Development BES* has the potential to help teachers complete the loop by showing them how to effectively access and use new pedagogical understandings in their daily practice:



In the final analysis, as the authors insist, the effectiveness of professional development is not measured by how teachers feel about it, but by the impact that it has on their practice and—more importantly—the achievement of their students.

Graham Young
Immediate past president

[Diagram adapted, with thanks, from the work of Drs Graeme Aitken and Claire Sinnema, University of Auckland.]

NZEI Te Riu Roa

NZEI Te Riu Roa welcomes the *Teacher Professional Learning and Development BES*, recognising its significance and, at the same time, the enormity of the challenges it presents. Chapter 1 says, "If the greatest single lever for achieving positive outcomes for students is the quality of teaching, the most important audience for this synthesis is teachers." Therein lies the rub: if our diverse groups of students are to attain success, teachers need to understand the implications of this BES for their teaching practice. NZEI Te Riu Roa sees the evidence the BES presents as another stepping stone on the path towards success for all students but shares the concern of the authors that too little is yet known about the conditions that lead to sustainable change. More research is required in this area.

The stated purpose of the synthesis is to consolidate the evidence from Aotearoa/New Zealand and other countries around the emerging knowledge base about how to promote teacher learning in ways that impact on outcomes for the diversity of students in our classrooms. While the mean achievement of our students compares well with that of other countries, this statistical measure is strongly influenced by the number of students who are achieving to very high levels. The fact is that our country also has one of the greatest disparities in achievement for each of reading, mathematics, and science.

Teachers distilling the evidence will be particularly interested in the research that relates to raising Māori student achievement, since Māori are over-represented in the underachievement stakes. Research in this area is still in its infancy, and regrettably few studies with a specific focus on Māori student achievement met the criteria for inclusion. Particularly sparse was evidence from research using a kaupapa Māori framework: only the Te Kotahitanga study (Chapter 9) met the criteria for inclusion as a core study. The situation was similar for Māori-medium education: no studies met the criteria for inclusion as core studies and only two were included as supplementary studies. The authors note a general dearth of international literature focusing on professional learning leading to improved student outcomes for indigenous people. The same is true of research relating to Pasifika students and second language learners. Just as scarce is local research with a science focus: only one Aotearoa/New Zealand study was included—in the supplementary category.

NZEI Te Riu Roa acknowledges the particular attention given by the authors to addressing the 'responsiveness to diversity framework' as outlined in Chapter 3. The implications of this for teaching are explored in Chapters 6–9 and in the case studies in Appendix 1. Whilst there is much in the synthesis that will resonate with teachers and promote informed debate around changed teaching practice, the intended impact in schools will take time and require coordinated planning at all levels of the system.

NZEI Te Riu Roa looks forward to further Aotearoa New Zealand research into professional learning linked to student outcomes for Māori-medium education, Pasifika students, second language learners, and in science. A particularly ambitious challenge is further research using a kaupapa Māori framework and comparable international research relating to other indigenous peoples.

The authors found that conditions most closely associated with success were related to the content and form of the professional learning experiences. While they found that some factors such as release time were not necessary to effect positive changes, all the core studies had teachers participating in various kinds of learning communities in which ideas, experiences, and challenges were shared. In this way, teachers supported each other to implement changed practice. The conditions for collective, evidence-informed inquiry and theoretical development should not be underestimated. Similarly, principals and teachers need high-quality professional learning opportunities in which they engage with the research, with the goal that all teachers will become responsive to the diversity and diverse realities of the students in their classrooms.

Irene Cooper
NZEI National President
Te Manukura

Post Primary Teachers' Association

PPTA welcomes this latest Best Evidence Synthesis as a significant contribution to our understanding of the role of professional learning in assisting teachers to develop their practice. It has bravely taken on a very challenging task, to attempt to unpick the 'black box' between the kinds of professional learning made available to teachers and their relative impacts on teachers' ability to enhance student learning. While the BES draws some tentative conclusions, it is careful not to offer a simplistic 'recipe' for what constitutes quality professional learning and development.

What the BES does clearly indicate is that quality professional development does not come cheaply because it is not superficial. For many teachers, one-day workshops are all the professional development they experience because of the cost and unavailability of better options. These are not the ideal form of PD, although they may still have their place to share new information or to enable teacher networking. Extended opportunities to learn and the availability of external expertise, while not sufficient in themselves, provide far more effective contexts for teacher learning.

Quality PD is also not 'training'. It must integrate theory with practice, enabling teachers to make ongoing decisions about their classroom practice within the context of deeply understood relevant theory. It therefore engages with teachers as thinking professionals, as intellectual workers (Gramsci, 1971[2]), rather than treating them as technicians who merely need to be taught what to do and then subjected to compliance measures to ensure that they do it.

It is sometimes argued that the only way to improve teaching quality is to develop professional standards that outline an 'effective' teacher's learning progression throughout their career, and use these as 'drafting gates' for promotion and/or pay increments. This BES demonstrates that such an approach reflects a limited view of what in fact contributes to a teacher's ongoing learning. What is needed is a comprehensive approach to ensuring that the kind of professional development that has a significant positive impact on teachers' ability to meet the needs of all their students is made available to all teachers.

Timperley et al. have shown that quality professional learning comes from providing opportunities for each teacher to engage at a deep level with ideas and approaches. They must have extended time to do this, they need access to external expertise, they need their thinking challenged, they need to learn alongside colleagues, and their leaders need to provide the right conditions for the learning. PPTA believes strongly that these learning opportunities must be personalised to each teacher's needs.

PPTA members tell us that such learning is rarely available to them. This needs to change.

Robin Duff
President

[2] Gramsci, A. (1971). *Selections from the prison notebooks,* ed. and trans. Q. Hoare and G. Nowell Smith. London: Lawrence and Wishart.

New Zealand Teachers Council

Teaching is a highly complex weaving of professional knowledge, professional relationships and values, and professional practices. This Best Evidence Synthesis establishes that how teachers' own ongoing professional learning occurs is equally complex. It is one of the 'black boxes' of how learning actually takes place—whether it be the learning of young people, or of teachers, or of those who teach or coach teachers.

The theoretical framework developed for this BES makes a significant contribution to our understanding of how teachers' professional learning is most effectively supported. It shifts the focus from delivery mechanisms to the *processes* by which teachers take up new learning and embed it in their practice for the benefit of their diverse students. By examining where teachers' professional learning and development did and did not lead to improved outcomes for students, the authors are able to make tentative findings that require our attention.

These findings will be invaluable in helping us to understand why professional practice frequently slides back to the so-called 'tried and true' or fails to shift the outcomes for some groups of students. But the findings will only make a difference to the profession if those in positions of influence also learn from them and use them to inform policies and projects designed to support good teaching.

Research emphasises that the prime motivation for becoming a teacher is the desire to make a difference to the life outcomes of learners (Hall & Langdon, 2006[3], Kane & Mallon, 2006[4]). A major frustration for teachers is when they do not have the knowledge, the tools, or the support to engage effectively with their students. As one teacher from the Te Kotahitanga project said:

> … it felt like for the first time ever in my teaching career that I had those things, that I had support. I had goals and I had a group of people, colleagues that I was working with to achieve that. And that for me was magic. It was about achievement for the kids for the first time ever, rather than just survival.
>
> Bishop et al., 2007, p. 150[5]

There are challenges in this BES for teachers and others who too often allow their practice to be driven by what Dr Lorna Earl refers to in her foreword as "tacit knowledge, opinion, and histories masquerading as fact". Our main challenge, however, is how, as a community of professionals, we will reflect on, disseminate, and be informed by this important synthesis of knowledge about teachers' professional learning.

The New Zealand Teachers Council has supported this BES as it believes it will make a significant difference to teacher practice and outcomes for students. One of the Council's key responsibilities is to provide professional leadership to teachers; these findings will inform our professional projects and policies to the benefit of the profession.

One such project is focused on the learning of teachers in their first two or three years and the creation of learning communities that will benefit not only new teachers but also their more experienced colleagues. It is important to continue to grow a culture of professionalism in our schools and centres, where leaders understand 'what works' and for whom, and how to support their teachers to develop practices that benefit all learners.

---

3 Hall, D. & Langton, B. (2006). *Perceptions of the status of teachers.* Wellington: Ministry of Education and New Zealand Teachers Council.

4 Kane, R. & Mallon, M. (2006). *Perceptions of teachers and teaching.* Wellington: Ministry of Education and New Zealand Teachers Council.

5 Bishop, R. et al. (2007). *Te Kotahitanga Phase 3 Whānaungatanga: Establishing a culturally responsive pedagogy of relations in mainstream secondary school classrooms.* Report to the Ministry of Education. Wellington: Ministry of Education.

Without question, the findings of this BES will inform and help shape the recommendations arising from this project. The Council congratulates the authors and managers of the project for their major contribution to the profession and to quality teaching and learning in New Zealand.

Cynthia Shaw
Manager, Policy and Strategic Development

Pasifika

Schooling Improvement work in Aotearoa New Zealand is about supporting clusters of schools with high numbers of Māori and Pasifika students to design solutions for specific achievement problems. This necessitates the use of relevant evidence and the most important evidence is context-specific achievement data. Once such data has been analysed and the problem clearly identified, cluster leaders can think about solving it. Teacher development has increasingly become an important tool for tackling issues at the local level and, in this connection, the *Teacher Professional Learning and Development BES* is a valuable resource. A better understanding of the 'black box' that sits between professional learning opportunities and teacher practice is crucial for schooling improvement—for getting things working well for the Māori and Pasifika students in our classrooms. This synthesis is not a silver bullet but, along with the other Best Evidence Syntheses, it represents a very useful evidence base on which to draw when designing context-specific solutions to complex achievement problems.

Elena Fa'amoe-Timoteo
Schooling Improvement Coordinator
Te Puna o te Matauranga

Teacher education

We are all grappling with the urgent issues of raising achievement and reducing disparity. As educators, we expect to be successful in improving the outcomes for all students. We know we need to get better at evaluating the impact of what we do—individually and collectively—and smarter at using what the research can tell us about what works for diverse students in different contexts.

The Iterative BES Programme is a key resource for developing this greater understanding. With each new BES published, we gain a richer picture of what constitutes effective practice at each of the layers of the education system, and a greater understanding of how each layer influences outcomes for students. The result of this should be a much sharper focus on student outcomes, and closer alignment of the efforts of all those in the chain of influence—politicians, policy makers, researchers, practitioners and those who support them, and the community.

The value of the *Teacher Professional Learning and Development BES* is that it offers a window—albeit with some opaque panes—into the second 'black box' of learning, learning by teachers. This window reveals the complexity of effective provider pedagogy. It is now our responsibility as providers of professional learning opportunities to understand this complexity and use these understandings to inform and evaluate our practice and—to borrow Sir Isaac Newton's metaphor—to stand on the shoulders of the authors to create new knowledge.

And it *is* all about learning and the interactions that lead to learning. So often it is our students who give us insight into the joys, difficulties, interactive complexities, and rewards of learning. Here is my four-year-old's take on learning:

Learning (*n*). Through a four-year-old's eyes.

Alastair	I'm going to have a learning!
Carolyn	What's a 'learning'?
Alastair	A learning is when you have a 'can't', then you learn you can.
Carolyn	Who says 'you can't'?
Alastair	You and Dad say I can't stay up, so tonight I'm going to learn to stay up.
Carolyn	Sometimes you say 'I can't' but you can if you practise. Like when you can't do a backwards roll at gym, but if you think you can and practise, you will be able to.
Alastair	I'm going to practise staying up tonight.

It is about being a learner and having a learning. The more expertise we have, the better we should be at learning. Professional practice—of teachers, school leaders, ISTEs, and policy makers—is also about knowing, and being responsible for, the impact of that practice. If we are to know what to learn and what to monitor, we must know how to inquire into that impact.

This BES assumes that what goes on in the black box of teacher learning is fundamentally similar to student learning. Three iterative processes are described—cueing and retrieving prior knowledge, developing an awareness of new information, and creating dissonance with current position—along with the conditions for creating effective and extended opportunities to learn. The outcome of these processes is very dependent on teachers engaging with both the new information and their existing understandings.

In section 2.2.1, the research of Robinson and Lai (2006)[6] has been used to describe the type of engagement with prior knowledge that is needed to bring about change. These researchers talk about the need for professional learning experiences that support teachers to evaluate the adequacy of tacit knowledge and routines. If we then link this to the view of Donovan et al. (also referred to in section 2.2.1) that engagement is a process where both the teacher and learner negotiate the meaning of new information in relation to existing knowledge and strengths, we have a powerful way of understanding the complexity of learning—and the central role that engagement plays in the process.

One of the gaps identified by this BES is a lack of research into what providers do to promote teacher learning. We now understand that learning is a universal process in which understandings are deepened and/or positions are reshaped and we understand that teaching is a "complex, theoretically informed activity" (see page xxiii). We are also deepening our understanding that effective teacher practitioners are effective learners in their own classrooms and schools. Our next challenge is to explore the effectiveness of the teachers-of-teachers as practitioners and learners. Are their sites of learning their classrooms and schools or their institutions—or both? The research findings from the In-service Teacher Education Project (INSTEP), a national New Zealand project, should deepen our understanding of provider pedagogical content knowledge (see page xxix) but this will only happen if we engage with and evaluate the adequacy of our current knowledge and practice in relation to the outcomes we collectively seek—raised achievement and reduced disparity.

Carolyn English
Professional Learning Project Director
Learning Media Limited

[6] Robinson, V. M. J. & Lai, M. K. (2006). *Practitioner research for educators: A guide to improving classrooms and schools.* Thousand Oaks, California: Corwin Press.

Māori education

Being asked to write a foreword for this BES, while an honour, has presented me with some difficulties. My first thought was to work through the BES, addressing all the major points, but two factors led to a change of tack. The first was that the synthesis is already very well summarised within the text. The second was that reading the BES moved me to reflect on my own early experiences as a teacher and my current position as a provider of professional learning opportunities for teachers. Rather than create a synthesis of a synthesis, I decided therefore to offer a personal narrative for others to reflect on. In this way, I may be able help readers critically evaluate where they position themselves when constructing images, principles, and practices in relation to professional learning opportunities and teaching within their own settings …

I began my teaching career in 1973 at Mana College in Porirua, moving later to Aotea College, where I spent most of my 14 years as a secondary school teacher. My age is approximately the median for the profession. My hair is now going grey. But my sense of enjoyment when interacting with groups of adolescents is still as strong as it ever was. In many ways, I miss being with large numbers of students on a daily basis.

As those of you of similar age will remember, we entered teaching with more than a desire to get a job; we were going to make a difference to the world and help the next generation gain their share of the benefits that education had to offer. Most of us were from working class backgrounds and were able to access the higher education denied to our parents because the state supported us financially to gain both a university degree and a teaching diploma. Many of us were the first in our families to gain degrees. In doing so, we were torn from our roots and thrust into another world: the heady world of social change and social justice—and adolescents en masse.

Michael Fullan [7] and many others who write about teaching are quite clear that it must have a moral purpose; that is, teachers must be more than transmitters of predetermined knowledge; they must actively promote social justice. I don't see this as a problem in New Zealand because it seems to me that the vast majority of teachers enter the profession with this as their vision; they want to make a difference for children and they want to relate to and interact with them in ways that will enable them to enjoy their learning as much as they do themselves. Our teachers are, in the main, very good at their job, as can be seen in international comparisons of student achievement.

There remains, however, the seemingly immutable problem of achievement differential, with Māori and other minoritised children continuing to score less on standardised achievement tests across all age ranges. Over all, this group has a very poor experience of school, and this has been the case for generations. I was bemused by this when I starting teaching in Porirua. How come Māori were not doing as well as the rest of the students? And how come my recent teachers' college experience had not prepared me for teaching Māori students?

The usual explanation was that Māori students were culturally deprived: there were few books in their homes, they were not read to from an early age, and so on. Yet many of the Māori students at Mana College came from Takapuwahia Pa. Their families were mostly members of the LDS church and they were actively involved in their marae, Toa Rangatira, known for hosting groups from around New Zealand and overseas. I remember that David Bowie was welcomed on to the marae; a photo showed him and Harata Solomon sitting next to each other at some function, a tartan rug over their knees. I'm sure that Prince Charles, too, visited at some point. I spent lots of time at the marae and was surprised that these people could be regarded as 'culturally deprived'. David Bowie had been in their midst—how more culturally cool could they be! Yet their children were part of the great exodus from the benefits of schooling. I felt professionally limited and frustrated.

---

[7] Fullan, M. (2003). *The moral imperative of school leadership.* Ontario Institute for Studies in Education, Toronto: Corwin Press.

A light on the horizon was a professional development programme called Te Kete Raukura. Although based on the now heavily critiqued[8] Taha Māori initiative, this programme showed me that my concerns about Māori achievement and the theories purporting to explain it were not mine alone; the same concerns were being voiced up and down the country. Unfortunately, while the programme gave me lots of ideas and resources, I struggled to translate the messages from the hui into my own classroom.

This same problem affects professional development today. Indeed, it is the 'black box' that Timperley et al. seek to address in this BES, asserting that "Little is known about how teachers interpret the available understandings and utilise the particular skills offered during professional learning opportunities, or the consequent impact of these on teaching practice and student outcomes."[9]

In 2001 I returned to my concern about the achievement of Māori students. During that year, a group of us began a systematic examination of teachers' experiences of working with Māori children.[10] As I interviewed teachers, I heard them recount time and time again exactly the same kind of experiences that I had had in the 70s and 80s. They told me of their high aspirations for all of their students, including Māori. They told me of their frustration at not being able to reach Māori students and make the difference for them that, by and large, they were able to make for their other students. They talked about not being able to be what we have since come to term 'agents of change', to feel that they were *agentic* or efficacious. They felt that their ability to make a difference was being compromised by forces beyond their control. Most spoke of being angry, isolated, and professionally bereft of solutions, yet expected by society to provide them. They also spoke about the difficulties they had experienced when trying to translate externally located and curriculum-focused professional development into classroom practice. They were hoping that we could provide them with answers.

Exacerbating these teachers' frustrations was the discursive shift that was taking place at the time. The structural theories that had dominated the later decades of the century were giving way to explanations that were more 'culturalist' in nature. These theories, promoted by Hattie and Alton-Lee[11], among others, asserted that teachers can and do make a difference to the education of children, despite apparently immutable structural impediments. Although most of the teachers we interviewed intuitively believed this to be true, they remained concerned. Could they really do it? If so, what did it mean in practice? The precise nature of the barriers preventing teachers making that crucial difference for Māori were still unknown, as were the solutions.

We found the work of Jerome Bruner[12] particularly helpful in that it identifies that teaching occurs, progress is evaluated, and practices modified as "a direct reflection of the beliefs and assumptions the teacher holds about the learner" (p. 47). This means that "… our interactions with others are deeply affected by our everyday intuitive theorizing about how other minds work" (p. 45). In other words, our actions as teachers, parents, or whoever we are at the time, are driven by the mental images or understandings that we have of other people. For example, if we think that certain other people have deficiencies, our actions will tend to follow from this thinking and our interactions with them will tend to be negative and unproductive. No matter how good our intentions may be, if our students sense that we think they are deficient, they will respond negatively.

---

8 Smith, G.H. (1990). Taha Māori: Pakeha capture. In J. Codd, R. Harker, and R. Nash (Eds). *Political issues in New Zealand education.* (pp. 183–197) Palmerston North: Dunmore Press.

9 Timperley et al. (2007).

10 Bishop, R. and Berryman, R. (2006). *Culture speaks: Cultural relationships and classroom learning*. Wellington: Huia Publications.

11 Alton-Lee, A. (2003). *Quality teaching for diverse students in schooling: Best evidence synthesis.* Wellington: Ministry of Education.
Hattie, J. (2003). *Teachers make a difference: What is the research evidence?* Paper presented at the Australian Council for Educational Research annual conference.

12 Bruner, J. (1996). *The culture of education.* Cambridge, MA: Harvard University Press.

We were told time and again by many of those we interviewed in 2001 that negative, deficit thinking on the part of teachers was a fundamental cause of negative student–teacher relations. Students, whānau, principals, and teachers gave us numerous examples of the resulting negative behaviours and their consequences for both students and teachers. Teachers spoke of their frustration and anger. Students told us of their aspirations to learn and to take advantage of what the school had to offer, and how negative teacher actions came across as an all-out assault on their identities as Māori and their need to be accepted and acceptable. The end result was that they were precluded from participating in what the school had to offer.

Such understandings have major implications for teachers hoping to be agentic in their classrooms and for educational reformers. As Elbaz[13] (1981, 1983) explains, understanding the relationship between teachers' theories of practice about learners and learning is fundamental to teachers being agentic because the principles they hold dear and the practices they employ are developed from the images they hold of others. According to Foucault[14], the images that teachers create when describing their experiences are expressed in the metaphors found in the language of educational discourse. In other words, teachers are able to draw from a variety of discourses to make sense of the experiences they have when relating to and interacting with Māori students.

This was exciting stuff because it explained that it was the discourses that teachers drew upon that kept them frustrated and isolated. It was not their attitudes or personalities. It was what Foucault termed their "positioning within discourse". That is, we are not *of* the explanations but rather, by drawing on particular discourses to explain and make sense of our experiences, we position ourselves *within* these discourses and act accordingly in our classrooms. The discourses already exist; they have developed throughout history and are often in conflict with each other through power differentials. Most importantly for our desire to be agentic, some discourses hold solutions to problems, and others don't.

The crucial implication of this analysis is that it is the discursive positions that teachers take that are the key to their being able to make a difference for Māori students. For us, this meant that before we began any in-class professional development, it was important to provide teachers with a learning opportunity in which they could critically evaluate where they discursively positioned themselves when constructing their own images, principles, and practices in relation to their Māori students. Further, it was important that these learning opportunities provide teachers with an opportunity to undertake what Davies[15] called "discursive repositioning". This means drawing upon explanations and practices from alternative discourses that offer solutions instead of problems and barriers. According to Burr (1995, p. 146)[16] , we are all able to discursively reposition ourselves because, while we are partly the product of discourse, we do have agency that allows us to change the way we see and make sense of the world by drawing from alternative discourses. We have agency, but the discourses we draw on may limit our power to activate it.

---

[13] Elbaz, F. (1981). The teacher's 'practical knowledge': Report of a case study. *Curriculum Inquiry*, *11*, 43–71. Elbaz, F. (1983). *Teacher thinking: A study of practical knowledge.* New York: Nichols.

[14] Foucault, M. (1972). *The archaeology of knowledge.* New York: Pantheon.

[15] Davies, S. & Guppy, N. (1997). *Positioning the discursive production of selves. Journal of the Theory of Social Behaviour, 20*, 43-65. Reprinted in M. Wetherell, S. Taylor, & S. Yates (Eds.) (2001), *Discourse theory and practice: A reader*, pp. 261–271. London: Sage.

[16] Burr, V. (1995). *An introduction to social constructionism*. London: Routledge, p. 146.

In Te Kotahitanga, we use the narrated experiences of the people most closely involved with the education of Māori students—including the young people themselves—to give teachers the opportunity to reflect upon the experiences of others in similar circumstances. For some, it is the first time they have listened to the student experience. By vicariously sharing in these experiences, teachers are able to reflect on their own understandings of Māori students' experiences, their own theorising and explanations, the practices that follow, and the likely impact of these theorisings and practices on the achievement of their Māori students. In other words, we seek to open the 'black box', affording teachers the opportunity to critically reflect upon their discursive positioning and the implications of this positioning for their own agency and for the learning of Māori. Where necessary, teachers are able to discursively reposition themselves from limiting discourses to those in which they have agency.

As we began to implement what was to become Te Kotahitanga, we learned that positive classroom relationships and interactions were built upon positive, non-deficit thinking by teachers about students and their families, in which students were seen as having loads of experiences that were relevant to classroom interactions. Using agentic thinking, teachers see themselves as able to solve the problems that come their way. They have recourse to skills and knowledge that can help all their students, and they discover that all their students can achieve. We learned that this positive thinking is fundamental to the creation of learning environments where young Māori can be themselves, where Māori students' humour is acceptable, where students can care for and learn from each other, where being different is acceptable, and where the power of Māori students' own self-determination is fundamental to classroom relations and interactions. Indeed, it is the interdependence of self-determining participants in the classroom that creates vibrant learning environments characterised by the growth and development of quality learning relations and interactions, increased student attendance, engagement, and achievement on both school- and nationally-based measures.

The authors of this BES found that as teachers understood the impact of their practice on their relationships with students in their classrooms and/or learned new approaches to teaching that led to accelerated student learning, they felt more agentic and, in turn, refocused on the teaching–learning relationship. As a result, they had higher expectations of their students. Higher expectations cannot be taught or imposed independent of context; they develop out of improved relationships.

This BES, as part of the Iterative BES Programme, offers those of us who are determined to bring about changes in socially constructed inequities a wonderful opportunity to respond to the research it uncovers and to progress the debate. My hope is that the questions raised and learnings made available will move us as a nation to solve what is our number one educational issue: the educational crisis that faces Māori people.

Ma Te Runga Rawa koutou, e tiaki, e manaaki.

Russell Bishop

Russell Bishop is the Foundation Professor of Māori Education in the School of Education at the University of Waikato. He is currently project director of Te Kotahitanga, a research and professional development programme funded by the Ministry of Education.

Chief Education Adviser, BES

This first-iteration *Teacher Professional Learning and Development BES* offers a unique resource for teachers, teacher educators, leaders, researchers, and policy makers. The findings explain how we, as an educational community, can genuinely make a much bigger positive difference for all of our children. They show how, given supportive conditions, teacher learning can dramatically influence student achievement, critical thinking, self-regulation, sense of identity, and ability to relate to each other and contribute to the community—in some cases the difference represents a year or more's progress when compared with business as usual. Most important of all, the findings show how dramatic differences can be made for students who have traditionally been under-served by education. A theme that runs quietly through the evaluations of some of our most effective professional development is the delight and relief of teachers as they see their students flourishing.

This BES comes at a critical point in the history of educational policy. For decades there has been great scepticism concerning the influence of teaching and teacher education. In the 1960s and 70s, influential reports on the impact of schooling on inequality (Coleman et al., 1966; Jencks et al., 1972[17]) painted a grim picture in which schools made relatively little difference to student achievement. Coleman and his colleagues found that only about 10 percent of the variance in student achievement could be attributed to schools. His analysis, however, averaged the effects of schools and failed to differentiate the effects of different teachers. New Zealand pre-service teachers taking courses in the sociology of education encountered the legacy of this influential research, which, along with early theoretical literature in the sociology of education, provided a compelling case that implicated teachers (albeit unknowingly) in the production of a class society (e.g., Bowles and Gintis, 1976[18]). For some teachers and teacher educators these arguments provided the basis for diminished agency and an 'informed' view that teacher influence could never be significantly equitable or transformational.

The first *International Handbook of Educational Change*[19] signalled a marked shift in thinking about the potential for agency in education. This shift was informed partly by the evidence emerging from new multi-level modelling studies that captured both school- and class-level impacts on outcomes:

> Recent research on the impact of schools on student learning leads to the conclusion that 8–19% of the variation in student learning outcomes lies between schools, with a further amount of up to 55% of the variation in individual learning outcomes between classrooms within schools. In total, approximately 60% of the variation in the performance of students lies either between schools or between classrooms, with the remaining 40% being due to either variation associated with students themselves or to random influences.
>
> Cuttance, 1998, pp. 1158–9.

The importance of this new evidence base has become even more compelling for policy makers, given associated analyses of its economic implications. Hanushek's (2005) policy brief[20] for the International Academy of Education reports:

> One standard deviation on test performance (international mathematics and science tests) was related to one percent difference in annual growth rates of per capita GDP (p. 4).

---

17 Jencks, C., Smith, M. S., Ackland, H., Bane, J. J., Cohen, D., Grintlis, H., Heynes, B., & Michelson, S. (1972). *Inequality: A reassessment of the effects of families and schools in America*. New York: Basic Books.

18 Bowles, S. & Gintis, H. (1976). *Schooling in capitalist America*. London: Routledge & Kegan Paul.

19 Cuttance, P. (1998). Quality assurance reviews as a catalyst for school improvement in Australia. In A. Hargreaves, A. Lieberman, M. Fullan, & Hopkins, D. (Eds.), *International handbook of educational change* (Part Two; pp. 1135–1162). Dordrecht, Netherlands: Kluwer Publishers.

20 Hanushek, E. (2005). *Economic outcomes and school quality*. Education Policy Series. International Academy of Education & International Institute for Educational Planning, UNESCO. http:/www.smec.curtin.edu.au/iae/

He concluded that:

> Governmental investments should focus on school quality because they have such powerful economic impacts (p. 9) … The most likely way to improve student performance is to improve the quality of teachers (p. 14).

In a 2005 Education Indicators report, the OECD reported[21]:

> At the level of the education system, professional development of teachers is a key policy lever (p. 20).

The problem for both teachers and policy makers has been, however, the prevalence of professional development models and practices that have not necessarily been helpful for improving practice. As this BES reveals, some have intervened in teachers' work without sufficient understanding of the complexity of professional practice, changing practices in ways that have, in some cases, actually lowered student achievement.

This BES is a record of effective research and development in the interests of children. It calls for a systemic response to the development of expertise, for the integration of theory and practice, for school and classroom-embedded research and development, and for ongoing commitment to collaborative inquiry into the links between learning and teaching.

While this BES will be a valuable resource for teacher educators, teachers, and policy makers, it will possibly be of most value to educational leaders. The emerging findings of the companion BES on educational leadership indicate that leadership practices that involve promoting and participating in effective teacher professional learning are the practices most likely to distinguish otherwise similar schools in terms of student achievement. The foreword to this BES provided by the immediate past president of the Secondary Principals' Association of New Zealand exemplifies the kind of professional leadership needed to support teachers and students alike.

I owe a debt of gratitude to lead writer Professor Helen Timperley, who has led the development of a first-iteration BES that will be a landmark in New Zealand education. The quality, rigour, and accessibility of her work is an outstanding scholarly and professional accomplishment. To Aaron Wilson and Heather Barrar, who with great professional commitment integrated their work for School Support Services with the demanding tasks of BES development, my profound thanks. Thanks also to Irene Fung for a valued contribution. To all the writers, your constructive engagement with the challenging and often competing feedback you have had from contributors across policy, research, and practice has been deeply appreciated. The result, as you can see from the forewords, is a synthesis that brings with it knowledgeable national engagement, pride, and a high degree of ownership.

The BES has been scoped and constructed through an iterative and challenging process of dialogue and debate; always using as its touchstone a shared commitment to our children and their learning. Special thanks are due to principal Liz Patara (Te Reo Areare, NZEI) and Judie Alison (Advisory Officer, Professional Issues, PPTA) for their engagement at every stage of its development. Thanks are also due to Cynthia Shaw (New Zealand Teachers Council) and to the teacher educators who assisted with think tanks held to establish an agreed framework and scope: Professor Russell Bishop, Dr Lindsey Conner, Dr Mark Cosgrove, Dr Alison Davis, Dr Vince Ham, Dr Joanna Higgins, Professor Stuart McNaughton, Dr Judith Moreland, Dr Kathleen Quinlivan, Trevor Thwaites, and Tony Trinick. Thanks are due also to Robert Stratford (Te Puni Kōkiri) and to Ministry of Education colleagues from Group Special Education, Schooling, Data Management and Analysis, Education Management Policy, Medium Term Strategy, Group Māori, and the Pasifika Education Unit, who all contributed expertise and engagement. I am deeply grateful to Prue Kyle of the Ministry of Education's Professional Leadership Team for taking a support and partnership role in the development of this BES, and to Martin Henry, Professional Leadership.

---

[21] OECD (2005). *Education at a glance: OECD indicators 2005*. Paris, France: OECD Publications.

To Dr Lorna Earl, the knowledgeable international perspective that you have brought to the formative quality assurance of this development, and the role you have played as critical friend to the Iterative Best Evidence Synthesis Programme, have been of immeasurable value.

As this BES shows, New Zealanders can be proud that some of our professional development is world leading in terms of quality. The BES also gives New Zealanders an opportunity to learn from influential professional development carried out elsewhere.

The publication of this BES marks the beginning of a new phase of the iterative process of research and development. If the reader knows of other studies of teacher professional development that meet our touchstone criterion (substantive impact on student outcomes) and which could potentially be added to this knowledge base, please send details to us at best.evidence@minedu.govt.nz

If this BES is to serve New Zealand education well, teacher education and research communities, teachers, leaders, and policy makers must make it a 'living' BES by building on the powerful insights it offers, creating the systemic conditions that support teacher learning, addressing the gaps, and growing a cumulative and increasingly dynamic shared knowledge base about what works for diverse learners.

Adrienne Alton-Lee
Chief Education Adviser, BES

Summary of Findings

This summary brings together the main findings from separate syntheses of professional learning and development in various curricula, and topical issues. It does not follow the usual format of an executive summary in that its focus is the synthesis of the themes identified in the different sections on mathematics, science, and literacy; teachers' social construction of students; and the topical issues of leadership, multiple roles of assessment, engaging teachers' theories, and professional learning communities. The summary begins with a brief introduction to the purpose of the synthesis and an overview of the methodological approach, then presents the findings themselves. Its summary nature means that much of the detail and the case descriptions are omitted. For this reason, we refer the reader to material located in the body of the synthesis that elaborates on and illustrates the ideas presented.

Chapter 1 has more details about key purposes and related issues.

The purpose of the synthesis is to consolidate the international and New Zealand evidence around the emerging knowledge base about how to promote teacher learning in ways that impact on outcomes for the diversity of students in our classrooms. Although New Zealand students typically achieve well in OECD surveys, disparities in student achievement are amongst the greatest in the OECD[1]. Of particular concern is the large 'tail' of underachievement, and special consideration was given to this problem. Two further contextual conditions were also given specific attention: New Zealand's self-governing administrative structures and the education community's obligations under the Treaty of Waitangi.

The black boxes of student and teacher learning are illustrated in Figure 2.1.

Processes of teacher learning are described in Chapter 2.

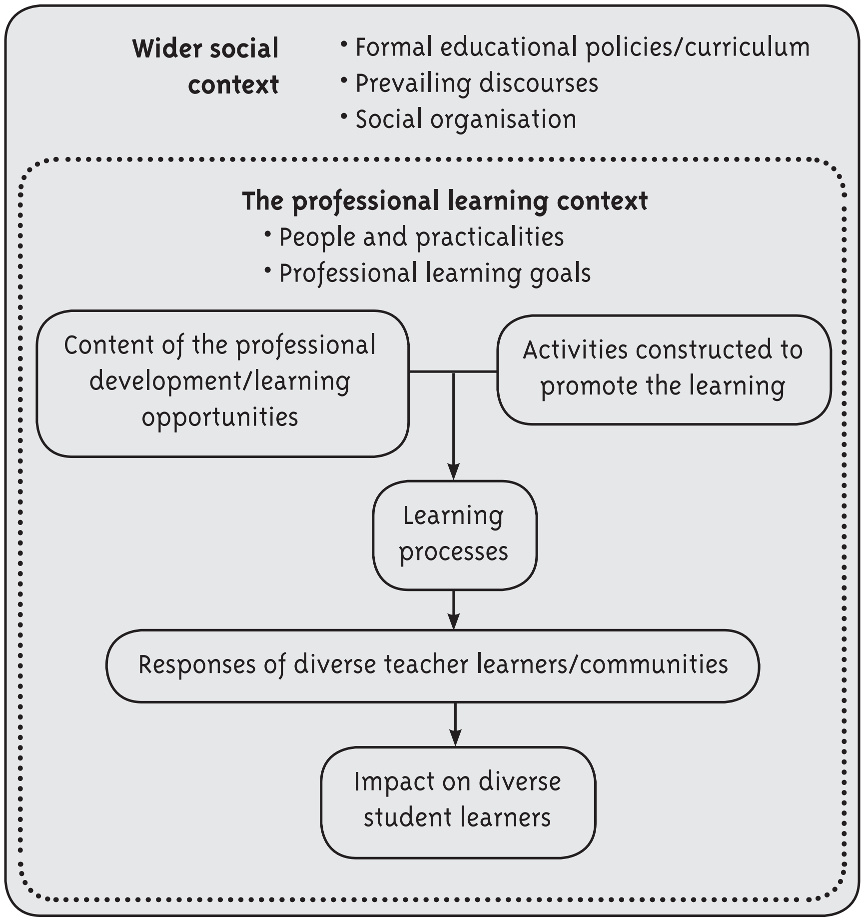
Considerable effort has been directed to understanding the 'black box'[2] between acts of teaching and associated student outcomes, and other syntheses in the Iterative Best Evidence Synthesis Programme[3] seek to address this issue. In this synthesis we have attempted to unpack a second black box, situated between particular professional learning opportunities and their impact on teaching practice. Little is known about how teachers interpret the available understandings and utilise the particular skills offered during professional learning opportunities, or the consequent impact of these on teaching practice and student outcomes. What is known is that the relationship is far from simple. This synthesis begins to unpack the contents of that black box.

Theoretical and methodological frameworks

The features of Figure 4.2 are described in detail in Section 4.3.

A theoretical framework comprising 84 different characteristics of the professional learning environment likely to impact on student outcomes was developed and used to analyse the studies located in our search of the literature. These categories included the social context in which teachers work—the wider policy and school environments—together with the specifics of the professional learning context. These specifics and their relationships are presented in Figure 4.2. They included the content of the professional learning and development opportunities, the activities constructed to promote the learning, and the consequent learning processes and responses of the diverse teacher learners. Finally, links were made between these responses and the impact of changed teaching practice on diverse student learners.

Figure 4.2. Framework for analysing the effectiveness of professional learning experiences

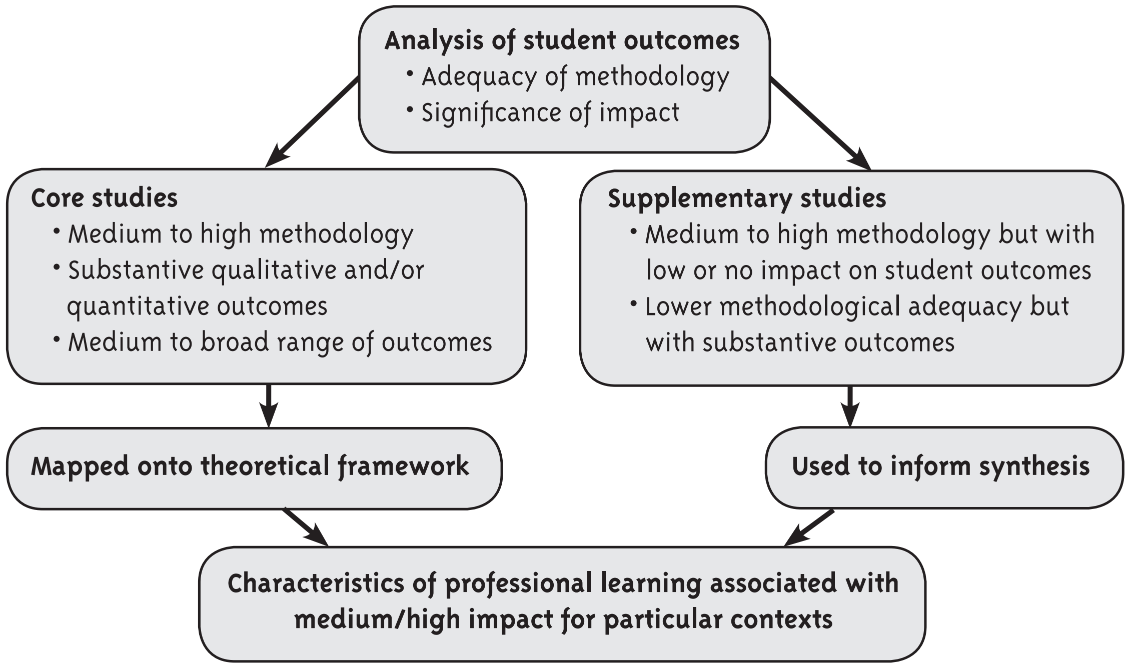


By searching selected New Zealand and international databases and contacting individual researchers, we located 97 individual studies and groups of studies that met a set of methodological criteria and had substantive student outcomes associated with teacher professional learning and development. The range of outcomes included personal, social, and academic attributes. These studies formed the basis of the synthesis and are referred to as the 'core' studies. In addition, a number of supplementary studies were used to complement the analysis of the core studies. These studies either met the methodological criteria but reported limited or no change in student outcomes, or had substantive student outcomes but did not provide sufficient methodological details to allow for judgments to be made about the links between professional learning and student outcomes. These studies were all mapped onto the theoretical framework (Figure 4.2) in order to identify what works, for whom, and under what circumstances. The analysis process is depicted in Figure 4.1.

Details of the methodology and outcomes for students are described in chapters 4 and 5, with further technical information provided in Appendix 2.

The limitations of this process must be acknowledged. Much professional learning is informal and incidental or occurs in meetings after school. In such situations, neither the process nor the outcomes are typically documented, so they do not appear in this synthesis. We do, however, wish to acknowledge their importance and the possibilities they offer for promoting professional learning.

Figure 4.1. Flow chart for the analysis



Findings

Opportunities for teachers to engage in professional learning and development can have a substantial impact on student learning. For example, in literacy studies, substantial effect sizes were reported by Phillips, McNaughton, and MacDonald (2001) (ES = 0.48) and by Timperley (2006) (ES = 0.89). These gains equate to more than two years' progress in one year. In writing, English and Bareta (2006) reported an overall effect size of 1.3 over two years, which similarly equates to about two years' progress in one year. More important was the progress made by the 20% of lowest-achieving students. Their progress equated to average achievement gains of an extra three to four years for every one year of schooling (ES = 2.1). In numeracy, the effect sizes reported by Bishop and colleagues (ES = 0.76) represent a shift from the 50th percentile to between the 66th and 77th percentiles, equivalent to 1–2 stanines.

Many of the findings that concern the kind of learning required to achieve these outcomes will confirm what is already known and believed. This synthesis provides a theoretical framework for thinking about what is known, together with the associated empirical basis. What is known to be effective, however, is not always what is practised. For example, it is generally accepted that listening to inspiring speakers or attending one-off workshops rarely changes teacher practice sufficiently to impact on student outcomes. Yet, at least in the United States, this type of activity is the predominant model of professional development[4]. The popularity of conferences and one-day workshops in New Zealand indicates that it is not too different in this country. However, the number of recent New Zealand studies that met our outcomes criteria indicates that, in some circumstances, opportunities are also provided for more substantive learning that does have an impact on student outcomes.

Extended opportunities to learn, however, are not necessarily more effective than their one-off counterparts. Two extremes that are sometimes portrayed as effective have little evidence to support them. The first is that teachers should be treated as self-regulating professionals who, if given sufficient time and resources, are able to construct their own learning experiences and develop a more effective reality for their students through their collective expertise[5]. Unfortunately, we found little evidence to support the claim that providing teachers with time and resources is effective in promoting professional learning in ways that have positive outcomes for students. Conditions that promote learning are more complex than this.

One possible exception is teachers engaging in self-study using a set of professional standards for guidance, as in the certification system used by the US National Board for Professional Teaching Standards[6]. In this situation, the process involved teachers working towards meeting a set of standards, during which time they engaged in self-directed professional development, often with the assistance of a mentor. Although standardised measures of student outcomes have shown relatively small effect sizes when compared with other teachers in the same state[7] and experienced teachers who failed to obtain certification[8], samples of student work from observed lessons in the latter study did show a substantive difference when the depth of student understanding was assessed.

The alternative extreme is where outside experts develop recipes for teaching (typically based on research about what works for students) then present prescribed practices to teachers with an underpinning rationale and monitor their implementation carefully to ensure integrity. The overall evidence is that these processes can be effective in changing teaching practices, but either the changes have limited impact on student outcomes[9] or they are not sustained once the providers withdraw[10].

The remainder of the findings presented in this chapter focus on what *does* work. They are presented in summary only, with detailed explanations and examples cross-referenced to the relevant sections of the main synthesis. The summary begins with the findings presented in relation to the different aspects highlighted in Figure 4.2: the professional learning context, the content of the professional development/learning opportunities, the activities constructed to promote the learning, the learning processes, and the responses of the participating teachers. Each section begins with an overview of the main findings, followed by a brief explanation. Cross-references to more detailed explanations and examples in the main synthesis are made throughout.

1. The context of professional learning and development

Seven elements in the professional learning context were identified in the core studies as important for promoting professional learning in ways that impacted positively and substantively on a range of student outcomes: providing sufficient time for extended opportunities to learn and using the time effectively; engaging external expertise; focusing on engaging teachers in the learning process rather than being concerned about whether they volunteered or not; challenging problematic discourses; providing opportunities to interact in a community of professionals; ensuring content was consistent with wider policy trends; and, in school-based initiatives, having leaders actively leading the professional learning opportunities. These key themes are summarised in Overview 1 and further elaborated in the remainder of this section.

Overview 1. Effective contexts for promoting professional learning opportunities that impacted on a range of student outcomes

Extended time for opportunities to learn was necessary but not sufficient

- Learning opportunities typically occurred over an extended period of time and involved frequent contact with a provider.

  But extended opportunities also resulted in no or low impact on student outcomes.
  Limited time was adequate for relatively narrow curriculum goals.

- How time was used was more important than the exact nature of the provision (for example, release from teaching duties).

  Funding for release time and the absence of such funding were both associated with the interventions in the core studies and with those that had low or no impact.

External expertise was typically necessary but not sufficient

- Engagement of external expertise was a feature of nearly all the interventions in the core studies, with funding frequently used for this purpose.

  But interventions with low or no impact also involved external experts.

Teachers' engagement in learning at some point was more important than initial volunteering

- Neither who initiated the professional learning opportunities nor whether they were voluntary or compulsory was associated with particular outcomes for students.

  What was more important was that teachers engaged in the learning process at some point.

Prevailing discourses challenged

- Where prevailing discourses were problematic, they were typically based on assumptions that some groups of students could not learn as well as others and/or emphasised limited curriculum goals.

  The challenge to discourses typically involved iterative cycles of thinking about alternatives and becoming aware of learning gains made as a result of changed teaching approaches.

Opportunities to participate in a professional community of practice were more important than place

- Interventions in the core studies were both school-based and external to the school.

  Nearly all included participation in some kind of community of practice but such participation on its own was not associated with change.
  Effective communities provided teachers with opportunities to process new understandings and challenge problematic beliefs, with a focus on analysing the impact of teaching on student learning.

Consistency with wider trends in policy and research

- Approaches promoted typically were consistent with current research findings, recommendations of professional bodies (e.g. national subject associations), and/or current policy.

Active school leadership

- School-based interventions in the core studies had leaders who provided one or more of the following conditions:

  Actively organised a supportive environment to promote professional learning opportunities and the implementation of new practices in classrooms;
  Focused on developing a learning culture within the school and were learners along with the teachers;
  Provided alternative visions and targets for student outcomes and monitored whether these were met;
  Created the conditions for distributing leadership by developing the leadership of others.

Time

With the exception of two in mathematics[11] and one in special education[12], the learning opportunities documented in the core studies occurred over an extended period of time. Between six months and two years was common, with some extending to five years. There were two exceptions to this general finding.

The first was that, in some cases, powerful ideas formed the basis of new practice and had a high impact on student outcomes even though the training was relatively short. This high impact appeared to apply particularly when teachers were working with students experiencing low levels of success. For example, in a single one-hour session, Rowe, Pollard, and Rowe[13] showed teachers how to screen students for auditory processing problems and address the implications for classroom communication. After adjusting for intake characteristics, the reading scores of these teachers' students at the end of one year were significantly better than those in control schools. Cardelle-Elwar[14] worked with teachers for three days on developing students' metacognitive strategies for solving mathematical problems. The experimental group (those whose teachers had received the training) substantively outperformed the control group.

Details about time and frequency of professional development are provided in each of the context sections in Chapters 6–9.

The second exception was that short sessions were sufficient to raise student achievement when narrow curriculum goals were targeted[15]. While it is possible to create these kinds of changes over a relatively short time, it appears that under most circumstances, an extended timeframe is needed for substantive learning to occur.

Extended timeframes, however, were also associated with studies that showed no or low impact on student outcomes[16]. How the time was used was more important than the amount of time.

In reading, writing, and science, frequency of contact was particularly important. In most studies that reported on frequency, contact occurred at least every two weeks. In some, contact was less frequent than this, but rarely less than once per month.

There did not appear to be a relationship between funding for release time and impact on student outcomes. Both generous funding for release time and no funding for this purpose were associated with core studies that reported a positive impact on student outcomes and those that reported low or no impact. Many core studies did not provide this information.

Extended timeframes and frequent contact were probably necessary because, in most core studies, the process of changing teaching practice involved substantive new learning that, at times, challenged existing beliefs, values, and/or the understandings that underpinned that practice. The learning process was iterative rather than linear as new ideas were revisited in terms of their implications for the ideas on which current practice was based. Providers who trained teachers to implement a defined set of preferred practices rarely had a sustained impact on student outcomes[17].

The time required to engage in the iterative learning process in the core studies is described in the cases found in Appendix 1.

External expertise involved

Box 6.1 describes how a researcher collaborated with a teacher in developing more effective mathematics practice.

Engagement of external expertise, often researchers, was a feature of nearly all core studies, with additional funding frequently used for this purpose. The professional development was usually informed by concurrent research. This finding could be an artefact of study selection in that researchers were more likely than practitioners to publish their findings in ways that met our criteria for methodological adequacy. The need for external expertise is understandable, however, because the substantive new learning involved in most core studies required teachers to learn new content and skills and to think about their existing practice in new ways. It is unlikely that any group of professionals would be able to manage this level of new learning without support and challenge from someone with expertise in the area. It is not sufficient simply to provide time and opportunity.

The presence of external experts, however, did not guarantee success—most programmes that had no or low impact also involved external experts, including researchers. Experts need more than knowledge of the content of changes in teaching practice that might make a difference to students; they also need to know how to make the content meaningful to teachers and manageable within the context of teaching practice. We are calling these skills *provider pedagogical content knowledge*. As noted in the section on time, external experts who expected teachers to implement their preferred practices were typically less effective than those who worked with teachers in more iterative ways, involving them in discussion and the development of meaning for their classroom contexts. Effective teaching practice is based on a coherent and integrated set of beliefs and values[18]. How a teacher does one thing is not divorced from how he or she does something else, and a teacher's practices are connected to the beliefs underpinning them[19]. Expecting teachers to act as technicians and to implement a set of 'behaviours' belies the complexity of teaching, the embeddedness of individual acts of teaching, and the need to be responsive to the learning needs of students.

Teachers engaged in learning at some point

Box 8.1 describes how teachers' motivation waxed and waned during their six-month participation in a course on new approaches to early literacy acquisition.

There was no clear relationship between student outcomes, those who initiated the professional development, and whether participation was voluntary or compulsory. The commitment to participate did not need to be a prior condition, nor was it associated with greater engagement. Volunteering was typical of those taking part in vacation or tertiary courses. It was also a condition usually required of schools adopting comprehensive school reform (CSR) models in the United States. But several researchers[20] have documented how the circumstances of initial engagement in CSR bear a complex relationship to implementation and sustainability. Administrative or peer pressures influence volunteering behaviours. In addition, at the time of volunteering, teachers do not necessarily understand the level of engagement and change required. Teacher participants rarely believe that they need to engage in deep learning or to change practice substantively[21], whereas providers typically believe they will but do not necessarily disclose this to the participants. Under these circumstances, learning is likely to be uncomfortable, even if teachers have volunteered.

In our synthesis of the core studies, the learning content and the activities to support it, together with the rationale for participating, had a greater influence on student outcomes than the circumstances of initial engagement. It was these that determined whether teachers engaged sufficiently during the learning process to deepen their knowledge and extend their skills in ways that improved student outcomes.

Prevailing discourses challenged

Two types of teacher discourse were challenged in many of the core studies. The first related to teachers' social construction of students. Where this discourse was problematic, it was usually based on the assumption that some groups of students could not or would not learn as well as others. These groups of students were usually those who had experienced failure over a long period of time and did not benefit as much as others from traditional teaching practices and pedagogical relationships.

Box 9.4 describes changes in how teachers thought about the causes of student failure at the beginning and end of professional development in literacy.

These discourses changed as teachers understood the impact of their practice on their relationships with their students in the classroom[22] and/or they learned new approaches to teaching that accelerated student learning[23]. As their practice became more focused and their students learned more quickly, they felt more efficacious and, in turn, refocused on the teaching–learning relationship. Changes in expectations about what might be possible occurred in iterative cycles, not linearly.

Close examination of one popular approach to addressing teacher expectations through a prescribed set of teaching behaviours in the United States[24] showed that attending a course and changing behaviours had little impact on either teacher expectations or student learning. Higher expectations cannot be taught or imposed independently of context. Rather, they develop as new teaching approaches are mastered and student learning is seen to improve.

The second type of prevailing discourse that was challenged in many professional learning opportunities related to how to teach particular curricula most effectively. In mathematics and science in particular, there were large discrepancies between prevailing discourses about what counted in learning and teaching and the approaches being promoted in the professional development. The shift involved moving the focus from facts, procedures, and memorisation to processes of inquiry and the development of students' conceptual understandings.

Box 6.3 describes changing discourses and models of practice in mathematics.

As teachers became more skilled in implementing inquiry-based approaches, and student learning deepened, the ways in which teachers thought about what constituted effective teaching in mathematics and science changed[25].

Opportunity to participate in a professional community of practice was more important than place

Some core studies were school-based and others took place off-site with teachers from different schools. A common feature of both the school-based and the off-site opportunities was participation in some form of professional community of practice. In no case, however, did such participation, on its own, lead to changes in student outcomes. In several cases, the opposite occurred, with participation reinforcing an ineffective status quo[26].

More details on the characteristics of effective professional communities are provided and illustrated in topical issue 4 in Chapter 10.

Effective professional communities were characterised by two conditions. Firstly, participants were supported to process new understandings and their implications for teaching. Sometimes this involved challenging problematic beliefs and testing the efficacy of competing ideas[27]. Expertise external to the group brought new perspectives and assisted in challenging prevailing dialogical norms.

Descriptions of professional learning communities in action are provided in box 8.12 and Section 10.4.

Secondly, the focus was on analysing the impact of teaching on student learning. This focus was assisted by grounding discussions in artefacts representing student learning and by teachers having high but realistic expectations of students and believing they could make a difference. Norms of collective responsibility for student learning replaced those of individualism and autonomy, focused on teachers.

Examples of less effective professional communities are described in boxes 6.13 and 8.13.

Consistency with wider trends

Specific instances of this policy alignment are provided in Section 6.2.1.2 for mathematics and Section 7.2.1.2 for science.

The pedagogical approaches promoted in mathematics and science professional development in particular were consistent with policy emphases and recommendations by national subject associations and/or were based on generally accepted research findings. They did not occur in isolation of a wider research/policy environment.

Some studies of interventions that had low or no impact were also justified on the basis of 'research', but this research was typically not of the kind that had survived the rigours of adoption by a policy or professional body or was part of a wider programme of research. The research was usually used for the purposes of prescribing particular teaching behaviours.

Effective school leadership

More details on the characteristics of effective leadership can be found in topical issue 2 in Chapter 10.

The qualities of effective leaders came through most clearly in the school-based studies, not those that took place off-site, although not all school-based studies reported on leaders' roles. Effective leaders actively supported the professional learning of their staff and, at times, participated themselves. Their activities were consistent with a number of theoretical perspectives on leadership, rather than one particular perspective. Most frequently, leaders ensured organisational arrangements were put in place that provided teachers with the opportunities to learn, access to relevant expertise, and opportunities to meet to process new information.

An example of how a leader developed a learning culture within a school is provided in Box 9.1.

In some studies[28], leaders went beyond this organisational brief and systematically developed a learning culture in the school, where they participated as learners rather than organisers of others' learning.

A third way in which leaders actively led was in setting a vision for the outcomes of professional learning. Visions were always associated with better outcomes for students and linked to professional learning goals, student achievement targets, and more general school goals. They were typically associated with some form of monitoring to check that they were met. At times, these accountabilities had high stakes[29], with both teacher and student promotion dependent on them. At other times, they involved monitoring of progress and professional discussion about their adequacy and implications for improvement[30].

Case 4 describes the development of teacher leadership within the context of developing teacher understandings of the use of formative assessment to promote student learning.

Given the complexity of leading and managing schools, it is increasingly recognised that one leader cannot do everything alone. Several interventions[31] systematically developed specific teacher expertise and leadership in relevant curricula and pedagogical approaches. The reasons for doing this were usually associated with sustaining changed practice once providers had withdrawn. None of these studies, however, empirically tested the effectiveness of this approach in terms of sustainability. In two studies, the teacher leaders interviewed expressed concerns about this role, associated with their change in status[32].

2. The content of professional learning and development

This section is central to the purpose of this synthesis, for without content on which to base deeper understandings and extend teaching skills there is no foundation for change. Content included discipline knowledge and the interrelationship between such fundamentals as new curricula, pedagogy, and assessment information; knowledge of students, including their developmental progressions through particular curricula, and their culture; linguistic and cultural resources; and theoretical frameworks and conceptual tools. Skills of teacher inquiry included analysis of the teacher's own practice and new possibilities in relation to a standard of practice; the ways in which practice impacted on diverse student learners, and new possibilities for greater impact; and methods of inquiring into the adequacy and improvement of practice. The main findings for this section are listed in Overview 2.

Overview 2. The content of professional learning and development in the core studies

Different aspects integrated

- Integration of theory and practice was a key feature.

  Theory provided the basis for making curricular and pedagogical decisions.
  Teachers were assisted to translate theory into classroom practice.

- Integration of pedagogical content knowledge, of assessment information, and of how students learn particular curricula was a feature of most curriculum-based interventions documented in the core studies but was given different emphasis in different curricula.

  Greater emphasis on curriculum content knowledge was evident in mathematics, science, and writing than in reading.

Clear links between teaching and learning and/or student–teacher relationships established

- All interventions in the core studies were underpinned by an assumption that student learning and teacher–student relationships were strongly influenced by what teachers did in their classrooms.

  Sometimes it was an analysis of the teacher–student relationship that, by identifying problems and providing new vision, gave teachers the motivation to engage in the professional learning opportunities.

Assessment used to focus teaching and enhance self-regulation

- Approximately half the interventions in the core studies included assessment for one or more of the following purposes:

  Providing a catalyst for initial and ongoing engagement;
  Identifying professional learning needs;
  Identifying student learning needs through assessment of their understandings and skills in order to focus teaching;
  Inquiring into the effectiveness of practice with particular students for the purpose of confirming or refining practice.

Sustainability

- Sustainability was dependent on teachers acquiring both of the following:

  In-depth understanding of theory, which served as a tool to assist instructional decision making;
  The skills of inquiry to judge the impact of teaching on learning and to identify next teaching steps.

Integrating aspects of content

In no core study was a particular kind of knowledge addressed in isolation from other kinds of knowledge. Integration occurred with respect to theory and its translation into practice, and in relation to teacher understanding of pedagogical content knowledge, how students learn particular curricula, and how that learning should be assessed in order to focus teaching. This integration is consistent with the understanding that teaching is a complex, theoretically informed activity.

Box 7.3 provides an example of how theory and practice were integrated in science.

Box 8.10 provides an example of integrating theory and practice in reading.

Theory provided the tools on which to base curricular decisions. Teaching practice is influenced by individual teachers' personal theories about how to be effective. Indeed, experts are thought of as those who have a holistic grasp of relationships within their particular context and who fluidly and efficiently solve problems of practice in theoretically consistent ways[33]. The presentation of isolated pieces of information about preferred practice without an integrative theory was predictably ineffective in changing student outcomes in sustainable ways[34]. In the core studies, teachers were provided with the theoretical underpinnings of alternative practice.

Presentation of theory in isolation from its implications for practice was also insufficient to change student outcomes. In all the core studies, support was provided to help teachers translate the theory into practice. Theory and practice did not stand apart from one another. Even in the most extreme example, in which science teachers worked with research scientists over the summer, structured meetings were held through this period and throughout the following year to consider the implications of participation for teaching purposes.

Box 6.7 describes how different aspects of content were integrated in mathematics.

Integration also occurred with regard to the fundamentals of teaching (curriculum, pedagogical, and assessment knowledge) and how students learn particular curricula. The emphasis given to each aspect, however, varied among the studies. Some gave greater emphasis to pedagogy while others were more curriculum focused. Mathematics, science, and writing typically emphasised curriculum content more than reading did. A likely explanation for these different emphases is that teachers, particularly in the primary sector, are reputed to have poorer content knowledge in mathematics, science, and writing. Content knowledge was emphasised as much in the secondary as the primary school sector.

It is nearly 20 years ago that Shulman[35] coined the term 'pedagogical content knowledge' and argued that teachers needed this specialised form of knowledge in order to teach effectively. While the evidence from this synthesis strongly supports this claim, it appears that underpinning curriculum knowledge needs to be adequate in order to integrate it with effective teaching strategies.

Focusing on the links between teaching and learning and/or student–teacher relationships

One of the key features of the core studies was a focus on the relationship between teaching and learning. An underlying assumption was that learning outcomes were systematically influenced by what was taught. Part of the shift in teacher beliefs described in some of the studies[36] involved teachers taking greater responsibility for promoting the learning of all students, rather than dismissing their learning problems as an inevitable reflection of their home or community situation. In one of the few New Zealand studies[37] of interventions that have impacted on student outcomes in secondary schools, the focus was on improved relationships with Māori students. The message was, however, the same: what teachers did impacted on how students responded.

In this New Zealand study and in others internationally[38], it was how students were learning and responding in their existing situations that provided the catalyst for teachers to engage in professional development. In the New Zealand study, it was students' stories of their classroom experiences that provided the catalyst. In another New Zealand secondary school, it was the rate of student suspensions[39]. In other studies, it was a disaggregated analysis of patterns of student achievement data that revealed that some students were not benefiting[40] from what was described as an impoverished curriculum.

Case descriptions of the two New Zealand studies referred to can be found in Appendix 1.

Identifying a problem, however, only provides a catalyst for finding a solution if there is a vision of a realisable alternative. Wherever identified problems provided the rationale for engagement, a vision of better outcomes for students, and the support for teachers to pursue it, were part of the picture.

Using assessment to focus teaching and review effectiveness

Approximately 50% of the core studies with substantive positive outcomes for students made specific reference to teachers developing their understanding of and use of assessment, with part of the professional development focused on the skills of interpreting and using data. Assessment was never an isolated component of professional development. The types of assessments varied widely and included: students' thinking and understandings, expressed in drawings and interviews; close observation of their work; and results from standardised tests.

Issue 1 in Chapter 10 provides a more detailed analysis of the multiple roles of assessment in professional learning and development.

In all these studies, assessment was used to provide an analysis of the teaching–learning relationship for the purpose of improving teaching. As noted above, student learning was seen to be a function of teaching, and assessment provided the information to improve and refine teachers' understanding of that relationship.

Assessment information was variously used to identify the next steps for teaching at individual, class, and programmatic levels and, as noted above, to provide the motivation for teachers to engage in professional learning. Assessment was also used as a tool for reflecting on the effectiveness of teaching practice with particular students, so that practice could be either confirmed or revised for the next group.

Box 6.6 describes how a teacher understood students' thinking and their learning needs through close observation.

It is not surprising that skills in the interpretation and use of assessment information were addressed so often in the core studies because this information is fundamental to teachers' responsiveness to student learning needs—particularly the needs of students who are not currently benefiting as much as others from traditional teaching practices. Good assessment information allows for targeted teaching. It can only serve this purpose, however, if teachers are focused on the teaching–learning relationship and how to improve it; without this focus, assessment becomes a tool for labelling.

Issue 1 in Chapter 10 describes the multiple uses of assessment.

Sustainability

In the synthesis, we have defined sustainability in terms of continued or improved student outcomes once the support provided during the earlier phases of professional development has been largely or totally withdrawn. This definition did not preclude teachers seeking continued support from those with expertise, but it did preclude the further intensive involvement of the external experts responsible for the programmes concerned. Only seven core studies satisfied this criterion[41], so the conclusions must be considered conjectures rather than solid findings. Sustainability was not a neglected issue but it was treated as an article of faith more than a condition subject to empirical verification.

Chapter 11 provides a more detailed analysis of the content of professional development associated with sustained student outcomes.

Section 11.2 describes the features of professional learning associated with sustainability.

Features of professional learning and development that were associated with sustained student outcomes included a strong theoretical base that provided the foundation for principled decisions about practice, and the skills to collect relevant evidence and use it to inquire into the impact of teaching on student learning, particularly in relation to understanding students' problematic thinking or achievement.

In the studies that specifically documented sustainability issues, teachers were given considerable discretion to solve teaching/learning problems within structured frameworks. The two interventions that were both sustained and 'scaled-up'[42] were more prescriptive about lesson structure and some of the content. There was insufficient evidence, therefore, to make claims about what should be prescribed and what should remain discretionary.

Section 11.3 describes the organisational conditions associated with sustainability.

The acquisition and continued use of knowledge and skills were dependent on school organisational arrangements that supported ongoing learning and application. These organisational arrangements complemented the key features identified in the professional learning opportunities themselves. They included leaders providing goals or targets for student learning, collecting evidence on progress towards them as the basis for teacher reflection, and motivating continued teacher engagement.

The evidence related to sustainability is consistent with the conditions known to promote self-regulated learning for teachers. Self-regulated learners are able answer three questions: 'Where am I going?', 'How am I going?', and 'Where to next?'[43] Teachers with both inquiry skills and content knowledge, and who received support from their leaders, were consistently able to do this in terms of the impact of their teaching on student learning. The 'Where am I going?' question was sometimes answered in ways as explicit as meeting state standards, but more frequently in less explicit ways, such as improvements in students' mathematical problem-solving[44] or students' text comprehension levels getting closer to what was expected[45]. The answer to the question 'How am I going?' was a measure of the effectiveness of teaching on student progress. The answer to the 'Where to next?' question was guided by a detailed and theoretically sophisticated knowledge of curriculum content and student progressions.

3. Activities constructed to promote professional learning

Much of the writing on professional development emphasises the importance of engaging in particular activities. In a review of mathematics and science studies, Kennedy[46] noted that form has been emphasised to the detriment of content in the professional development literature. Similarly, our findings in this section do not identify any particular activity or form as being more effective than others. What was important was that teachers were able to engage in multiple and aligned opportunities that supported them to learn and apply new understandings and skills. The key features of activities identified as most effective are listed in Overview 3. We suggest that these activities should comprise a pedagogy for professional development.

Overview 3. Activities in the core studies that were constructed to promote professional learning

Content and activities aligned

- A clear alignment between the intended learning goals and the activities was evident.

  Individual activities often served multiple purposes.

A variety of activities needed

- Teachers were provided with a variety of ways to understand the content.

  Apart from listening to those with expertise, no single type of activity was common to all interventions and no individual activity stood out as more effective than others across studies or within particular categories.
  Listening to experts was not in itself sufficient to change practice.

Content conveyed through the activity was more important than any particular activity

- Every type of activity that was associated with positive outcomes was also associated with low or no impact.

Professional instruction sequenced

- Typical sequences involved a rationale or catalyst to engage, instruction in key theoretical principles, and then opportunities to translate theory into practice and deepen understanding of theory.

Understandings discussed and negotiated

- Professional development pedagogies shared a focus on providing opportunities for teachers to discuss and negotiate the meaning of concepts taught.
- Understanding of new theories was sometimes developed through engaging teachers' existing theories.

  Initial activities sometimes showed that there were problems with teachers' existing theories of practice.

Student perspective maintained

- A variety of activities served to develop teachers' understanding of the relationship between their teaching and student learning.

Content and activities aligned

The interventions that were the subject of the core studies aligned content and activities closely. For example, activities such as examining student outcomes assisted teachers to focus their teaching practices on student needs and understand their impact; feedback from observations assisted teachers to translate theoretical principles into practice. Although this type of alignment may seem to be obvious, it was not always evident in studies that had low or no impact on student outcomes[47].

Alignment did not mean that one activity met one purpose only. For example, activities where teachers were positioned as students served the multiple purposes of developing teachers' own content knowledge, demonstrating good pedagogical practices, developing teachers' insight into their own learning practices, developing greater teacher empathy with students as learners, and providing a vehicle for rich conversations about practice with other participants.

A variety of activities needed

In all the core studies, teachers engaged in a range of activities. The only activity which was consistent across studies, either within or between groups, was listening to others with greater expertise. By itself this activity was, however, insufficient to change practice in ways that impacted on student outcomes. Other activities included discussing practice with colleagues and with someone with specific expertise, having opportunities to see real or simulated practice (particularly in science), examining student understandings and outcomes, being observed and receiving feedback (particularly in literacy), discussing teachers' own theories of practice and their implications for teaching and learning, receiving student activities and materials (particularly in science), participating in activities positioned as students (particularly in mathematics), and engaging with professional readings.

It appears from this analysis that teachers require similar conditions to students when in-depth learning is being promoted; that is, they need multiple opportunities to learn through a range of activities. These activities need to be focused on content aims, such as translating theory into practice or demonstrating how assessment could be used to focus and refine teaching.

Content more important than any particular activity

Every type of activity that was part of the core studies with positive outcomes was also associated with studies with low or no impact. Table 1 lists some examples. The understandings promoted through engagement in these activities were more important than the activities themselves.

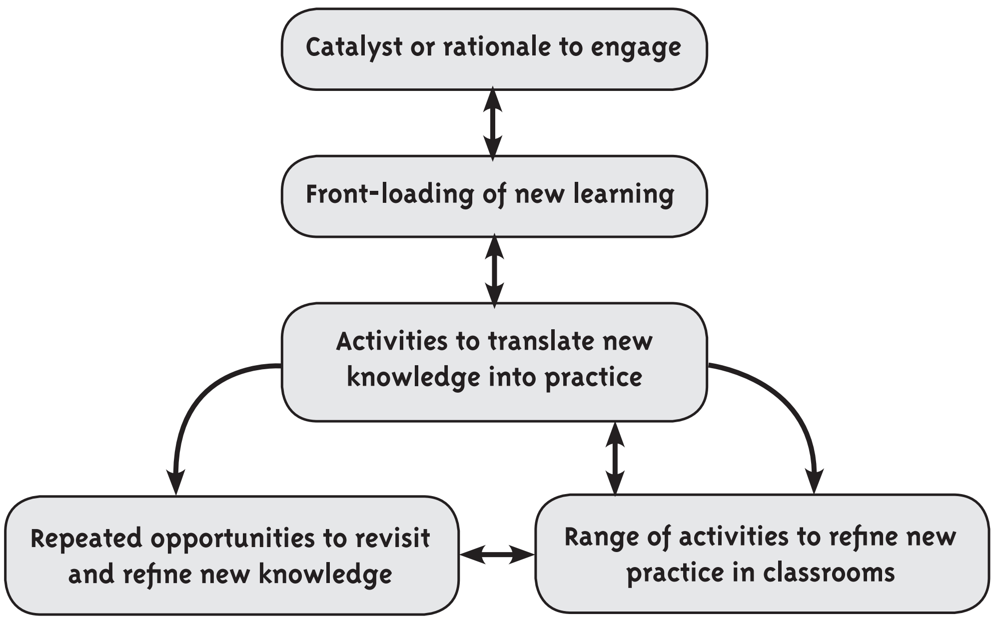
Table 1. Positive and negative examples of activities

Location in synthesis	**Activity**	**Positive example**	**Negative example**
Positive – Box 9.7 Negative – Box 8.2.3.2	Demonstrations and examples of teaching practice	Providers modelled practice with teachers	Underpinning theory not well understood
Positive – Box 9.9 Negative – Section 7.2.4.3	Observation and feedback	Main component of coaching	Ensuring correct implementation of teaching practices to raise expectations
Positive – many Negative – Box 8.9	Using assessment to refine teaching	Many examples	Assessment used inaccurately
Positive – many Negative – Section 7.2.4.4	Discussing practice with colleagues	Many examples	Teachers reinforced each other's deficit thinking
Positive – Box 6.8 Negative – Sections 6.2.2.4 and 6.3	Describing/ prescribing practice	Detailed description with responsiveness to students	Prescription without responsiveness to students

Professional instruction sequenced

A typical but not invariable sequence in most core studies began with some kind of rationale or catalyst to engage in the professional learning, followed by front-loading of new learning in relatively formal ways, followed by more individualised opportunities to learn. This sequence occurred whether the professional learning opportunities were school based, occurred off-site for groups of teachers, or involved participation in tertiary courses. It is depicted in Figure 6.2.

Figure 6.2. Typical sequence of professional learning opportunities



Catalysts to engage were varied. In some studies, the catalyst was information showing that some aspects of current teaching practices were not achieving the desired outcomes for particular groups of students. Student outcomes included achievement, engagement, and/or student–teacher relationships.

Other catalysts problematised the adequacy of teachers' current definitions of particular curricular outcomes. For example, in mathematics and science, providers frequently challenged teachers' definitions of what mattered in these subjects. In mathematics, teachers traditionally focused on computation, with providers advocating in-depth understanding. Similarly in science, teachers' emphasis on knowledge of scientific facts was challenged by providers who gave greater emphasis to developing inquiry and investigative skills.

Case 7 in Appendix 1 describes how students' stories challenged teachers' understandings about how their practice impacted on their relationships with Māori students.

In some supplementary studies[48], the lack of a shared understanding of the rationale for engagement was a problematic aspect. It is not surprising that teachers, like other learners, need a powerful reason to engage with new information in sufficient depth to change their practice. Although an initial catalyst was not sufficient to ensure this level of engagement, problematising current practice in terms of the outcomes for students was an obvious motivator, provided that identification of problems was accompanied by an alternative vision and the support to pursue it.

Box 8.3 describes an example of misunderstandings about the rationale to engage.

In the typical sequence, the presentation of key concepts and theoretical principles served to provide teachers with the theoretical basis on which to build their understanding of the implications for practice. This was obviously more efficient than individualised instruction. The repeated opportunities to learn that followed this initial input were, however, an essential part of the process and it was here that substantive changes in practice were addressed.

Box 9.3 describes this study.

An exception to this sequence was evident in one school-based study[49], in which there was no formalised instruction as such but student outcomes still improved. In this study teachers were left to develop solutions to identified student achievement problems, provided they specifically addressed the problem within a broad framework. Monitoring of both the professional learning and how it was implemented was undertaken by the principal. This ongoing monitoring was probably crucial to its success because other studies in which teachers were left to find their own solutions were ineffective in changing student outcomes.

Understandings discussed and negotiated

Part of the typical sequence described above consisted of activities that assisted teachers to translate theory into practice, together with repeated opportunities to refine and revisit important content. Effective professional development pedagogies provided teachers with opportunities to discuss and negotiate the meaning of the new learning and its implications for practice.

Issue 3 in Chapter 10 provides a more detailed analysis of the engagement of teachers' theories of practice.

Twenty of the core studies made specific reference to engaging teacher theories of practice[50] as part of the professional learning process. Teacher theories of practice are personal theories that comprise: particular beliefs and values; the knowledge, skills, and practices that follow from them; and the desired outcomes[51]. Engaging such theories requires negotiating the meaning of new practice in terms of what it means for existing practice, and how and why it needs to change. Other core studies did not provide sufficient information for us to be able to determine if theory engagement occurred.

Box 8.7 describes how teachers' theories influenced their understanding.

A high proportion of those interventions detailed in the supplementary studies that failed to have a substantive impact on student outcomes did not engage teacher theories. In some of these[52], teachers were provided with opportunities to learn but the content and activities were left largely to their discretion. In other studies[53], teachers were taught (and expected to implement) a set of behaviours considered by the professional development providers to constitute effective teaching practice, but without their rationales for existing practice being addressed.

The exceptions to this pattern of engagement in the core studies and non-engagement in the supplementary studies occurred when the focus of the professional development related to relatively narrow aspects of curricula, such as spelling, phonemic awareness, and questioning in a particular lesson format in science[54]. In such situations, ensuring that teachers implemented a particular set of behaviours appeared to have been sufficient to impact on student outcomes. Whether the behaviours were sustained was not determined.

An issue frequently noted in the literature on teacher change is that of *over-assimilation*[55]. This is what happens when teachers believe that they are enacting new practices when, in reality, they have made only superficial changes. For example, in a study of mathematics in the United States[56], group work was promoted as a way to engage students with mathematics content at deeper levels. Researchers found that while teachers did indeed group their students, curriculum content and pedagogical approaches remained essentially unchanged. As noted in various sections of this synthesis, teachers' personal theories about effectiveness underpin all practice. Without engaging their current theories about why they do what they do, new practice is likely to become layered onto existing practice, not replace it.

In advocating such an approach, it should not be assumed by providers that teachers' current theories of practice are problematic or that providers' theories are, by definition, more effective. The number of examples we have analysed in which teachers have implemented providers' theories with integrity, without change in student outcomes, suggests that, at times, teachers' existing theories have merit. It should be assumed that teachers cannot teach in the absence of theories of practice, and that the degree of congruence between existing theories and those promoted through professional learning opportunities needs to be understood. Negotiating meanings, and debating and testing evidence of the effectiveness of both providers' and teachers' theories, are part of the process of achieving mutual understanding and effective practice.

4. Learning processes

Changing practice in substantive ways is difficult. We have reached this conclusion from evidence of the length of time involved, the depth of pedagogical content and assessment knowledge typically addressed, and the multiple learning opportunities that appear to be required. Understanding the processes involved in changing teaching practice is, however, a neglected area. Few studies have addressed the issue directly. In some studies it appeared that the process was essentially one of acquiring new knowledge and skills. In others, it was apparent that existing theories of practice were challenged. The limited available evidence means that our findings are based on a mix of theory and evidence and should be considered conjecture, not definitive. These findings, with limitations noted, are summarised in Overview 4.

Overview 4. Learning processes and teachers' responses

Substantive change is difficult

- Learning to change teaching practice in ways that impacted on student outcomes provided many challenges for teachers.

  Specific learning processes were usually implied rather than specified.
  Teachers' responses were more often implied than specified.

New understandings

- The interventions in all the core studies involved teachers developing new understandings and extending their skills through becoming aware of new information.

  Cueing existing knowledge was necessary for theory engagement but insufficient to change practice.

Some new understandings were consistent with current positioning

- These new understandings were able to be accommodated within teachers' existing conceptual frameworks.

  This situation occurred when specific skills were acquired or when teachers were aware that their existing knowledge was limited.
  Acceptance (not necessarily deep understanding) was usually achieved.

Some new understandings created dissonance with current positioning

- Some new information challenged teachers' current positioning with regard to students, curriculum content, and/or effective pedagogy.

  This situation typically occurred when teachers were more confident of their knowledge and practice base.
  Extreme reactions of rejection or engagement were likely.

In a few interventions, teachers learned to regulate their own and others' learning

- If teachers were to acquire the skills and habit of ongoing inquiry into practice, it was important that they were systematically introduced to such inquiry in the professional learning context.
- This response was fundamental to sustainability.

New understandings

Not surprisingly, teachers needed to understand new information if they were to change their practice. Simply cueing existing knowledge was not sufficient, but in studies that reported theory engagement (see previous section), such cueing was a necessary part of the process.

New understandings consistent with current positioning

Assimilation of information consistent with teachers' existing conceptual and practice frameworks appeared to occur in two different circumstances. The first was when specific skills were being promoted that were readily integrated into existing practice; for example, new forms of questioning[57]. Teachers were able to see the benefits of asking more probing and open-ended questions and were able to integrate new question forms into their existing frameworks without first having to revise them.

The second was when teachers were aware that their existing pedagogical content knowledge was limited and actively sought new knowledge and skills. The introduction of the literacy and numeracy strategies in primary schools in the United Kingdom illustrates this. In the case of literacy, many teachers were relatively confident about their existing pedagogical content knowledge and frequently challenged the worth of the strategies, particularly when they were perceived to conflict with existing practice. In numeracy, teachers were less confident of their existing knowledge and were more likely to seek guidance and support for implementation[58].

The problem of over-assimilation means that new information is sometimes perceived as congruent ("I already do this") when it is actually quite dissonant. As a result, teachers' new practice resembles the new learning only on the surface; in reality, little changes.

New understandings creating dissonance

Challenges to teachers' current positioning were reported in a number of different areas. These challenges were to: teachers' social construction of students, especially in relation to expectations of achievement for some groups of students; what constitutes curriculum (especially in mathematics and science); and how that curriculum should be taught. An example of the latter was cooperative learning. Catalysts to engage that challenged teachers' existing beliefs were even more important in these circumstances.

Enhanced regulation of own and others' learning

Relatively few studies[59] directly addressed the acquisition of the kinds of skills and knowledge needed by teachers to systematically improve their practice in ways that resulted in ongoing student achievement once intensive provider support was withdrawn. These skills and this knowledge allowed teachers to monitor their practice systematically, enabling them to identify and diagnose student learning problems and then to draw on a deep repertoire of theoretical and practice knowledge to address them.

Case 3 in Appendix 1 describes how researchers engaged with teachers to jointly solve problems in ways that upskilled teachers to undertake the process

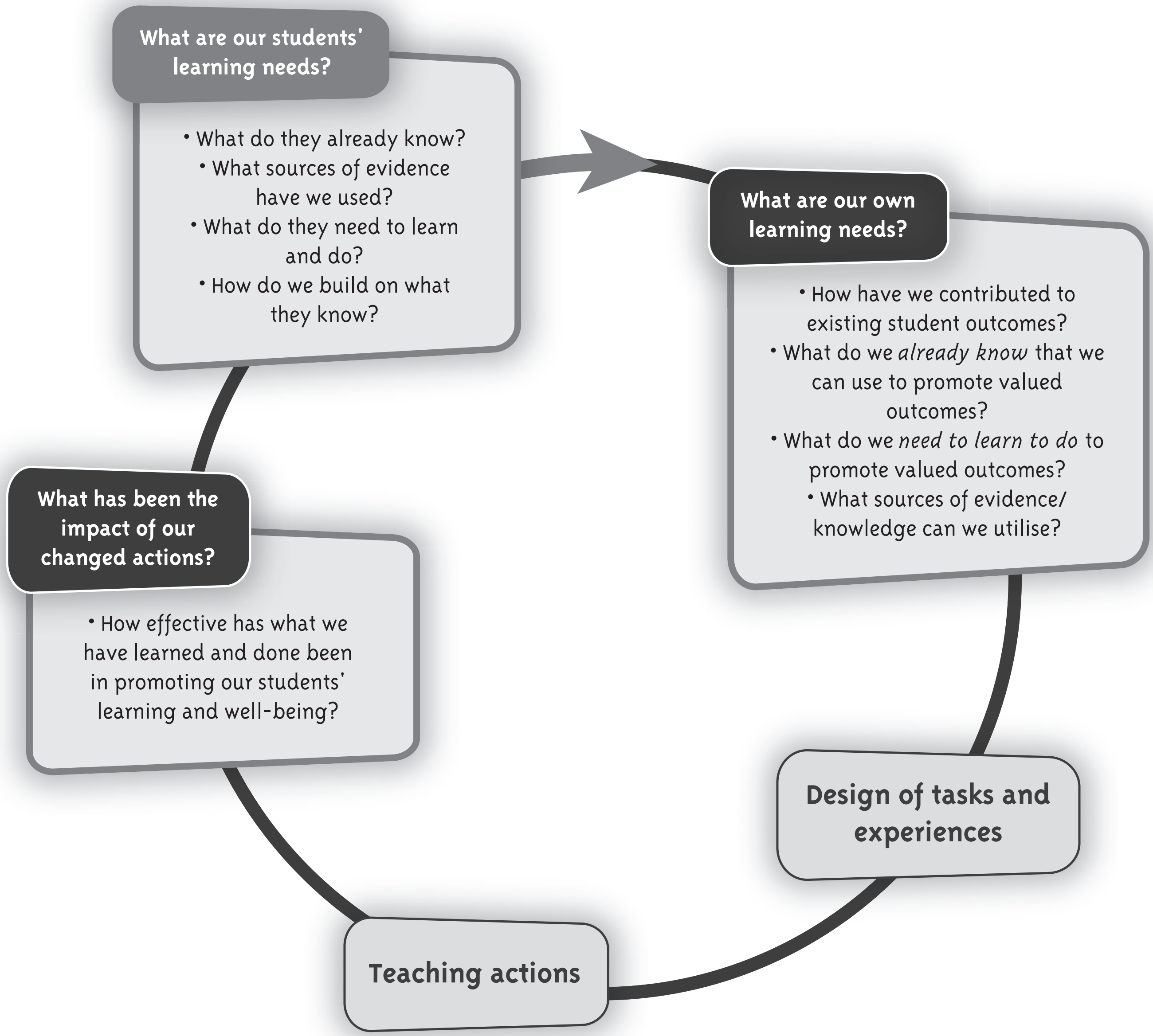
The evidence from the synthesis supports the idea that effective professional learning opportunities that promote these learning conditions combine some important elements. This is particularly important if outcomes are to be sustained. These elements build on and interact with each other iteratively. They include grounding learning in the immediate problems of practice, deepening relevant pedagogical content and assessment knowledge, and engaging existing theories of practice on which to base an ongoing inquiry process. This engagement both builds on and challenges those theories of practice.

In presenting these elements it is not intended to exclude the value of other types of professional learning. Developing teachers' discipline knowledge independent of immediate problems of practice, for example, may build a knowledge base that can be used when solving future problems of practice. The evidence from the synthesis, however, is that if this process is to have a substantive impact on student outcomes, this knowledge must be developed in the context of an analysis of student outcomes.

In Figure S.1 we propose a sequence of inquiries that combine the elements into a co- and self-regulatory learning cycle. By "co- and self-regulatory", we mean that teachers collectively and individually identify important issues, become the drivers for acquiring the knowledge they need to solve them, monitor the impact of their actions, and adjust their practice accordingly[60]. The figure is aligned with the work of Donovan et al. (1999) in that it integrates their key propositions about how people learn. These include the engagement of prior understandings and preconceptions about how the world works; a deep foundation of factual and conceptual knowledge, organised in ways that allow their retrieval; and a 'metacognitive' awareness that allows them to take control of their own learning by defining learning goals and monitoring progress towards them.

A key assumption underpinning these co- and self-regulatory learning cycles is that for inquiry to be effective it needs to occur at three inter-related and parallel levels: student, teacher, and organisation. The inquiries require the microprocesses of goal setting, enacting, monitoring, and adjusting at each of the three levels (Butler et al., 2004). Because this synthesis is focused on teachers, the figure foregrounds the co- and self-regulatory learning processes of this group. It must be kept in mind, however, that the findings on sustainability indicate that teachers are unlikely to engage in these inquiry processes unless they have the organisational conditions and support to do so.

Figure S.1. Teacher inquiry and knowledge-building cycle to promote valued student outcomes.



Goals are central to the development of co- and self-regulatory processes. In this model, teachers' learning goals are grounded in those for their students, as shown in the first inquiry, *What are our students' learning needs?* To make a difference in terms of student outcomes, goals must also be informed by knowledge of what the students already know and need to know. In the 'need to learn and do' category we include both curriculum content and learning process goals because students are unlikely to develop inquiry skills if they are not fostered within the learning environment. The student learning needs inquiry requires teachers to have sophisticated assessment knowledge and a variety of assessment tools that can be flexibly applied to meet situational demands. This assessment knowledge can then be used as a basis for planning. In doing so, instruction becomes evidence-informed and targeted at student needs.

The second inquiry, *What are our own learning needs?* is focused on identifying teacher learning goals. This inquiry demands much more of teachers than evidence-informed planning because it asks them to reflect on how their particular approaches and teaching emphases have contributed to existing patterns of student learning and achievement. This requires a collective rather than individual analysis because students are taught by more than one teacher in the course of their education. The evidence from the synthesis indicates that participation in mutual inquiry is a necessary (but not sufficient) condition for promoting professional learning that has an impact on students. The teacher learning needs inquiry begins by focusing teachers on existing teaching–learning links and the outcomes for students. Having established these, it asks teachers to understand what it is they need to learn and do to promote their students' learning. An essential element of this inquiry is that teachers see themselves as agents of change—for their students and their own learning. Learning cannot be co- or self-regulatory in the absence of this condition and in most of the studies showing sustained outcomes, these conditions were reported.

This second inquiry seeks to draw on and build two kinds of knowledge: the informal knowledge of practice and more formal knowledge, such as that found in the Best Evidence Syntheses on effective pedagogy for diverse learners[61], mathematics[62], and social sciences[63]. The importance of this latter kind of knowledge is supported by the findings of the synthesis. All the studies showing substantive outcomes for students systematically developed teachers' pedagogical content knowledge and approximately 50% developed their knowledge of assessment.

The third inquiry, *What has been the impact of our changed actions?* involves identifying the effectiveness of actions taken following the two earlier inquiries and is central to the co- and self-regulatory processes. Having established student and teacher learning goals and enacted appropriate teaching strategies, it is then essential to monitor the effectiveness of these in terms of their impact on students. Enacting this inquiry may involve teachers creating their own inquiry tools, such as questions to ask students about their learning and how they are learning, as well as comparing achievement information over time to determine whether they are achieving the desired achievement profiles.

In situations where this monitoring shows problematic student outcomes, improved outcomes are likely to require the adjusting of the goals, the plans, or their enactment. Thus the inquiry process cycles back to the student learning needs inquiry.

Co-construction of the meaning of the assessment information and the implications for practice of new pedagogical content knowledge is integral to the process. It is not possible to develop co- or self-regulatory learning in the absence of this deep understanding. This assertion is consistent with the general findings of the synthesis that prescriptive practices have less impact than those co-constructed. At the same time, the sophistication of the analyses required during the inquiry processes is likely to require high levels of expertise in the particular content areas. Part of the challenge is to find out whether existing knowledge is adequate or inadequate. Given that it is difficult for any individual to identify what they do not know, it is unlikely that these co- and self-regulatory processes will achieve this without external expertise. The evidence from the synthesis indicates this to be the case.

Consistency with findings from other syntheses

In our search of the literature, we did not find an equivalent synthesis of the impact of professional learning and development on student outcomes. A recent meta-analysis of student achievement outcomes in mathematics and science, however, supports our general findings[64]. Positive effects were found in most studies and greater effects were evident in mathematics when the professional development was longer than one year (this was not the case for science). In both mathematics and science, higher effect sizes were found in the studies that focused on building teachers' content knowledge and pedagogical knowledge than in those that focused on content knowledge alone. Particular activities did not yield different effects, although it was noted that nearly all the interventions involved workshops plus coaching. No finer grained analysis of activities was undertaken. The authors caution that few studies reported both teacher and student impact. We experienced a similar problem in undertaking this synthesis.

Gaps in the evidence

In preparing our analysis we encountered many difficulties. The greatest of these was a paucity of empirically verifiable detail concerning the sequence of events. Few studies provided descriptions of the professional development, evidence of teacher learning and change, and student outcomes. In many cases we needed to take a patchwork approach and consult several studies to obtain a more complete picture. In others, we were left with gaps. Another major problem was the reporting of student outcomes. This reporting was inconsistent and in many cases failed to reach even basic standards of adequacy. We would know so much more about the impact of professional learning and development if those reporting impact provided the basic statistical information (means and standard deviations) from which effect sizes could be calculated.

In addition, we could not find sufficient evidence about several issues on which to base sound conclusions. The first of these issues concerned the skills of providers. Rarely were providers and what they did to promote teacher learning the subject of investigation. Given that some were unsuccessful, this issue is clearly important. The second issue related to the question of how to promote the learning of beginning teachers in ways that led to improved student outcomes. This literature focused primarily on ways to support beginning teachers and encourage them to stay in the profession rather than on ways to promote student learning. The third issue concerned the use of information technology to promote professional learning. Related evidence focused either on giving teachers the skills to use new technologies or on promoting student learning and engagement. We were unable to locate articles that linked teacher learning to student learning in this area.

In relation specifically to the New Zealand context, additional gaps were evident in the kinds of professional learning that promoted better outcomes for students attending Māori-medium schools and Pasifika students attending schools in any language medium.

Summary

This synthesis has identified a number of conditions and principles associated with professional learning that impacted substantively on student outcomes. In summary, such learning required teachers to engage with new knowledge that involved theoretical understandings—typically pedagogical content and assessment knowledge—and the implications of these for practice. The focus of this new knowledge was on the links between teaching and its impact on student learning. The professional learning environment provided teachers with extended opportunities to learn through a variety of activities, and assisted them to integrate new learning into alternative forms of practice. Meanings of new knowledge and the implications for practice were negotiated with providers and colleagues.

A number of contextual conditions were identified as necessary but not sufficient to promote the learning of content in the necessary depth. These conditions included:

- consistency with wider policy trends and research;
- an extended time for teachers to engage with new ideas and their implications for practice;
- experts external to the group who could present those ideas in ways that promoted teacher engagement;
- opportunities to engage in a range of learning activities;
- participation in a professional community that supported the new ideas and practice at the same time as it challenged existing ones and focused on teaching–learning links.

These conditions were *necessary* because teacher professional learning does not occur in a vacuum but in the social context of practice, and the kind of learning that impacts on student outcomes requires considerable challenge and support[65]. They were not, however, *sufficient* because at times they existed in ways that diverted participants from the central purpose of developing new learning that would lead to improved student achievement.

Two other important contextual conditions were a rationale or catalyst to participate and the engagement of existing theories of practice. Some of the most powerful outcomes arose when teachers accepted that their practice was not optimising students' learning opportunities.

Evidence that improved student outcomes were sustained once providers reduced or discontinued their contact with teachers was limited but consistent. Professional development that led to sustained better practice had a focus on developing teachers' pedagogical content knowledge in sufficient depth to form the basis of principled decisions about practice. This knowledge needed to be combined with evidence-based skills of inquiry so that teachers could identify next teaching steps and test if changes to practice were having the desired impact on students. Participants needed the organisational support of their schools in terms of the evidence base, collective goals to aim for, and circumstances that continued to motivate improvement.

References

1 OECD (2001). *Knowledge and skills for life: First results from the OECD Programme for International Student Assessment (PISA) 2000*. Paris, France: OECD Publications.

2 Black, P. & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment.* London: King's College.

3 Alton-Lee, A. (2003). *Quality teaching for diverse students in schooling: Best evidence synthesis.* Wellington, NZ: New Zealand Ministry of Education. Available at: www.minedu.govt.nz/goto/bestevidencesynthesis.

Aitken, G. & Sinnema, C. (2006). *Best evidence synthesis: Tikanga-a-iwi/Social studies/Social sciences.* Wellington, NZ: Ministry of Education.

Anthony, G. & Walshaw, M. (2006). *Best evidence synthesis: Characteristics of pedagogical approaches that facilitate learning for diverse learners in early childhood and schooling in pangarau / mathematics.* Wellington, NZ: Ministry of Education.

4 National Staff Development Council (2001). *National Staff Development Council's standards for staff development* (Revised ed.). Oxford: OH: Author. Available at: http://www.nsdc.org/library/standards2001.html.

5 **Lipman, P. (1997). Restructuring in context: A case study of teacher participation and the dynamics of ideology, race and power. *American Educational Research Journal, 34* (1), 3-37.**

Saxe, G. B., Gearhart, M., & Nasir, N. (2001). Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support. *Journal of Mathematics Teacher Education, 4*, 55-79.

Timperley, H. & Parr, J. (2006). Theory competition and the process of change. *Journal of Educational Change, 6* (3), 227-252.

6 Bond, L, Smith, T., Baker, W., & Hattie, J. (2000). *The certification system of the National Board for Professional Teaching Standards: A construct and consequential validity study.* Center for Educational Research and Evaluation. The University of North Carolina at Greensboro.

Vandevoort, L., Amrein-Beardsely, A., & Berliner, D. (2004). National board certified teachers and their students' achievement. *Education Policy Analysis Archives, 12* (46), 1-117.

7 Vandevoort, L., Amrein-Beardsely, A., & Berliner, D. (2004), loc. cit. (ref. 6).

8 Bond, L, Smith, T., Baker, W., & Hattie, J. (2000), op. cit. (ref. 6).

9 **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

10 Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.

11 Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. *Teaching and Teacher Education, 11* (1), 81-95.

Mason, D. A. & Good, T. (1993). Effects of two-group and whole-class teaching on regrouped elementary students' mathematical achievement. *American Educational Research Journal, 30* (2), 328-360.

12 Rowe, K., Pollard, J., Rowe, K. (2005). *Literacy, behaviour and auditory processing: Does teacher professional development make a difference?* Background paper to Rue Write Memorial Award presented at the Royal Australasian College of Physicians Scientific Meeting, Wellington, New Zealand, 8-11 May 2005.

13 ibid.

14 Cardelle-Elawar, M. (1995), loc. cit. (ref. 11).

15 Caulfield-Sloan, M. B. & Ruzicka, M. F. (2005). The effect of teachers' staff development in the use of higher-order questioning strategies on 3rd grade students' rubric science assessment performance. *Planning and Changing*, *36* (3/4), 157-175.

Maheady, L. & Harper, G. (1991). Training and implementation requirements associated with the use of a class-wide peer tutoring system. *Education and Treatment of Children*, *14* (3), 177-199.

Baker, S. & Smith, S. (1999). Starting off on the right foot: The influence of four principles of professional development in improving literacy instruction in two kindergarten programs. *Learning Disabilities Research & Practice*, *14* (4), 239-253.

16 Lipman, P. (1997), loc. cit. (ref. 5).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 10).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., PLC condition (ref. 5).

17 Van der Sijde, P. (1989), loc. cit. (ref. 9).

Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 9).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 10).

18 Stoll, L., Fink, D., & Earl, L. (2003). *It's about learning*. London: Routledge Falmer.

19 **Kennedy, M. M. (1998). *Form and substance in inservice teacher education*. Research Monograph No. 13. Madison, WI: National Institute for Science Education (NISE) Publications, University of Wisconsin-Madison.**

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies, 31* (2), 143-175.

20 Datnow, A., Foster, L., Kemper, E., Lasky, S., Rutherford, C., Schmidt, M., Stringfield, S., Sutherland, S., & Thomas, J. (2003). Five key factors in supporting comprehensive school reform. In N. Bascia & A. Cummins & A. Datnow & K. Leithwood & D. Livingstone (Eds.), *International handbook of educational policy* (pp. 195-215). New York: Kluwer.

21 Wilson, S. & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of research in education* (Vol. 24, pp. 173-210). Washington, D.C: AERA.

22 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream education. Phase 2: Towards a whole school approach* (Progress report and planning document). Wellington, NZ: Ministry of Education.

23 Table 10.1 lists the core studies relating to changes in teachers' social construction of students.

24 Kerman, S., Kimball, T., & Martin, M.(1980). *Teacher expectations and student achievement: Coordinator manual*. Bloomington, IN: Phi Delta Kappan.

25 Table 6.1 lists the core studies in mathematics that challenged the ways teachers understood mathematics and Table 7.1 lists core studies in science.

26 **Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23* (2), 145-170.**

Lipman, P. (1997), loc. cit. (ref. 5).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 5).

Timperley, H. & Robinson, V. M. J. (2001). Achieving school improvement through challenging and changing teachers' schema. *Journal of Educational Change, 2* (4), 281-300.

[27] A more in-depth analysis of professional learning communities is undertaken and referenced in topical issue 4 in Chapter 11.

[28] **Appalachia Educational Lab. (1994b). *Questioning and Understanding to Improve Learning and Thinking (QUILT): The evaluation results*. A proposal to the National Diffusion Network (NDN), documenting the effectiveness of the QUILT professional development program. Charleston, WV, Author (ED403229).**

Davis, A. (2006). *Characteristics of teacher expertise associated with raising the reading comprehension abilities of Years 5-9 students*. Unpublished doctoral thesis, University of Auckland, Auckland, New Zealand.

French, R. (2001). Great job, now do it better. *Journal of Staff Development, 22* (4), 26-28.

Goldenberg, C. and Sullivan, J. (1994). *Making change happen in a language minority school: A search for coherence.* (Educational Practice Report). National Center for Research on Cultural Diversity and Second Language Learning (pp. 1-25).

Hirshman, J. (1996). Lingelbach Elementary School: A case study of a chapter 1 school wide project. *Journal of Education for Students Placed at Risk, 1* (2): 135-146.

Moxon, J. (2003). *A study of the impact of the Restorative Thinking Programme within the context of a large multi-cultural New Zealand secondary school*. Unpublished masters thesis, The University of Auckland, Auckland, New Zealand.

Parke, H. M. & Coble, C. R. (1997). Teachers designing curriculum as professional development: A model for transformational science teaching. *Journal of Research in Science Teaching, 34* (8): 773-789.

Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision*, *18* (3), 240-258.

Stevens, R. J. and R. E. Slavin (1995). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. *American Educational Research Journal, 32* (2), 321-351.

Taylor, B., Pearson, D., & Rodriguez, M. (2005). The CIERA school change framework: An evidence-based approach to professional development and school reading improvement. *Reading Research Quarterly, 40* (1), 40-69.

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 26).

[29] Borman, G., Slavin, R. E. et al. (2005). Success for all: First-year results from the national randomized field trial. *Educational Evaluation and Policy Analysis, 27* (1), 1-22.

Fisher, D. (2001). Trust the process: Increasing student achievement via professional development and process accountability. *NASSP Bulletin, 85* (629), 67-71.

Hirshman, J. (1996), loc. cit. (ref. 28).

Phillips, J. (2003), loc. cit. (ref. 28).

[30] English, C. & Bareta, L. (2005). *Milestone 3: Literacy Professional Development Project*. Report to the Ministry of Education. Wellington, NZ: Ministry of Education.

French, R. (2001), loc. cit. (ref. 28).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005). *Findings from the New Zealand Numeracy Development Project 2004*. Wellington, NZ: Ministry of Education.

Norton (2001). A story breakthrough. *Journal of Staff Development, 22*(4), 22-25.

Taylor, B., Pearson, D., & Rodriguez. M. (2005), loc. cit. (ref. 28).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001). *Evaluation of the Literacy Leadership Initiative: The Enhancement Programme 2001*. Final report to the Ministry of Education. Wellington, NZ: Ministry of Education.

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 26).

[31] **Appalachia Educational Lab. (1994a). *Collegial investigations: Shared inquiry through disciplined discussion and action research.* Charleston, WV: Author (ED403229).**

Appalachia Educational Lab. (1994b), op. cit. (ref. 28).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies*. London, UK: DfES.

English, C. & Bareta, L. (2005), op. cit. (ref. 30).

Fresko, B., Robinson, N., Friedlander, A., Albert, J., & Argaman, N. (1990). Improving mathematics instruction and learning in the junior high school: An Israeli example. *School Effectiveness and School Improvement*, *1* (3), 170-187.

Goldenberg, C. and Sullivan, J. (1994), loc. cit. (ref. 28).

Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 28).

Phillips, J. (2003), loc. cit. (ref. 28).

Pritchard, R. J. (1987). Effects on student writing of teacher training in the National Writing Project model. *Written Communication*, *4* (1), 51-67.

Rau (2004). *He Matai Matatupu: Assessment for Māori medium literacy learning*. Unpublished masters thesis, The University of Waikato, Hamilton, New Zealand.

Schorr, R. & Firestone, W. (2004). Conclusion. In W. Firestone & R. Schorr & L. Mondils (Eds.), *The ambiguity of teaching to the test: Standards, assessment and educational reform* (pp. 159-168). Mahway, New Jersey: Lawrence Erlbaum.

Stevens, R. J. & Slavin R. E. (1995), loc. cit. (ref. 28).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 30).

Wilson, S., L. Darling-Hammond, L., & Berry, B. (2001). *A case of successful teaching policy: Connecticut's long-term efforts to improve teaching and learning.* Center for the Study of Teaching and Policy: University of Washington.

32 **Adey, P. (2006). A model for the professional development of teachers of thinking. *Thinking Skills and Creativity, 1* (1), 49-56.**

Goldenberg, C. & Sullivan, J. (1994), loc. cit. (ref. 28).

33 Earl, L., & Katz, S. (2005). *Learning from networked learning communities (phase 2): Key features and inevitable tensions*. Phase 2 report of the Networked Learning Communities External Evaluation. London: DfES.

34 **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 9).**

Van der Sijde, P. (1989), loc. cit. (ref. 9).

34 Stallings, J., & Krasavage, E. M. (1986), loc. cit. (ref. 10).

35 Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57* (1), 1-22.

36 Chapter 9 on Teachers' Social Construction of Students provides a description of these studies.

37 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 22).

38 Moreland, J. (2003). *Becoming effective technology teachers: Enhancing assessment practice in primary classrooms.* Unpublished doctoral thesis, The University of Waikato, Hamilton, New Zealand.

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final report). Wellington, NZ: Learning Media.

Phillips, J. (2003), loc. cit. (ref. 28).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 26).

39 **Moxon, J. (2003), op. cit. (ref. 28).**

40 **Phillips, J. (2003), loc. cit. (ref. 28).**

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 38).

Moreland, J. (2003), op. cit. (ref. 38).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 26).

41 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education*, *4* (3), 179-210.**

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 31).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal*, *30* (3), 555-583.

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.

Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005). *Changing futures: The influence of Reading Recovery in the United States*. Worthington, OH: Reading Recovery Council of North America.

Timperley, H., & Wiseman, J. (2003). *The Sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement.* Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

42 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 31).

Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 41).

43 Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77* (1), 81-112.

44 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 41).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 41).

45 McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 41).

46 **Kennedy, M. M. (1998), op. cit. (ref. 19).**

47 **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 9).**

Lipman, P. (1997), loc. cit. (ref. 5).

48 Lipman, P. (1997), loc. cit. (ref. 5).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 30).

49 **Phillips, J. (2003), loc. cit. (ref. 28).**

50 For reasons of space, these studies have not been listed separately.

51 Robinson, V. M. J. (1993). *Problem-based methodology: Research for the improvement of practice*. Oxford: Pergamon Press.

52 Lipman, P. (1997), loc. cit. (ref. 5).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 5).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 30).

53 Cazden, C. B. (1990). Differential treatment in New Zealand: Reflections on research in minority education. *Teaching and Teacher Education, 6* (4), 291-303.

Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 9).

Robbins, P. & Wolfe, P. (1987). Reflections on a Hunter-based staff development project. *Educational Leadership, 44* (5), 56-61.

Van der Sijde, P. (1989), loc. cit. (ref. 9).

54 Baker, S. & Smith, S. (1999), loc. cit. (ref. 15).

Caulfield-Sloan, M. B. & Ruzicka, M. F. (2005), loc. cit. (ref. 15).

Maheady, L. & Harper, G. (1991), loc. cit. (ref. 15).

55 Hammerness, K., Darling-Hammond, L., Bransford, J., Berliner, D., Cochran-Smith, M., McDonald, M., & Zeichner, K. (2005). How teachers learn and develop. In L. Darling-Hammond (Ed.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 358-389). San Francisco: John Wiley & Sons.

56 Schorr, R. & Firestone, W. (2004), loc. cit. (ref. 31).

57 Caulfield-Sloan, M. B. & Ruzicka, M. F. (2005), loc. cit. (ref. 15).

58 Personal communication, Lorna Earl, lead author of *Watching and learning 3*: *Final report of the external evaluation of England's National Literacy and Numeracy Strategies*. London, UK: DfES.

59 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 41).**

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 41).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 31).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 41).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 41).

Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 41).

Timperley, H., & Wiseman, J. (2003), op. cit. (ref. 41).

60 Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65* (3), 245-274.

61 Alton-Lee, A. (2003), op. cit. (ref. 3).

62 Anthony, G. & Walshaw, M. (2006), op. cit. (ref. 3).

63 Aitken, G. & Sinnema, C. (2006), op. cit. (ref. 3).

64 Scher, L. S. & O'Reilly, F. E. (2007). *Understanding professional development for K-12 teachers of math and science: A meta-analysis*. Paper presented at the American Educational Research Association Annual Meeting, Chicago.

65 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 31).

1. Context

Quality teaching has a significant influence on a range of student outcomes[1]. While teachers' influence is moderated by a number of other factors such as students' prior learning and family contexts, it is teaching that is the greatest system influence. If teachers are to exercise this influence effectively, then they, like their students, need opportunities to deepen their understandings and refine their skills. As Smylie[2] noted, "We will fail … to improve schooling for children until we acknowledge the importance of schools not only as places for teachers to work but also as places for teachers to learn" (p. 92). The need for ongoing learning arises because teaching challenges do not remain static. Changing student demographics and an ever-changing knowledge base mean that teachers need to be kept, and to keep, abreast of current evidence about how best to meet the learning needs of their students. The central question explored in this synthesis is "What kinds of professional learning opportunities for teachers result in an impact on student outcomes?"

This Best Evidence Synthesis iteration on Teacher Professional Learning and Development was commissioned by the New Zealand Ministry of Education to consolidate the evidence around the emerging knowledge base on how to promote teacher learning in ways that impact on outcomes for diverse students. This synthesis of evidence about what works and does not work in professional learning and development is crucial if we are to have more than the latest fads driving our education system. The knowledge base pertaining to professional development is relatively recent and much of it is based more on professional preference than what is known to be effective. As one person centrally involved in professional development in New Zealand explained, "Ten years ago we were not allowed to go into teachers' classrooms. It just wasn't acceptable."[3] It is only as teacher educators are able to work with teachers in their practice contexts that we can begin to open the black box between the professional learning opportunities provided for teachers and the impact that these have on teaching practice and outcomes for students.

This synthesis draws as widely as possible on the international evidence related to professional learning and development with documented student outcomes. In accordance with *Guidelines for Generating a Best Evidence Synthesis Iteration*[4], its primary purpose is to inform the New Zealand educational context. A number of distinguishing features of New Zealand education that need to be taken into account when interpreting the evidence are described in the first part of this chapter because so much of what happens within schools is influenced by the communities and systems in which they are located. The chapter finishes by addressing the issues of audience and providing an overview of the rest of the synthesis.

1.1 New Zealand context

We have identified three main features of the New Zealand context in relation to professional learning and development: its self-management administrative structures; its particular student achievement profile (compared with the profiles of other OECD countries); and the special place of Māori in relation to the education system. These contextual features are described briefly below.

1.1.1 Educational administration structures

Prior to 1989, professional development was determined primarily by national and district authorities, who decided what should be provided and who should participate. Legislation in 1989 located responsibility for operational decisions, including the provision of professional development, in each school, under the governance of locally elected boards of trustees. (This does not, of course, preclude teachers attending courses in their own time at their own expense.) These governance arrangements mean that professional development and learning priorities are not imposed on schools[5]; rather, they are determined by and within each school. Schools can be invited to participate in nationally sponsored professional learning opportunities, but cannot be compelled unless the circumstances are exceptional.

1.1.2 Profile of student outcomes

A particularly urgent issue facing the New Zealand education sector is the need to promote teacher learning opportunities in ways that impact on student outcomes. International comparisons of student achievement in the compulsory school sector have, over a 15-year period, revealed an unchanging and concerning picture. In literacy, New Zealand students typically perform very well in international comparative studies but have one of the largest 'spreads' of any OECD country[6], representing ethnically stratified disparities.

This pattern has changed little since the International Education Assessment (IEA) and the Reading Literacy study in 1990[7] first identified the problem. The findings of these two studies have since been replicated in a number of other international studies including the Programme for International Student Assessment studies (PISA) in 2001[8] and 2005[9] and the Progress in International Reading Literacy Study (PIRLS)[10]. Both the PISA and PIRLS studies were snapshots in time but the same patterns were apparent in the TRENDS study that partly replicated the 1990–91 IEA Reading Literacy study in 2001[11]. Little had changed in 10 years and an analysis of asTTle results shows this pattern is similar for mathematics.

1.1.3 Treaty of Waitangi obligations

The third key feature of the New Zealand context relates to Māori as tangata whenua and the role education has to play in meeting Treaty of Waitangi obligations. The Treaty is recognised as the founding document of New Zealand as a nation and guarantees particular equalities for Māori. The over-representation of Māori in the lower achieving bands described above indicates that these obligations have not been adequately met. A central consideration for this synthesis, therefore, is to understand the issues that need to be addressed in the professional development and learning opportunities provided to teachers in both Māori- and English-medium schools, as Māori students attend both.

In a context of language regeneration, as is the case with Māori, there is a danger that what is taught in te reo (the Māori language) in Māori-medium schools will be a 'translation' of concepts and pedagogies from the dominant English language rather than a development of such concepts from the perspective of Māori beliefs, with appropriate linguistic referents[12]. This problem was evident in Te Poutama Tau[13], a numeracy professional development project that was developed first in English and then in Māori. A linguist was employed to ensure that translations were consistent with indigenous understandings of numeracy. Extra time was needed in professional development sessions to build teachers' linguistic competence and cultural understandings.

Other 'translation' problems have surfaced, affecting Māori in English-medium schools. In the case of Te Kauhua[14], a professional development project for teachers of Māori students, there was considerable debate as to what counted as successful outcomes for students from the particular iwi or communities involved. It cannot be assumed that mainstream achievement values such as those identified in the New Zealand curriculum are necessarily the ones most highly prized by Māori. This report noted that other achievements valued by the Māori community included: success of the group as well as the individuals in it[15]; cooperative and whānau-based accomplishments that encompass physical, emotional, and spiritual as well as intellectual growth[16]; excellence in the Māori world through the Māori language and body of knowledge, together with excellence in the wider/global world and the English language[17]; and the development of a strong sense of what it means to be Māori[18].

The evaluation of Te Kauhua also documented another issue that is central to the professional development of teachers who teach Māori students in English-medium schools. It became apparent to the independent researchers that profiles of lower average achievement often led to lower teacher expectations of Māori students. It is well recognised that low expectations lead to low achievement[19], so these need to be addressed if student outcomes are to improve and improvement is to be sustained.

Preliminary research by Te Kotahitanga[20], another project based in secondary schools, also uncovered problems with teacher expectations: in particular, the way teachers theorised about Māori students and the assumptions that teachers made about the causes of low achievement, absenteeism, and disruptive behaviour. It found that principals, students, and whānau all believed that the beliefs and actions of the other groups were the primary reason for lower Māori achievement and that, as a consequence, responsibility for overcoming learning and achievement problems did not rest with them. These findings indicated a need to address how teachers think about Māori students and to develop an understanding of the interdependent responsibilities of teachers, students, and whānau.

1.2 Issues of audience

To be useful, this synthesis needs to be accessible to multiple audiences, as different levels of the system and groups within each level have an interest in facilitating professional learning and development. If, however, the greatest single lever for achieving positive outcomes for students is the quality of teaching, the most important audience for this synthesis is teachers. If teachers are motivated to learn and understand the conditions that optimise their own learning, the likelihood of improvement is maximised. School leaders are in a position to optimise or limit such opportunities to learn. As Guskey[21] maintains, to maximise the impact of professional learning opportunities, barriers between teachers and administrators need to be removed so that they can work together as partners in improvement. So school leaders are another important audience.

External providers are often responsible for the professional development opportunities made available to teachers, so they should be vitally interested in the findings. These providers include universities (which are often responsible for credentialling teacher learning and researching its impact), school support services, and consultants. Although less directly involved, policy makers also need to understand the conditions that optimise professional learning so that policy levers can be operated in ways that promote a healthy system. We contend that a healthy system is one that engages teachers at all levels in continuous learning, with the aim of improving the quality of education offered to the full diversity of our students.

1.3 Organisation of the synthesis

The first three chapters form the introduction to the synthesis. The first two introduce its purpose and provide a theoretical framework for thinking about professional learning and development. The meaning of the term 'professional learning' (more commonly, 'professional development') is central to the synthesis; a definition and understandings are developed in the second chapter. Guskey[22] defines professional development as "those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (p. 16). It is an intentional, ongoing, and systematic process. Over time, the term 'professional development' has taken on connotations of delivering some kind of information to teachers in order to influence practice whereas 'professional learning' implies an internal process through which individuals create professional knowledge[23]. The two, however, are closely intertwined, for without professional learning, professional development is unlikely to have any impact, so any well-constructed professional development experience should be designed to promote learning. In this synthesis, therefore, the idea of professional learning is considered to be an umbrella term under which professional development of the 'delivery' kind is just one part. There are many situations and opportunities for teachers to learn, ranging from policy changes and related information dissemination, and carefully constructed opportunities to learn, through to talking to one's colleagues about a problem of practice.

Neither teachers nor students are homogeneous groups. Chapter 3 discusses diversity and its implications for this analysis. A related issue is outcomes for students: what are they, and which are desirable? Like ‘professional learning’, ‘student outcomes’ is an umbrella term and incorporates social outcomes (behaviour, interactions with peers and teachers), academic outcomes (engagement in learning tasks and in school), and personal outcomes (identity, self-esteem, self-concept).

Chapters 4 and 5 are dedicated to explaining how the theory articulated in Chapters 1–3 links with our analytic methodology and descriptions of student outcomes. Chapter 4 discusses methods and procedures. Chapter 5 discusses the range of student outcomes and the effect sizes for the studies that met our methodological criteria.

Chapters 6–10 comprise the synthesis proper and begin to answer the central question, ‘What is the impact of professional learning opportunities on student outcomes?’ The answer emerges from an analysis of the key features of the professional development detailed in those studies that met our criteria for methodology and outcomes. Each of the five chapters has a different focus: professional learning in mathematics, science, and literacy; changing approaches to pedagogy across the curriculum; and teachers’ social construction of students. We conclude this part of the synthesis by identifying the evidence related to five topical issues: the multiple roles that assessment can play in promoting teacher learning; leadership and professional development; the role of teacher theories; the attributes of effective professional learning communities; and an analysis of studies related to secondary school education.

Chapter 11 is a discussion of the conditions that lead to the sustainability of outcomes for students. The evidence base for sustainability is not strong, so any conclusions here are in the nature of conjectures. Chapter 12 discusses gaps in the body of literature about professional learning.

Appendix 1 presents a series of cases designed to provide a more integrated perspective on professional learning and development. Appendix 2 provides technical information about our methodology.

References

1 Alton-Lee, A. (2003). *Quality teaching for diverse students in schooling: Best evidence synthesis.* Wellington, NZ: New Zealand Ministry of Education. Available at: www.minedu.govt.nz/goto/bestevidencesynthesis.

Hattie, J. (2003). *New Zealand education snapshot: With specific reference to the Years 1-13.* Paper presented at the Knowledge Wave 2003: The leadership forum, Auckland, New Zealand.

Nye, B., Konstantopoulos, S., & Hedges, L. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26* (3), 237-257.

2 Smylie, M. A. (1995). Teacher learning in the workplace: Implications for school reform. In T. R. Guskey & M. Huberman (Eds.), *Professional development in education: New paradigms and practices* (pp. 92-113). New York: Teachers College, Columbia University.

3 Personal correspondence, professional development facilitator.

4 Alton-Lee, A. (2004). *Guidelines for generating a best evidence synthesis iteration 2004*. Iterative Best Evidence Synthesis Programme. Wellington, NZ: Ministry of Education.

5 Sections 75 and 76 of the Education Act 1989 stipulate that “except to the extent that any enactment or the general law of New Zealand provides otherwise, a school’s Board has complete discretion to control the management of the school as it thinks fit”.

6 OECD (2001). *Knowledge and skills for life: First results from the OECD Programme for International Student Assessment (PISA) 2000*. Paris, France: OECD Publications.

Ogle, L., Sen, A., Pahlke, E., Jocelyn, L., Kastberg, D., Roey, S., & Williams, T. (2003). *International comparisons in fourth-grade reading literacy: Findings from the Progress in International Reading Literacy Study (PIRLS) of 2001.* Washington, DC: US Department of Education, NCES.

7 Elley, W. B. (1994). *The IEA Study of reading literacy: Achievement and instruction in thirty-two school systems.* Oxford: Pergamon.

8 OECD (2001), op. cit. (ref. 6).

9 OECD (2005). *PISA 2003 Technical report*. Paris: Organization for Economic Co-operation and Development.

10 Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., & Kennedy, A. M. (2003). *PIRLS 2001 international report: IEA's study of reading literacy achievement in primary schools.* Chestnut Hill, MA: Boston College.

11 Martin, M. O., Mullis, I. V. S., Gonzalez, E. J., & Kennedy, A. M. (2003). *Trends in children's reading literacy achievement 1991-2001: IEA's repeat in nine countries of the 1991 reading literacy study.* Chestnut Hill, MA: Boston College.

12 Hohepa, M. K. (2000). Issues in the production of written Māori text. In J. Soler & J. Smith (Eds.), *Literacy practices: Yesterday and today* (pp. 58-72). Auckland: Pearson International.

Pereira, J. A. (2001). *Culture, language and translation issues in educational assessment: Māori immersion students in the National Education Monitoring Project.* Unpublished masters thesis, University of Otago, Dunedin, New Zealand.

13 Christensen, I. (2003). *An evaluation of Te Poutama Tau*. Wellington, NZ: Ministry of Education.

Trinick, T. & Stephenson, B. (2005). An evaluation of Te Poutama Tau 2004. In J. Higgins & K. Irwin & G. Thomas & T. Trinick & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Project 2004* (pp. 56-65). Wellington, NZ: Ministry of Education.

14 Tuuta, M., Bradnam, L., Hynds, A., Higgins, J., & Broughton, R. (2004). *Evaluation of the Te Kauhua Māori mainstream pilot project* Wellington: Ministry of Education.

15 Education Review Office (1999). *Good practice in far north schools.* Wellington, NZ: Education Review Office.

16 Hirsch, W. A. (1990). *Report on issues and factors relating to Māori achievement in the education system.* Wellington, NZ: Ministry of Education.

17 Smith, G. (1992). *Tane-nui-a-rangi's legacy ... Propping up the sky: Kaupapa Māori as resistance and intervention.* Auckland: Research Unit for Māori Education, University of Auckland.

18 Durie, M. H. (1994). Planning for Māori futures. In R. Capper & A. Brown & W. Ihimaera (Eds.), *Kaupapa New Zealand Vision Aotearoa.*

19 Delpit, L. (1995). *Other people's children: Cultural conflict in the classroom.* New York: The New Press.

20 Bishop, R. & Berryman, M. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream schools* (Progress report and planning document). Wellington, NZ: Ministry of Education.

21 Guskey, T. R. (2000). *Evaluating professional development.* Thousand Oaks, CA: Corwin Press.

22 Ibid.

23 Hannay, L., Mahony, M., & MacFarlane, N. (2004). *Reconstructing professional knowledge: The essence of successful educational reform.* Paper presented at the British Educational Leadership, Management and Administrative Society, Oxford University, England.

2. Processes and Outcomes of Teacher Learning

Teachers in New Zealand, as in other countries, are diverse and have diverse learning needs. Demographic descriptions of age structures and teaching contexts provide some limited information about these needs. Teachers new to the profession, for example, clearly have learning needs that are different from those of their more experienced colleagues. Beyond this relatively superficial level of analysis, this type of information cannot tell us much. The number of teachers new to the profession does not tell us anything about the learning experiences they bring from their pre-service education programmes.

One of the problems in identifying diversity issues within teacher groups involved in professional development is that the impact on individuals is often 'washed out' in reports that summarise teacher reactions and average data. Yet several in-depth studies that have taken diversity as a central theme have found that the same professional development experience can result in very different outcomes for teachers. For example, in a large federal study in United States secondary schools, involving teachers learning how to use 'teaching for understanding' pedagogy, McLaughlin and Talbert[1] found that the participants fell into three distinct groups. One group of teachers did not adapt at all and continued teaching as they had always done, blaming the students for not learning. A second group adapted negatively by lowering standards. Both of these groups felt that what was wrong with their schools lay in student deficiencies. The third group of teachers diagnosed the reason for poor performance as a lack of fit between traditional classrooms and contemporary students. These teachers found new ways to teach to high standards and engage students.

Two recent in-depth studies in New Zealand[2] showed similarly that teachers can react in very different ways as a result of engaging in the same professional learning activities. In these two projects, some teachers were positive about the experience, understood the significance of key messages, and were able to enact them within their classroom practice. Others were negative, rejected the relevance of key messages, and continued with habitual practices.

Another issue when determining teacher learning needs is that having expertise in one situation does not necessarily translate into expertise in another. Changing contexts, created by evolving student demographics and the development of new research knowledge, may render today's expertise inadequate for teaching tomorrow's citizens. Changing ideas about what kinds of learning are to be valued may have a similar effect. For example, a science teacher skilled at transmitting content may not have the skills to teach effectively in a system that values inquiry over the learning of facts.

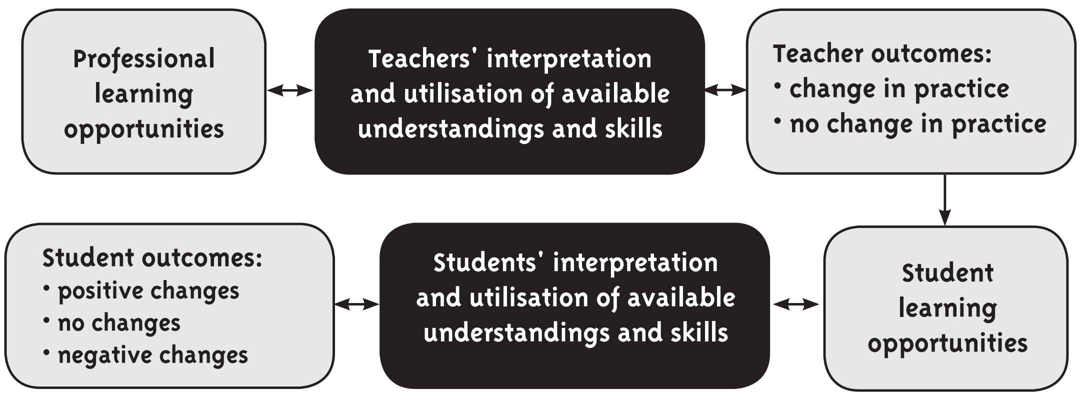
What is most important for this Best Evidence Synthesis is to recognise that, within any group of teachers, there are diverse professional learning needs. What needs to be learned depends on both the prior learning, skills, and dispositions of individuals and groups, and the demands of their current teaching context, because different practice contexts require different skills. For example, teachers who move from English-medium to Māori-medium schools face complex linguistic issues and have new vocabulary to acquire. Similarly, a teacher who is teaching at a particular year level for the first time has to get to grips with new sets of understandings related to students' developmental progressions.

2.1 Black boxes

In education, considerable effort has been directed at understanding the 'black box' between acts of teaching and what students learn[3]. There is no direct relationship between teaching inputs and student learning because *how* students interpret and utilise the available information determines *what* they learn. The synthesis on teaching for diverse student learners[4] contributed substantially to uncovering the processes and possibilities within that black box. The pāngarau/ mathematics[5] and social sciences[6] syntheses will add to this knowledge for specific curriculum areas.

This current synthesis faces an even more demanding task in that a second black box is added to the process. It is situated between professional learning opportunities and their impact on teaching practice. Little is known about how teachers interpret the understandings and utilise the particular skills made available through professional learning opportunities, and about the consequent impact on teaching practice, except that the relationship is far from simple. How teachers change their practice, of course, impacts on student outcomes. Figure 2.1 illustrates the processes and the parallels.

Figure 2.1. The black boxes of teacher and student learning



The major challenge of this synthesis is to unpack the black box between professional learning opportunities and teacher outcomes that impact positively on student outcomes. A major factor to be considered is the extent to which new information is congruent with existing understandings[7]; congruent information is more likely to be understood and acted on than that which is dissonant. The extent to which new information is used is strongly influenced by the extent to which conceptual understandings and practical resources offered through the learning experience make sense to the recipients in terms of their existing understandings and practice contexts[8]. In addition, what occurs at any point in the process feeds back and influences other parts. Student learning outcomes, for example, may influence teachers' practice. In the remainder of this section we identify the learning processes likely to lead to different teacher interpretations and utilisation of available understandings and skills, and typical teacher reactions. These processes have been used to develop a theoretical framework for synthesising the empirical studies.

2.2 Professional learning processes

Three professional learning processes and their associated outcomes are proposed: cueing and retrieving prior knowledge, becoming aware of new information and skills, and creating dissonance with a teacher's current position. These processes are not mutually exclusive: all may be present in a given professional learning opportunity. The three processes and their associated outcomes are set out in Figure 2.2.

The first process, cueing prior knowledge, occurs when the professional learning experience serves to surface for teachers what they already know. The second involves developing teachers' awareness of information and skills that are consistent with their current values and beliefs. This may occur at a relatively superficial level, or involve deeper learning. The final process involves creating dissonance with a teacher's current position and is activated when what is currently known and believed is incongruent with what is proposed. The more inclusive term, 'position', is used in this third process instead of 'knowledge' because knowledge is only one component of possible dissonance. Incongruities are also likely to involve attitudes and values and cover a range of possibilities, such as the nature and motivations of students, forms of effective pedagogy, and what might count as important curriculum content.

Figure 2.2. Teacher learning processes and outcomes

(Iterative) Learning Processes	
The learning processes engaged when developing new understandings and skills involve cycles of (one or more of) the following:	
Process 1	Cueing and retrieving prior knowledge *Outcome:* Prior knowledge consolidated and/or examined
Process 2	Becoming aware of new information/skills and integrating them into current values and beliefs system *Outcome:* New knowledge adopted or adapted
Process 3	Creating dissonance with current position (values and beliefs) *Outcome:* Dissonance resolved (accepted/rejected), current values and beliefs system repositioned, reconstructed

The associated outcomes for the three processes in Figure 2.2 are: consolidating and/or examining prior knowledge, adapting or adopting new knowledge, and resolving dissonance by accepting or rejecting the new position. The processes are described as 'iterative' because deeper learning typically requires repeated cycles of engagement with learning processes, practice, and outcomes. However, in the heading to the figure, 'iterative' is bracketed because many of the learning opportunities in which teachers engage do not allow for multiple cycles of learning. For example, a national survey by the United States National Staff Development Council reported in 2001[9] that in nine out of ten content areas, most teachers said that they had spent one day or less on professional development during the previous year.

The separation of learning processes into three categories is an organising device to assist with identifying key features of effective learning situations, not a depiction of a tidy reality. Learning processes in any given situation are highly complex, likely to take different forms for different participants, and may involve a single process or a mix of all three.

In presenting this model of learning, we make the underlying assumption that adult professional learning is fundamentally similar to that of student learning[10]. It is not intended to discount the obvious differences between adult and student learning situations, such as the richer life experiences from which adults draw, the learning contexts in which they occur, and the greater demand adults place on the relevance of learning in order to engage[11]. Rather it is assumed that the underlying processes and the conditions that promote them are similar in each case.

2.2.1 Process 1: Cueing prior knowledge

In any learning situation, participants arrive with preconceptions about how the world works[12]. The richer the participants' prior experience, the more extensive and complex those preconceptions are likely to be. Experienced teachers do not approach professional learning situations as empty vessels, but as people who have rich theories about how students learn, how best to teach them, and what comprises desired content and outcomes. Messages about expectations to change, therefore, "are not inert, static ideas that are transmitted unaltered into local actors' minds to be accepted, rejected, or modified to fit local needs and conditions"[13] (p. 92). Prior theories have a powerful effect on how the learning experiences are understood and how the relevant understandings are integrated into practice.

The process of cueing prior knowledge is most likely to result in the retrieving and possibly the consolidating of this knowledge. If the professional learning experience stops at this point, teachers are likely to respond with "I already knew that," possibly adding "… but it was useful to revisit it", but with little substantive change in practice.

Cueing and retrieving prior knowledge can, however, serve to lay a foundation for the other two processes. Donovan and colleagues highlight its importance as a starting point for new learning, making such engagement the first of their three key findings about how people learn [14]. Engagement goes beyond cueing and requires exploration and understanding, so that both teacher and learner can negotiate the meaning of new information in relation to existing knowledge and skills. At times, the new knowledge and skills will be consistent with current understandings and values (Process 2) and at other times they will be dissonant (Process 3).

Robinson and Lai[15] explain the importance of engaging teachers' prior understandings in any change situation. In their view, teaching practice can be thought of in terms of solving problems: how to manage and engage students, how to teach particular content, and how to do it all within the available time and resources. How best to solve these problems is decided, usually on the run, according to an integrated theory of action based on a coherent set of beliefs, values, and practical considerations, and is strongly influenced by a teacher's history. Most of this problem solving, using personal theories of action, is tacit and routine, not conscious and deliberate. Professional learning experiences that seek to change practice need to interrupt these routines and help teachers to understand the theories of action underpinning them, to examine what is tacit and routine (so that they can evaluate its adequacy), and to decide what should be changed. If such engagement does not occur, it is likely that new learning will fail to be integrated adequately with existing theories and, as a consequence, be rejected because it does not 'fit' with current practice or be interpreted according to existing theories of action and adapted so that it barely resembles what was intended.

2.2.2 Process 2: Developing an awareness of new information

This process, with its associated outcomes of adopting/adapting new knowledge in the practice situation, can involve either superficial or more substantive learning[16]. Given the prevalence of the one-day professional development model, at least in the United States[17], it seems likely that professional learning is often seen in terms of one-off opportunities to acquire relatively discrete pieces of knowledge and new skills that can be easily translated into practice[18] (p. 415). The popularity in New Zealand of one-day, school-based workshops presented by consultants, and conferences with both international and local speakers, suggests that such a view is also common here. The research evidence, however, fits more closely with Phillips'[19] conclusion that this kind of training is inadequate for those requiring challenging, advanced instruction. Phillips condemns most current staff development as "intellectually superficial, disconnected from deep issues of curriculum and learning, fragmented, and non-cumulative"[20] (p. 258).

Developing an awareness of new information (Process 2) need not, however, be restricted to the superficial acquisition of knowledge and skills; it may involve more substantive development and change. The essential element of Process 2 is that the new information is consistent with current values and beliefs and does not create dissonance with the learner's current understandings of their practice context.

Process 2 does not presume engagement with prior knowledge (Process 1), but neither is it antithetical to it. In one-off opportunities to learn, it is unlikely that teacher educators will be able to engage prior knowledge in any depth because there is not enough time. Extended opportunities to learn are likely to provide greater possibilities for engagement and for meanings to be negotiated between the learner and the provider. It cannot be assumed, however, that greater time will ensure deep interaction because such interaction depends on the theories of learning of those providing the learning opportunities, and whether they value such engagement.

The next two subsections of this chapter consist of discussions of issues around the 'one-off' and 'extended opportunities to learn' approaches within Process 2.

2.2.2.1 One-off opportunities to learn (Process 2)

One-off opportunities may be adequate if the learning involves relatively straightforward transmission of information or increased awareness of new ideas. The limitations of the one-off approach, however, have been documented extensively, with two issues at the heart of the criticism. The first concerns the complexity of teaching as an activity and the in-depth understandings required for the integration and retrieval of new knowledge in diverse situations. Donovan, Bransford, and Pellegrino[21] identify the importance of a deep foundation of knowledge as one of their three key findings relating to how people learn. This deep foundation includes understanding how that knowledge fits into conceptual frameworks, and organising it in a way that facilitates its retrieval and application. They note that professional learning situations rarely provide opportunities for participants to acquire this depth of knowledge.

The second, related issue is described by Kennedy[22] as "the problem of enactment"; that is, translating what is learned into an individual's particular teaching context. In a video analysis of teaching practice and its underpinning beliefs in the United States, Kennedy[23] identified how decisions about lesson content and process were influenced by many things, not just the agenda of those who hoped that teaching might change. These other influences were strong determinants of practice even when the teachers agreed with the change agenda. At any given moment, classroom activities were determined by a complex interplay of teachers' beliefs about important content and how students learn and their concerns about their students' willingness to participate. Teachers' actions were also influenced by their interpretation of a particular situation in terms of specific events and more general conditions, and by what they wished to accomplish, and what they wanted to avoid.

Kennedy identified three important constraints that limited teachers' implementation of reform practices. The first, the need for more rigorous and important content, was difficult for teachers to translate into practice because they had no specific criteria for determining what might count as important in the bigger picture. As a result, the content they chose to teach at any given moment was that which appeared to be the most appropriate in the situation, independent of the bigger picture. The second, the need for more intellectual engagement, conflicted with their concern that demands for high levels of intellectual challenge could hinder lesson momentum (and reduce engagement) and also prevent them from finishing lessons on time. The third, making knowledge accessible to all students, was interpreted as encouraging the participation of all students. At times, increasing participation meant reducing the level of intellectual engagement in order to manage participation. These influences, in combination, made it difficult for teachers to implement what the reformers desired.

2.2.2.2 Extended opportunities to learn (Process 2)

The more substantive concept of professional learning in Process 2 is underpinned by the metaphor of professional growth and the concept of 'novice-to-expert' developmental progressions[24]. Although this model was developed by studying how new teachers changed their practice over time as they gained experience, the idea of developmental progressions is applicable whenever new skills or knowledge are the subject of the professional learning experience[25]. The novice is someone who perceives the unfamiliar teaching situation in terms of discrete elements and, in making use of new skills and knowledge, relies on rules rather than an integrated vision of practice. The primary focus is on the self and one's performance. As competence develops, the discrete elements become integrated into patterns, with some aspects becoming automatic and the teacher less reliant on rules. In contrast, experts have a more holistic grasp of relationships within a particular context and fluidly and efficiently solve problems as they arise. The resources on which they are able to draw are much richer. Within this framework, the role of a provider of professional learning opportunities is to assist teachers to reach higher levels of expertise. The most frequently reported outcome of professional development, changes in practice, is consistent with this thinking.

2.2.2.3 Important conditions for creating effective extended opportunities to learn (Process 2)

Studies underpinned by assumptions about the need for substantive learning and professional growth have identified a number of important conditions in professional learning situations that we considered when constructing the framework for analysing the empirical studies in this synthesis. Although the first set of conditions is more cognitively oriented and the second set more focused on sociocultural contexts, none can be considered in isolation. Cognition is shaped not just by new information but by social, emotional, and cultural processes.

Of the more cognitively oriented conditions, one relates to the importance of developing conceptual frameworks into which new information can be integrated and of teacher learners being able to apply the available information and skills[26]. As noted above[27], teachers do not implement discrete bits of practice independent of an integrated set of beliefs and the practical constraints of their classrooms, so it is important that new understandings are presented in terms of a coherent conceptual framework. New conceptual frameworks, however, do not get transplanted into learners' minds independently of existing frameworks. Like any new understandings, they are adapted and adjusted according to current understandings. At the same time, such understandings are strongly shaped by the contexts in which teachers practise and learn:

> The physical and social contexts in which an activity takes place are an integral part of the activity, and the activity is an integral part of the learning that takes place within it. How a person learns a particular set of knowledge and skills and the situation in which a person learns become a fundamental part of what is learned.
>
> (Putman and Borko[28], p. 4)

Teaching practice, therefore, both shapes teachers' conceptual frameworks and is shaped by them.

Context extends well beyond an individual teacher in a particular class. Part of the teacher's context is the broader organisational and social situation that influences how they make sense of new information[29]. Social influences can range from the more distant political environment and related policies, to the types of literature accessed and/or colleagues with whom the teacher interacts each day.

Knapp[30] found that policy can influence professional learning in a variety of ways. These include: providing general messages about purposes and what is important; regulation and requirements for both professional development and teaching-related activities; allocations of money, time, and available expertise; provision of information; incentives in terms of sanctions and rewards; and assistance available in terms of structures, personnel, and associated resources. The influence of policy and any other professional learning opportunity, however, is strongly mediated by the more immediate social interactions among teachers as they negotiate the meaning of the information provided. These negotiations may hinder or facilitate professional learning opportunities[31].

Teaching and learning to teach are also about ‘emotional practices’[32]. Expectations to change practice may touch raw nerves because they are likely to impinge on teachers’ sense of professional identity and competence. Stoll, Fink, and Earl[33] describe how “neglecting emotions can close people up to learning, and lead teachers to behave defensively to protect themselves from situations that they might feel expose their ‘inadequacies’” (p. 85). More than a decade ago, Gene Hall and colleagues[34] introduced the notion of C-BAM (Concerns-based Adoption model) as a way of understanding the relatively predictable stages that teachers go through when introduced to innovations to practice—the essence of professional learning experiences. They demonstrated that teachers typically move from a period of personal concern (‘What will this do to me and my world?’) to a stage of management concerns, where the focus is on ‘doing’ the innovation. Only when teachers are emotionally comfortable with the innovation can they begin to adapt and adjust the new practice to particular students and contexts. The way in which these stages are conceptualised is consistent with the notion of novice-to-expert developmental progressions.

The final important condition identified in the professional growth paradigm of Process 2 is motivation. While motivation plays a key role for all learners, as adults, teacher learners are less likely than school-aged students to engage in new learning experiences if they do not see the relevance to their professional lives[35]. The immediate demands of everyday teaching inevitably compete with the demands of professional learning. For busy and often overworked teachers to devote effort to engaging with new learning and changing their practice, they need a good reason. Faced with a new teaching strategy, teachers want to know that it is practical and useful[36] and they are unlikely to sustain their involvement if the learning experience is not sufficiently meaningful.

2.2.2.4 Limitations of Process 2

Process 2 identifies key conditions relevant to professional learning but, as a process, has two major, related limitations. The first is that the integrated practice of experts may not be effective in creating the desired outcomes for students. When searching for empirical material for this synthesis, we found that studies documenting changes in teaching practice were far more common than studies documenting outcomes for students. An underlying assumption appeared to be that professional growth and changed practice were sufficient in themselves. However, it was a concern that a number of other studies found that such changes had a neutral or even negative impact on students[37] and that teacher self-reports of positive emotional and motivational indicators were not necessarily related to student outcomes[38]. It cannot be assumed that changing practice—however effective the new practice may appear to be—and helping teachers to feel competent about doing so will result in improved outcomes for students.

> If we are to make a difference to students, improving teaching practice should not be considered an end in itself but should be judged according to the impact on students.

The second limitation is that dissonance between the theoretical frameworks that underpin existing practice and into which new practice must be integrated may be a problem. Effective professional learning may require key assumptions to be challenged. Constructed meanings that incorporate new information are likely to be closely aligned with prior conceptual frameworks.

Yet these conceptual frameworks are often problematic, and a challenge to them may be a challenge to one's beliefs about the purposes of education, to one's professional identity, and to what it means to be an effective teacher. Spillane[39] found, when investigating a maths reform in the USA, that if teachers "... are to get to the core reform ideas, [they] have to question, unlearn and discard much of their current, deeply rooted understandings of teaching, learning and subject matter" (p. 154).

For this reason, a third process with associated outcomes has been added to Figure 2.2, one that differentiates between situations where new understandings and skills are needed because the existing ones are limited, and those where teachers already have a rich tapestry of understandings and skills, but better outcomes for students are dependent on the reconstruction of those understandings.

2.2.3 Process 3: Creating dissonance

Professional learning for experienced teachers is very different from professional learning for pre-service teachers because the former group bring with them a wealth of knowledge and well-formed positions on all manner of matters related to teaching. While all professional learners have had experience of being taught and bring with them a set of beliefs and understandings about teaching and learning, the more extensive repertoire of experienced teachers means they have a greater wealth of ideas on which to draw. These ideas may be an asset in terms of acquiring and integrating new knowledge following relatively brief engagement with professional learning opportunities, but this is likely to be the case only when the new information is consistent with current values, beliefs, and practices. When new information challenges previously held beliefs and values, dissonance is created. Dissonance, according to Hannay and Ross[40], challenges tacit knowledge, creates philosophical tension, and requires current knowledge to be reconstructed. Reconstruction of professional knowledge is more difficult than its original construction; some authors go so far as to claim that most professional learning requires some disequilibrium and emerges only from occasions when teachers' extant assumptions are challenged[41].

One of the difficulties involved in challenging current values and the beliefs on which practice is based is that they are usually tacit rather than explicit[42]. While explicit knowledge is articulated in formal language and, therefore, more easily expressed, tacit knowledge is often intuitive, involving such intangible factors as personal beliefs, perspectives, and value systems, and it may never have been articulated[43]. Tacit knowledge is built up over time and embedded in personal experience. It is accepted because it is known to work, but it can be a deterrent to creating change because it is often unexamined and unquestioned[44].

Because an individual's educational values and beliefs are nested in a complex web of social and cultural history, challenge inevitably creates issues of identity, personal dissonance, and motivation[45]. For this reason, the dissonance referred to in Process 3 (see Figure 2.2) is dissonance with current position, not knowledge and/or skills.

2.3 Responses of diverse teacher learners

The above processes and outcomes typically result in the kinds of responses listed in Figure 2.3. These responses reflect the diversity of teacher learners and their reaction to the learning experience. They range from ignoring or rejecting new theories and practices, to actively engaging with new ideas and applying them to new learning situations, and/or enhancing one's own or others' self-regulated learning. In this section, specific learning processes are not linked to particular teacher responses because that analysis will be undertaken as part of the synthesis in Chapters 6–10. Instead, we describe the range of possibilities and what they might mean and provide a framework for analysing the empirical studies.

The first three responses in Figure 2.3 involve limited or no change in practice. Rejecting or ignoring new theory and practice implies no change, by definition. Rejection assumes there has been sufficient engagement with what is offered for the teacher (or community of teachers) to decide not to practise what is advocated by the provider. Ignoring does not require this level of engagement. In any professional learning situation, rejecting or ignoring are options and have been well documented in teacher education literature[46]. The second response, where teachers believe they are enacting new practice while in reality they continue with their previous practice, is also well documented[47] and occurs most frequently when new ideas are misunderstood as familiar. A typical reaction is "… but we already do this." Practice becomes a blend of the old and the new in ways that are barely recognisable to those trying to bring about change[48]. Hammerness et al.[49] refer to this phenomenon as 'over-assimilation'. The third response, selecting parts of new theory and practice and adapting them to current practice, is similar to the second but the discrepancy between the old and the new is better understood. Selection and adaptation go on as teachers try to adjust new ideas so that they fit existing practice contexts in ways that, they believe, will better meet the needs of their students.

Figure 2.3. Responses of diverse teacher learners/communities

Following assessment and interpretation of the relevance, usefulness, and cost/benefit, teacher learners/communities do one or more of the following:

- reject/ignore new theory and practice and continue with prior practice;
- continue with prior practice, believing that it is new practice;
- select parts of new theory and practice and adapt to current practice;
- implement as required;
- actively engage with, own, and apply new theory and practice and change practice substantively;
- demonstrate enhanced regulation of own and others' learning.

The last three responses listed in Figure 2.3 are more likely to involve substantive change but the ways in which practice is changed and the reasons for change differ. The 'implement as required' response captures those situations in high-accountability environments where teachers are required to implement what is taught. Provider requirements are often underpinned by concerns about programme fidelity. The implicit aim of providers is often actually response 5 (getting teachers to actively engage with, own, and apply new theory and practice). But response 4 implies that there is a body of knowledge to be learned and a set of practices to implement, and that once these have been mastered, that is sufficient. In this synthesis we challenge this notion and propose that ongoing improvement requires teachers to learn how to test the impact of their practice on the diversity of students for whom they are responsible so that improvement in practice continues. Hence response 6, which involves developing inquiry skills so that the teacher can detect when practice is not having the desired outcomes for students and needs, therefore, to be changed. We describe this response as 'enhanced regulation of one's own and others' learning'.

A key condition fostering such regulated learning is teacher awareness of discrepancies between the goals to which they aspire and the evidence about what is actually happening, particularly in relation to student outcomes. The processes involved are complex because what is going on in a student's mind in response to a particular act of teaching is essentially unobservable, but developing the skills to piece together as accurate a picture as possible is central to understanding the impact of one's practice on students and creating the conditions for self- and other-regulation. These skills are of particular consequence for the learning of students who do not share their teacher's understanding of the culture of the classroom or their implicit assumptions about what is being learned. Such students can be seriously disadvantaged by the teacher's use of hidden meanings, assumptions, and implications that they do not understand[50]. Learning to inquire into these students' understandings, interpret their responses, and develop an appropriate pedagogy to address them is not, however, just a matter of skill. It also requires the teacher to value this source of learning and to have a developmental theory of how knowledge progresses in a particular curriculum area, plus have an understanding of pedagogical approaches that might address misconceptions.

Being able to access student knowledge is also important for assessing when teaching activities might have unexpected consequences for students. For example, Alton-Lee, Nuthall, and Patrick[51] found, in a case study involving teachers from an intermediate school, that the clues teachers took to be signals of what was occurring in students' minds were often unreliable or even misleading. These researchers found that lessons designed to decrease racism, for example, had the opposite effect for some students. Unless teachers are able to inquire into the links between their pedagogical practice and students' learning processes, teaching has the potential to bring about student 'learning' that is actually counter to curriculum and/or social goals.

Self-regulation cannot happen in the absence of goals, because it is the discrepancy between the goals to which teachers aspire and the evidence about what is actually occurring that creates the motivation to learn and provides information about what needs to be monitored[52]. Teachers themselves become responsible for learning and changing instead of passive recipients of others' expertise that they may then choose to accept, modify, or reject. Wilson and Berne[53] note in a review of professional development that the goals for engagement in professional development experiences are typically not shared. The goal of most professional development providers is to create some kind of change in beliefs, practices, or both. Teachers, on the other hand, usually do not assume that something needs to change. Although they may engage with professional development programmes with clear ideas of what kinds of knowledge are most helpful and relevant to their ongoing learning, seldom do they participate assuming that their views or knowledge of subject matter or student learning need to change. This absence of shared goals is highly problematic in promoting self-regulation in professional learning situations.

2.4 Implications of the professional learning framework

Figures 2.2 and 2.3 provided part of the framework used to analyse the empirical studies when identifying the characteristics of effective professional learning and development experiences for teachers. Effectiveness was judged from documented outcomes for students. The key questions asked of each study were 'What processes of teacher learning were promoted through the professional learning experience?', 'What were the teachers' responses?', and 'What were the outcomes for students?' The parameters that were considered in relation to the last question are outlined in Chapter 3.

References

1 McLaughlin, M. W. & Talbert, J. E. (1993). *Contexts that matter for teaching and learning: Strategic opportunities for meeting the nation's educational goals.* Stanford, CA: Stanford University: Center for Research on the Context of Secondary School Teaching.

2 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final Report). Wellington, NZ: Learning Media.

Wilson, A. & Saville, S. (2005). *What impact does the Te Kotahitanga professional development initiative have on student-centred teaching and why?* Unpublished manuscript. Auckland, NZ: University of Auckland.

3 Black, P. & William, D. (1998). *Inside the black box: Raising standards through classroom assessment.* London: King's College.

4 Alton-Lee, A. (2003). *Quality teaching for diverse students in schooling: Best evidence synthesis.* Wellington, NZ: New Zealand Ministry of Education. Available at: www.minedu.govt.nz/goto/bestevidencesynthesis.

5 Anthony, G. & Walshaw, M. (2006). *Best evidence synthesis: Characteristics of pedagogical approaches that facilitate learning for diverse learners in early childhood and schooling in Pangarau/Mathematics.* Wellington, NZ: Ministry of Education.

6 Aitken, G. & Sinnema, C. (2006). *Effective pedagogy in social studies (tikanga-a-iwi) and social sciences education: Best evidence synthesis iteration.* Wellington, NZ: Ministry of Education.

7 **Lipman, P. (1997). Restructuring in context: A case study of teacher participation and the dynamics of ideology, race and power. *American Educational Research Journal, 34* (1), 3-37.**

8 Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies, 31* (2), 143-175.

9 National Staff Development Council. (2001). *National Staff Development Council's standards for staff development* (Revised ed.). Oxford: OH: Author. Available at: http://www.nsdc.org/library/standards2001.html.

10 Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999). *How people learn: Bridging research and practice*. Washington, DC: National Academy Press.

11 Merriam, S. B. & Caffarella, R. S. (1999). *Learning in adulthood: A comprehensive guide* (2nd ed.). San Francisco: Jossey-Bass.

12 Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999), op. cit. (ref. 10).

13 Spillane, J. & Louis, K. S. (2002). School improvement processes and practices: Professional learning for building instructional capacity. In J. Murphy (Ed.), *The educational leadership challenge: Redefining leadership for the 21st century* (pp. 83-104). One hundred-first yearbook of the National Society for the Study of Education. Part I. Chicago: The University of Chicago Press.

14 Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999), op. cit. (ref. 10).

15 Robinson, V. M. J. & Lai, M. K. (2006). *Practitioner research for educators: A guide to improving classrooms and schools.* Thousand Oaks, California: Corwin Press.

16 Spillane, J. P. (1999), loc. cit. (ref. 8).

17 National Staff Development Council. (2001), op. cit. (ref. 9).

18 See p. 415 in Spillane, J. P. & Jennings, N. E. (1997). Aligned instructional policy and ambitious pedagogy: Exploring instructional reform from the classroom perspective. *Teachers College Record, 98,* 449-481.

19 **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

20 Ball, D. & Cohen, D. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as a learning professional: Handbook of policy and practice* (pp. 3-32). San Francisco: Jossey Bass.

21 Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999), op. cit. (ref. 10).

22 Kennedy, M. M. (1999). The role of preservice teacher education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of teaching and policy* (pp. 54-86). San Francisco: Jossey Bass.

23 Kennedy, M. M. (2004a). Examining teacher quality. In F. L. Jr & J. Ferrini-Mundy (Eds.), *Proceedings of the NCTM Research Catalyst Conference*. Washington DC: National Council of Teachers of Mathematics.

24 Boshuizen, H. P. A., Bromme, R., & Gruber, H. (2004). *Professional learning: Gaps and transitions on the way from novice to expert*. Dordrecht: Kluwer.

25 Earl, L. & Katz, S. (2005). *Learning from networked learning communities (phase 2): Key features and inevitable tensions.* Phase 2 Report of the Networked Learning Communities External Evaluation. London: DfES.

26 Donovan, M. S., Bransford, J. D., & Pellegrino, J. W. (Eds.). (1999), op. cit. (ref. 10).

27 ibid.

Kennedy, M. M. (1999), loc. cit. (ref. 22).

Robinson, V. M. J. & Lai, M. K. (2006), op. cit. (ref. 15).

28 Putnam, R. T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29* (1), 4-15.

29 Cobb, P., McClain, K., Lamberg, T., & Dean, C. (2003). Situating teachers' instructional practices in the institutional setting of the school and district. *Educational Researcher, 32* (6), 13-24.

30 Knapp, M. S. (2003). Professional development as a policy pathway. *Review of Research in Education*, *27*, 109-157.

31 **Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23* (2), 145-170.**

Louis, K. S., Marks, H. M., & Kruse, S. D.(1996). Teachers' professional community in restructuring schools. *American Educational Research Journal, 33* (4), 757-798.

32 Hargreaves, A. (1998). The emotions of teaching and educational change. In A. Hargreaves et al. (Eds.), *International handbook of educational change* (pp. 558-575). Dordrecht: Kluwer.

33 Stoll, L., Fink, D., & Earl, L. (2003). *It's about learning*. London: RoutledgeFalmer.

34 Hall, G. (1979). The concerns-based approach to facilitating change. *Educational Horizons, 57* (4), 202-208.

Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G. (1998). *Taking charge of change.* Austin, TX: Southwest Educational Development Laboratory.

[35] Stoll, L., Fink, D., & Earl, L. (2003), op. cit. (ref. 33).

[36] ibid.

[37] For example, Alton-Lee (2005) has raised the concern about research evidence showing no positive (and even negative) impact on student outcomes after teachers' change to use learning style approaches to teaching culturally diverse students. Alton-Lee, A. (2005). *A collaborative approach to knowledge building to strengthen policy and practice in education: The New Zealand Iterative Best Evidence Synthesis Programme.* Paper presented at the Australian Association for Research in Education National Conference, Quality in Educational Research, Cairns (4-5 July, 2005).

Irvine, J. J., & York, D. E. (1995). Learning styles and culturally diverse students: A literature review. In J. Banks & C. McGee (Eds.), *Handbook of research on multicultural education* (pp. 484-497). New York: MacMillan Publishing.

McMillan, B. (2001). The serious limitations of 'learning style'. *Set: Research Information for Teachers, 1*, 36-39.

[38] Ball, D. & Cohen, D. (1999), loc. cit. (ref. 20).

Wilson, S. & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of Research in Education* (Vol. 24, pp. 173-210). Washington, D.C: AERA.

[39] Spillane, J. P. (1999), loc. cit. (ref. 8).

[40] Hannay, L. & Ross, J. A. (2001). Internalizing change capacity in secondary schools. *Alberta Journal of Educational Research, 47* (4), 325-340.

[41] ibid.

[42] Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company.* New York: Oxford University Press.

[43] Lam, A. (2000). Tacit knowledge, organizational learning and societal institutions: An integrated framework. *Organizational Studies, 21* (3), 487-513.

[44] Hannay, L., Mahony, M., & MacFarlane, N. (2004). *Reconstructing professional knowledge: The essence of successful educational reform.* Paper presented at the British Educational Leadership, Management and Administrative Society, Oxford University, England.

Jarvis, P. (1997). *Ethics and the education of adults in late modern society*. Leicester: NIACE.

[45] Hargreaves, A. (1998), loc. cit. (ref. 32).

[46] McLaughlin, M. W. & Talbert, J. E. (1993), op. cit. (ref. 1).

[47] Firestone, W. A., Schorr, R. Y., & Monfils, L. F. (2004). *The ambiguity of teaching to the test: Standards, assessments, and education reform*. Mahwah, NJ: Lawrence Erlbaum.

[48] Cohen , D. K. & Ball, D. L. (1990). Relations between policy and practice: A commentary. *Educational Evaluation and Policy Analysis, 12,* 331-338.

Hill, H. (2001). Policy is not enough: Language and the interpretation of state standards. *American Educational Research Journal, 38* (2), 289-318.

Kennedy, M. M. (2004b). Reform ideals and teachers' practical intentions. *Education Policy Analysis Archives, 12* (13), http://epaa.asu.edu/epaa/v12n13/

Spillane, J. (2004). *Standards deviation: How schools misunderstand education policy.* Cambridge, MA: Harvard University Press.

[49] Hammerness, K., Darling-Hammond, L., Bransford, J., Berliner, D., Cochran-Smith, M., McDonald, M., & Zeichner, K. (2005). How teachers learn and develop. In L. Darling-Hammond (Ed.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 358-389). San Francisco: John Wiley & Sons.

[50] Nuthall, G. & Alton-Lee, A. (1997). *Student learning in the classroom: Understanding Learning and Teaching Project 3.* Wellington, NZ: New Zealand Ministry of Education.

[51] Alton-Lee, A. G., Nuthall, G. A., & Patrick, J. (1993). Reframing classroom research: A lesson from the private world of children. *Harvard Educational Review, 63* (1), 50-84.

[52] Butler, D. L. & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65* (3), 245-274.

[53] Wilson, S. & Berne, J. (1999), loc. cit. (ref. 38).

3. Student Outcomes and Responsiveness to Diversity

The programme of best evidence syntheses is "intended to deepen understanding of what works in education, how context is significant, what the evidence suggests can make a bigger difference to optimise outcomes for diverse learners"[1]. The focus of this synthesis is on identifying the characteristics of professional learning or development opportunities that impact positively on outcomes for the diversity of students in our education system. There is potentially a wide range of outcomes to consider; all are difficult to measure and, in each case, it is difficult to determine what constitutes improvement.

3.1 Determining student outcomes

The diversity of students and communities served by the education system inevitably means that there is a diverse range of desirable outcomes. While a case can be put forward for almost any outcome, some boundaries needed to be placed on the outcomes considered in the context of this synthesis. We thought of them as a group that may include any or all of the following: academic, social, personal or performance outcomes. Outcomes in the group are not hierarchical and all are considered desirable in and of themselves. There may also be other student outcomes that might assist in achieving those in the group—these are typically described as processes. For example, increased student engagement in school might be considered desirable because without it, it is unlikely that students will achieve other desired outcomes. To be included in the synthesis, however, the causal relationship between these processes and the outcomes in the basket needed to be established empirically because assumed relationships may not be supported by the evidence. Staying longer at school, for example, might be classified as improved student engagement but not achieve any of the desired outcomes in the group. The form of engagement and the link to particular outcomes need to be analysed further. Another outcome might be improved self-concept. While enhanced self-concept is to be valued, the evidence does not support the assumption that this outcome will necessarily improve student achievement[2], in spite of what is often claimed.

Most of the empirical studies accessed for the synthesis reported outcomes that were related to some aspect of student achievement. However, what counts as meaningful learning and achievement is highly contested and it needs to be acknowledged that not all tests measure what is valued by the particular discipline or teacher community. Especially in contexts where student outcomes are measured by high-stakes tests, there are concerns about trivialising students' learning experiences. On the basis of Heisenberg's Uncertainty Principle[3] —"The more important that any quantitative social indicator becomes in social decision-making, the more likely it will be to distort and corrupt the social process it is intended to monitor"—critics warn us that to attach serious personal and educational consequences to performance on tests for schools, administrators, teachers, and students may have distorting and corrupting effects. Potential distorting and corrupting effects include test-driven pedagogy and a narrow, impoverished curriculum[4].

Other studies used teacher reporting of student outcomes as evidence of improved outcomes[5]. There is a developing body of evidence, however, that teacher reporting, either of student outcomes or their own practice, can be problematic. Langley[6], for example, trained teachers in early childhood education centres in the principles of behaviour management. He found that teachers' self-reported changes in practice and related improvements in children's behaviour were inaccurate. Teachers reported that both their practice and the behaviour of the targeted students had improved in line with the guidance offered to the teachers, but observations at the centre contradicted these perceptions. Both Firestone[7] and Spillane[8] in the United States found that observations of changes in teaching practice in mathematics did not match the teachers' self-report of such changes, partly because the teachers did not understand the depth of change being envisaged. Some of the complexity of this picture was demonstrated in a study by Timperley and Wiseman[9], following professional development in early literacy instruction. These authors found that teachers could accurately report the extent to which their practice was consistent with that advocated in the professional development, but they were inaccurate in judging its impact on students' literacy achievement. For these reasons, only studies that had some independent verification of student outcomes have been included in the synthesis.

3.2 Determining teacher outcomes

It is also important to note that many valuable professional learning activities occur within schools independently of documented outcomes for students and that not all such activities should be tied to student outcomes. These may include, for example, interacting with others who teach within the same discipline, teachers having opportunities to discuss and reflect on their teaching, or the induction and mentoring of beginning teachers. These activities serve different purposes, such as re-enthusing experienced teachers or enabling beginning teachers to cope, and it is important to acknowledge their worth. This synthesis, however, focuses on studies that are able to provide some evidence of student outcomes because, as Camburn[10] reminds us, "while creating learning communities for teachers may be a worthwhile development for many schools, our public school system is ultimately in the business of educating students not teachers" (p. 60).

In reviews and evaluations of professional development, changes in teacher practice are typically the focus and considered sufficient. Improved student outcomes are assumed rather than assessed[11]. Professional development is usually about changing the knowledge, skills, beliefs, and attitudes of teachers without necessarily expecting these changes to have a direct or immediate impact on their students. Instead, the expectation is that cumulative experiences, rather than any specific experience, will result in more effective teaching.

Caution needs to be exercised, however, in ascertaining which of these teacher-related changes have particular outcomes for students. The evidence analysed for the purposes of this synthesis shows that, sometimes, apparently common-sense assumptions are not supported by outcome evidence in a range of situations. For example, high teacher expectations are associated with schools with good achievement outcomes for students[12], but Gottfredson et al.[13] found that professional development targeting expectations had very mixed and sometimes negative effects. Similarly, Ross[14] reported counter-intuitive outcomes for students whose teachers had participated in professional development designed to help them feel more efficacious in facilitating cooperative learning. Teachers who indicated in their self-ratings that they were feeling both personally and generally more efficacious over the period of the professional development had students who rated their willingness to offer and seek help lower on average than students in classes where the teachers did not report the same improvement in self and efficacy. These student outcomes do not appear to be consistent with the principles of cooperative learning. In a third example, from technology, Harwell and colleagues[15] established through a range of measures, including classroom observations, that professional development resulting in increased integration of technology into science and mathematics classrooms was not associated with any positive changes in student perceptions of their classroom learning environment over the period of the academic year in which the professional development occurred. Two additional studies, one in the Netherlands[16] and another in the United States[17], also found that the students of teachers who participated in professional development had poorer outcomes than the students of the teachers who did not participate.

The most common measure used to judge the success of professional development is teacher satisfaction with the professional development, or, using Guskey's[18] term, 'happiness quotients'. We did not consider such measures to constitute evidence because there is no independent verification that such satisfaction is related to improved student outcomes. In fact, we see some danger in accepting such reports as evidence because to do so may promote the development of a closed system in which adult perceptions and preferences become the criteria for success, not the desired outcomes for the students.

3.3 Responsiveness to diversity

One of the challenges in this synthesis was to identify what is effective for particular groups of students without marginalising the groups concerned or considering their needs through the dominant cultural lens. Responsiveness to diversity is central to the BES concept and recognises the issues of differential achievement between and within demographic groups or categories of students. There is no 'normal' group of students from which others are marginalised. Such responsiveness also acknowledges that within categories of students (e.g. ethnic, age, and gender groups), there is diversity. This means that students should not be too narrowly categorised as belonging to a particular group. In fact, individual students may well belong to a number of groups or communities of focus that may have a cumulative effect on their educational needs.

This synthesis had to consider how outcomes could be improved for all students, across ethnic, gender, ability, and other groupings. A core concern of the Ministry of Education is the failure of the New Zealand education system to equitably meet the needs of Māori and Pasifika students. What makes this a particularly complex issue is that these communities of students are not homogeneous and many students have multiple ethnicities, sometimes changing their ethnic designation when moving between education sectors. To add to the complexity, if a different lens, such as gender, is applied, a different set of needs is likely to be identified.

The implications for this particular synthesis are that teachers, in both their practice and their learning, must develop the skills and knowledge to meet the needs of groups of students (such as the whole class), while at the same time attending to the diversity of individuals within the group. If the learning of all students is to be promoted, it may be necessary to separate out assessment data at the level of specific groups or particular individuals in order to understand the full range of learning needs. A so-called 'successful' charter school in the United States was prompted to reassess its definition of success when the disaggregated analysis demonstrated to the staff that they were not meeting the needs of many of their students[19]. The high scores of those attracted to the magnet school disguised the low scores of the students from the local neighbourhood. The responsiveness-to-diversity framework therefore has important implications for what teachers need to learn and what constitutes success for their students.

References

1 Ministry of Education (2004). *Guidelines for generating a best evidence synthesis iteration*. Wellington, NZ: Ministry of Education.

2 Hattie, J. (1999). *Influences on student learning*. Paper presented at the Inaugural Lecture, University of Auckland, Auckland, NZ.

3 Campbell, D. T. (1975). On the conflicts between biological and social evolution and between psychology and moral tradition. *American Psychologist*, *30* (12), 1103-1126.

Madaus, G. & Larke, M. (2001). The adverse impact of high stakes testing on minority students: Evidence from one hundred years of test data. In G. Orfield & M. L. Kornhaber (Eds.), *Raising standards or raising barriers? Inequality and high-stakes testing in public education*. New York: The Century Foundation Press.

4 Amrein, A. L. & Berliner, D. C. (2002). High-stakes testing, uncertainty, and student learning. *Education Policy Analysis Archives, 10* (18), http://epaa.asu.edu/epaa/v10n18/.

5 Ingvarson, L., Meiers, M., & Beavis, A. (2005). Factors affecting the impact of professional development programs on teachers' knowledge, practice, student outcomes and efficiacy. *Education Policy Analysis Archives, 13* (10), 1-28.

Ingvarson, L., Beavis, A., Bishop, A., Peck, R., & Elsworth, G. (2004). *Investigation of effective mathematics teaching and learning in Australian secondary schools*. A report to the Australian Government, Department of Education, Science and Training. Melbourne, AU: Australian Council for Educational Research.

6 Langley, J. (1997). *The development of an in-service training programme to enable kindergarten teachers to better manage the behaviour of young children with behaviour disorders*. Unpublished doctoral thesis, University of Canterbury, Christchurch, New Zealand.

7 Firestone, W. A., Schorr, R. Y., & Monfils, L. F. (2004). *The ambiguity of teaching to the test: Standards, assessments, and education reform*. Mahwah, NJ: Lawrence Erlbaum.

8 Spillane, J. P. (2000). Cognition and policy implementation: District policy-makers and the reform of mathematics education. *Cognition and Instruction*, *18* (2), 141-179.

[9] Timperley, H. & Wiseman, J. (2003). *The sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement.* Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

[10] Camburn, E. (1997). *The impact of professional community on teacher learning and instructional practice.* Unpublished doctoral dissertation, University of Chicago, Chicago.

[11] Cordingley, P., Bell, M., Rundell, B., Evans, D., & Curtis, A. (2003). *The impact of collaborative continuing professional development on classroom teaching and learning: How does collaborative continuing professional development for teachers of the 5-16 age range affect teaching and learning?* London: EPPI-Centre, Institute of Education, University of London.

[12] Reynolds, D. & Teddlie, C. (2000). The processes of school effectiveness. In C. Teddlie & D. Reynolds (Eds.), *The international handbook of school effectiveness research* (pp. 134-159). London: Falmer Press.

[13] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

[14] Ross, J. A. (1994). The impact of an inservice to promote cooperative learning on the stability of teacher efficacy. *Teaching and Teacher Education, 10* (4), 381-394.

[15] Harwell, S., Gunter, S., Montgomery, S., Shelton, C., & West, D. (2001). Technology integration and the classroom learning environment: Research for action. *Learning Environments Research, 4,* 259-286.

[16] Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

[17] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 13).**

[18] Guskey, T. R. (1998). The age of our accountability: Evaluation must become an integral part of staff development. *Journal of Staff Development, 19* (4), 36-44.

[19] **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

4. The Framework for Analysis and Synthesis: Methods and Procedures

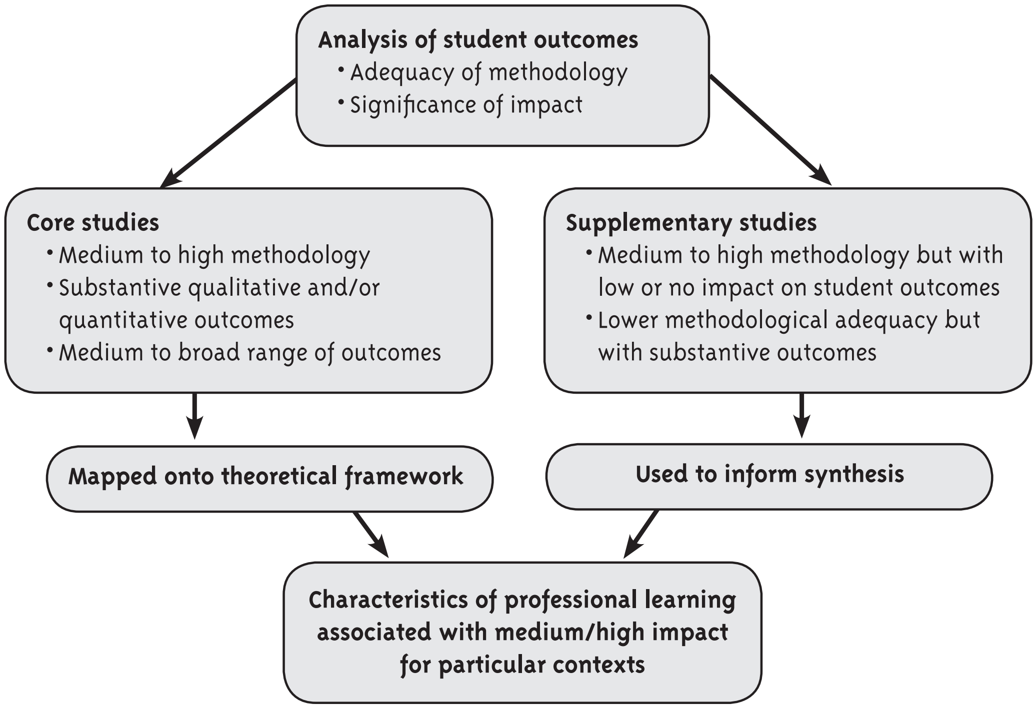
The primary purpose of this synthesis is to unpack the 'black box' between the professional learning opportunities and teacher outcomes (Figure 2.1) that impact positively on student outcomes. What are the qualities of the professional learning opportunities that lead teachers to interpret and utilise the available understandings and skills in ways that lead to positive student outcomes? This task required an approach different from that of a traditional literature review or meta-analysis. The starting point was similar to a meta-analysis in that we began by identifying empirical studies of professional learning and development with documented student outcomes. We had to go beyond a meta-analysis, however, because such an approach was unlikely to identify how and why teachers interpreted and utilised the available understandings in particular ways. In an attempt to answer these 'How?' and 'Why?' questions, we drew on both the theoretical and the empirical literatures related to professional learning and development. This approach was close to that of a realist synthesis, described most succinctly by Pawson (2002)[1], and consisted of identifying the underlying resources offered participants by different programmes and activities and determining what worked or did not work in a given context.

Pawson has argued that the resources offered to participants influence their thinking and behaviour in different ways, depending on the individuals involved and the circumstances under which the resources are offered: a resource offered through a particular activity in one situation or to one individual may not work in different circumstances or with another person. It is important, therefore, to consider what works for whom and under what circumstances.

To identify the circumstances associated with success, it was necessary to consider studies of interventions with both highly successful and less successful outcomes. The process of categorising studies is summarised in the flow chart in Figure 4.1. Studies were assessed according to basic methodological criteria (see Appendix 1) and the significance of the impact on a range of student outcomes. Those studies that met our methodological criteria and had a substantive impact were identified as core studies. The different characteristics of the professional learning/development projects and initiatives were then mapped onto a theoretical framework so as to identify those characteristics associated with successful student outcomes.

Given the relatively small number of studies that met these criteria, and that we also wished to identify what did *not* work, we did not discard those studies that failed to meet the initial criteria. Two groups of supplementary studies were also analysed. The first included those that met our methodological criteria but had no or low impact on student outcomes. The second group included those that failed to meet our methodological criteria but reported substantive outcomes. Several reports of professional development in individual schools came into this group. Both groups of supplementary studies were used to inform the synthesis.

Figure 4.1. Flow chart for the analysis



4.1 Identifying and retrieving the studies

The range of search strategies used to locate relevant articles is elaborated in Appendix 1. Strategies included searching standard library databases, using both key words and author searches, hand searching specific journals, searching websites of institutions known to be involved with professional development, and following up the extensive material provided by the Ministry of Education and researchers and practitioners known personally to the authors.

Once located, an initial 'cut' of the studies was made according to reported outcomes and the studies were classified on two dimensions: the adequacy of the reported methodology and the significance of the impact. Criteria for determining methodological adequacy are listed in Appendix 2. For studies reporting quantitative outcomes, the criteria were adequacy of student sample, scoring reliability, and the content validity of the assessment in relation to the focus of the professional development. For studies reporting qualitative outcomes, the criteria were the depth of data collection and analysis and the extent to which data were triangulated. Each study was rated 'high', 'medium', or 'low'.

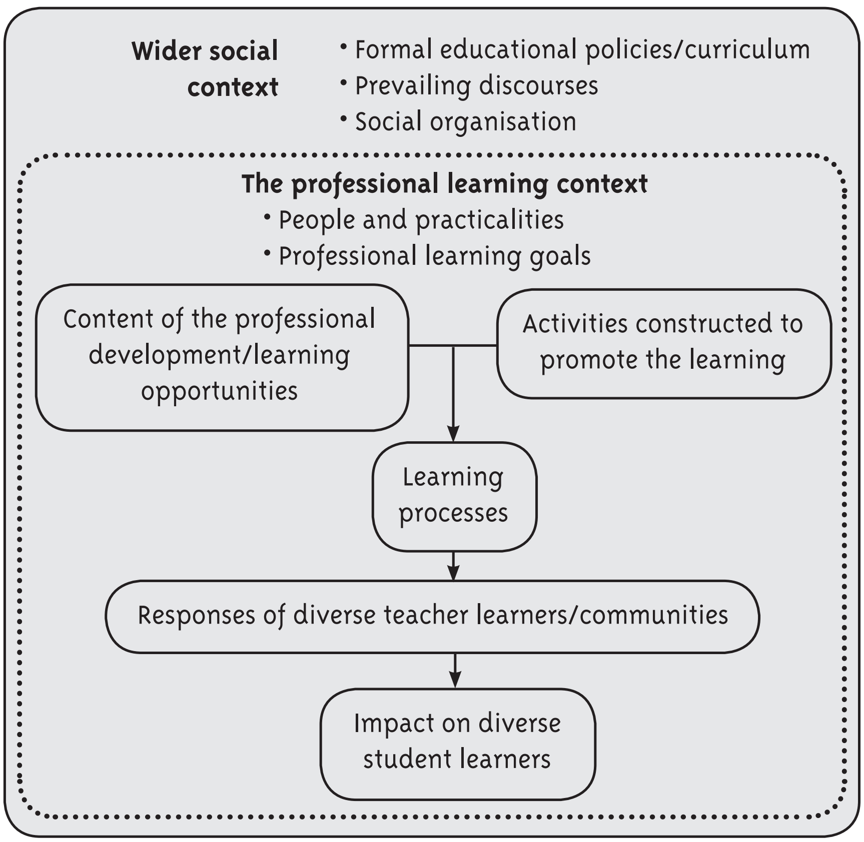
Educational significance of the impact was determined by the magnitude of the effect sizes of student outcomes and the range of the participating students' activities. Outcomes reported for a very small domain, such as spelling, were designated 'narrow', outcomes reported for a substantial part or all of a curriculum area were designated 'medium', and outcomes that encompassed more than one curriculum area or included personal/social domains were designated 'broad'. Details of study selection on this criterion are reported in Chapter 5 and Appendix 2.

The core studies selected for the synthesis were those rated as medium to high in terms of methodological adequacy as well as medium to high impact for a medium to broad range of outcomes. Supplementary studies with low, no, or negative impact, or that were methodologically weak, were also used to complement developing understandings related to different parts of the framework. The core studies were then classified according to outcome area (e.g. social, academic) and subcategories were developed within those areas (e.g. primary/secondary, literacy/mathematics)[2].

4.2 Development of the theoretical framework

The core studies were entered onto an Excel database and key attributes of the various approaches to professional development were identified. At the same time, a theoretical framework was developed, based on the realist synthesis concept of content or resources (What professional understandings and skills were deepened and refined?), the circumstances under which they were offered (activities and context), and the outcomes for teachers. This framework was informed by both sociocultural and psychological learning theories outlined in the section on professional learning. An iterative checking process was undertaken to ensure that the theoretical framework captured the specific attributes of the professional development/learning situation referred to in the various studies. At the same time, the attributes of the studies were synthesised more theoretically.

Figure 4.2. Framework for analysing the effectiveness of professional learning experiences



The framework was developed from the theoretical and empirical literature on professional learning and development. It was intended that the elements of the framework should be ‘neutral’ and subject to testing against the qualities associated with substantive outcomes for students, as documented in the studies. The initial framework was presented to and critiqued by a ‘think tank’ of national researchers, union officials, and professional development providers and approved in principle as appropriate for mapping the studies. The framework was developed further throughout the process of mapping the studies with substantive student outcomes. In all, 56 characteristics of the professional learning environment and teachers’ learning processes were identified, together with the range of student outcomes. Each study was mapped via short descriptive statements for each of the characteristics of the framework, to the extent that information was available. For some studies, there were many blanks because information was not included in the written text and extensive searches of related studies provided no more detail. Supplementary studies that reported low or no impact on student outcomes were also mapped onto the framework but were noted as such.

Given the importance of context in a realist synthesis analysis, note was also made of the situation (country, school level, teacher demographics) to help answer the question 'What works, for whom, under what circumstances?' Throughout the search and mapping process, it was evident that research into the impact of professional development on student outcomes is not an area of research that has systematically built up an evidence base; rather, it is a collection of individual studies and, in some cases, small collections of studies. The synthesis is, therefore, somewhat like a picture[3] painted with the evidence from a collection of studies: the colours are much brighter and clearer in some areas than others.

4.3 Mapping the studies on the framework

The basic structure of the theoretical framework used to map the core studies is presented in Figure 4.2. Details are elaborated in subsequent sections. Each study was systematically mapped onto the framework, initially by the whole team, then by individual members. Reliability procedures are reported in Appendix 2.

4.3.1 The context for professional learning

The learning of an individual teacher is strongly influenced by the sociocultural context in which the professional learning and the teaching practice take place. The wider sociocultural environment provides the medium in which the professional learning activities occur and strongly influences how teachers may understand and react to the learning opportunities. The professional learning context provides a more specific environment that creates the conditions for professional learning. In the New Zealand situation, the Ministry of Education is more able to influence these contexts than it is able to influence the detail of content and activities. The importance of these two contexts is signalled by their positioning at the top of Figure 4.2 and their influence on all other activities and outcomes is signalled by the frames around the more individually oriented aspects of the framework.

4.3.1.1 Wider social context

The particular attributes of the wider social context taken account of in the synthesis include formal education policies and curriculum, prevailing discourses, and school organisation. These are elaborated below.

4.3.1.1.1 Formal education policies

Formal education policies pervade teachers' working lives and their motivation to learn, through both their content and their implicit messages about what it means to be a teacher and the value of teachers' work. The two countries from which most of the studies in this synthesis were sourced have contrasting policy contexts. In the United States, there is no national curriculum, although prescription may occur at the state or district level. Students are assessed regularly under a very tight and potentially punitive regime of accountability[4]. Multiple levels of administration exist: federal, state, district, and school. Professional development for teachers can be sponsored by or demanded at any of these levels.

In contrast, New Zealand has a loosely defined national curriculum but no requirements for student assessment until the typical student has been at school for 10 years. A light national sampling of students is undertaken at year 4 (ages 8–9) and year 8 (ages 12-13)[5] on a rotating cycle for different curricula, but the results are not traced back to schools or teachers. A range of standardised assessment tools are available, such as asTTle and STAR[6], but their use is discretionary. Apart from participation in OECD surveys, the state knows little about the achievement of its students for the first 10 years. Participation in professional development is either individual—typically through participation in teachers' centres or tertiary courses—or determined by the school. There is no administration at district level and unless a school has been identified as seriously in trouble, professional development can only be offered, not mandated.

Attributes of the policy context entered on to the framework were:

- country;
- relevant national education policies;
- who initiated the professional learning opportunities;
- whether the professional learning opportunities were voluntary or mandated.

4.3.1.1.2 Prevailing discourses

Discourses that influence practice occur at all levels of the system: national, school, or within some other professional community, such as a curriculum association. In any particular situation, multiple discourses are taking place and may relate to the purpose of schooling, the role of teachers, the value of particular curricula, or the attributes of students and/or their ability to learn. Professional learning opportunities not only occur in the context of particular discourses; they may influence the nature of these discourses. For example, if the discourse within a school is that particular groups of students cannot be expected to learn at the same rate as others, professional development designed to improve the quality of teaching for these students may not be effective.

Specific attributes of the prevailing discourses entered onto the framework (where the information was available) were:

- prevailing discourses prior to the professional learning opportunities;
- prevailing discourses after the professional learning opportunities.

4.3.1.1.3 School organisation

School organisation would be worthy of a synthesis of its own because this context has arguably the greatest influence on teachers' practice and their motivation to engage in professional development but in this synthesis, we restrict our consideration to the organisational arrangements within the school, because these play a pivotal role in either facilitating or restricting teachers' opportunities to learn. A common scenario, described by Guskey[7], is one where, "… educators end up trying to implement innovations that they do not fully understand in organizations that do not fully support their efforts" (p. 149). Apart from the problem of implementation, the context of practice is the place where beliefs about appropriate instruction are constructed and reconstructed over time and attain taken-for-granted status as the natural or commonsense way to do things[8].

Specific attributes of school organisation entered onto the framework (where the information was available) were:

- school structure, culture, and practices;
- type of professional community;
- existence of accountability and targets;
- processes of institutional decision making;
- if part of more comprehensive reform, restructuring.

4.3.1.2 *Professional learning context*

The professional learning context was typically the most fully described aspect in the studies accessed for this synthesis. Specific attributes of this context entered onto the framework (where the information was available) were:

- length of the professional learning opportunities;
- frequency of the professional learning opportunities;
- mode of delivery;
- who was involved within the school (including leaders);
- focus of the professional learning opportunities;
- student year levels covered;
- whether attendance was mandated or voluntary;
- other competing or complementary activities;
- what internal or external expertise was utilised;
- whether the content was specific to individual teachers or generic to all;
- whether professional learning goals were explicit and shared;
- whether the goals were consistent with accountability and targets;
- whether the development of teacher leadership was part of the process.

The infrastructural support documented in the studies also varied. Some interventions were generously funded, for example, while others received no funding. Specific attributes of the infrastructural support reported in the studies and entered onto the framework were:

- allocation of funding;
- in-school time allocation for the professional learning opportunities to occur;
- extra time allocation beyond the formal professional learning opportunities;
- other supports.

4.3.2 The content of the professional learning opportunities

In realist synthesis terms, it is not the programmes or activities that work (or do not work) but the underlying resources that the programmes or activities offer participants to change what they are already doing. Because this synthesis is concerned with promoting the learning of practising teachers, it assumes that participating teachers already have a wide range of professional knowledge and skills. The content, therefore, needs to deepen professional understandings and extend those skills in ways that impact positively on the teachers' students. The design of any effective learning opportunity must begin with a clear idea of what knowledge and skills are to be developed[9]. For this reason, a key question, when deciding on the resources targeted in the professional learning situation, is: 'What is it that the designers, or those providing the learning opportunities, want the participating teachers to learn?'

A key question

What do teachers need to know in order to deepen their professional understandings (e.g. pedagogical content knowledge) and extend their skills so as to have a positive impact on student outcomes?

The understandings and skills identified in the core studies, and supported by the theoretical literature on how teachers learn (Chapter 2), are listed in Figure 4.3. These aspects of content formed the part of the framework related to what was learned. All the core studies were analysed for the learning content they offered the teacher participants and this information was entered onto the framework.

Figure 4.3. Types of professional learning content mapped on to the framework

Content of the professional learning opportunities
Conceptual understandings and skills deepened through the professional learning activities related to the following: Understandings that could be used to inform practice: • the discipline; • fundamentals and interrelationships of teaching (e.g. curriculum, pedagogy, assessment, standards); • students (development, culture, learning, behaviour, social constructions); • linguistic and cultural resources; • theoretical frameworks and conceptual tools. Understandings related to teachers' own practice: • own practice and new possibilities in relation to a standard; • how own practice impacts on diverse student learners and new possibilities. Methods of inquiry that challenged teacher practice: • methods of inquiry into adequacy and improvement of own practice.

The content areas listed in Figure 4.3 are grouped into three broad but not mutually exclusive categories. The first group includes understandings that could be used to inform practice. These understandings were inclusive of the discipline, fundamentals, and interrelationships of teaching, including curriculum, pedagogical, and assessment knowledge, and an awareness of standards of teaching practices in particular curriculum areas. Also in this first group was knowledge of students, their cultures, expected developmental progressions in a particular curriculum area, how students learn, and how teachers construct their views of students. In Māori-medium schools, linguistic and cultural understandings were also important. Developing new theoretical frameworks on which to base practice was also considered part of the understandings that could be used to inform practice. In Figure 4.3, they are called 'theoretical frameworks and conceptual tools' to indicate the interdependence of theory and practice in professional learning situations.

The second group consists of understandings related to the teacher's own practice: the standards the teacher sets and the impact of their practice on their students.

The third group consists of methods of inquiry that challenged teachers' taken-for-granted assumptions about the effectiveness of their practice and provided opportunities for improvement.

The language used in Figure 4.3 is necessarily cryptic, but attempts have been made to avoid generic expressions that have multiple meanings. For example, terms such as 'coaching' and 'professional learning community' are not used consistently in the literature. They can refer to any one of a number of different professional learning opportunities and forms of interaction and do not necessarily identify what content was learned. By being more descriptive, it is hoped that those constructing professional learning opportunities will think about the nature of the content being offered to teachers through particular activities. It is to those activities that we now turn.

4.3.3 Activities constructed to promote learning

Many of the articles read for this synthesis highlighted the learning activities constructed for teachers rather than the professional understandings to be deepened and skills to be refined. Activities do not offer new resources for teachers; they are the medium through which those resources are provided. The problem with activities is that, depending on how they are enacted, they can provide different learning opportunities. For example, workshops may involve the transmission of new knowledge or an examination of the adequacy of current practice through an analysis of student outcomes. In realist synthesis terms, these different enactments offer very different professional understandings and skills. Activities should, therefore, be considered as the vehicle for providing the content to deepen understandings and extend skills.

> **A second key question**
>
> What activities will provide teachers with the opportunities to deepen key professional understandings and skills?

A variety of activities were described in the studies analysed and these are listed in Figure 4.4. As before, the language is descriptive and does not assume shared understandings of commonly described activities.

Figure 4.4. Professional learning activities mapped onto the framework

Activities constructed to promote learning
Professional development / professional learning activities designed to develop and deepen professional understandings and skills: • listening; • watching; • being observed and receiving feedback; • receiving student activities and materials; • engaging with professional readings; • discussing practice with someone more expert; • authentic experience of subject in action; • discussing own theories of practice and their implications; • examining student understandings and outcomes; • analysis of current practice and reconstruction of new practice; • discussing self or mutually identified issues.

4.4 Putting the mapping framework together

In addition to the above, the learning processes and responses of diverse teacher learners discussed in Chapter 2 were also mapped onto the framework whenever this information was provided. The final element of Figure 4.5, impact on diverse teacher learners, was also noted. This material then formed the basis for the synthesis. In the figure, we have reported the findings in terms of the themes.

An aspect of the process that is not specifically addressed in Figure 4.5, however, relates to teacher motivation. The reason for this omission is that we have taken the position that motivation is affected by all, and affects all, aspects of the framework. For example, if the context in which teachers practise is supportive of learning, if the content offered is relevant to teachers' classroom practice, and if the activities are meaningful, the process is likely to promote iterative cycles of reflection and seeking new knowledge, with strong impact on teaching practice and student outcomes. Under these circumstances, teachers are likely to be motivated to engage in ongoing learning. If none of these conditions are present, motivation is likely to be low. If motivation were to be treated separately from these conditions, it would imply that motivation is separate from, rather than integral to, the learning process. We consider the notion that teachers must first be motivated, then educated, to be manipulative and demeaning of the concept of teacher professionalism.

Figure 4.5. A framework for mapping the studies

Wider Sociocultural Environment

- Formal educational policies/curriculum
- Prevailing discourses
- School organisation

The Professional Learning Environment

- People and practicalities
- Professional learning goals

Content of Professional Learning Opportunities

Conceptual understandings and skills deepened through the professional learning activities related to the following:

- the discipline;
- fundamentals and interrelationships of teaching (e.g. curriculum, pedagogy, assessment, standards);
- students (development, culture, learning, behaviour, social constructions);
- linguistic and cultural resources;
- theoretical frameworks and conceptual tools;
- own practice and new possibilities in relation to a standard;
- how own practice impacts on diverse student learners and new possibilities
- methods of inquiry into adequacy and improvement of own practice.

Activities Constructed to Promote Learning

The PD/PL activities designed to develop and deepen the professional understandings and skills:

- listening/watching;
- being observed and receiving feedback;
- receiving student activities and materials;
- engaging with professional readings;
- discussing practice with someone more expert;
- authentic experience of subject in action;
- discussing own theories of practice and their implications;
- examining student understandings and outcomes;
- analysis of current practice and reconstruction of new practice;
- discussing self or mutually identified issues.

(Iterative) Learning Processes

The learning processes engaged for developing new understandings and skills involve cycles of (one or more of) the following:

Process 1 Cueing and retrieving prior knowledge
Outcome: Prior knowledge consolidated and/or examined

Process 2 Becoming aware of new information/skills and integrating them into current values and beliefs system
Outcome: New knowledge adopted or adapted

Process 3 Creating dissonance with current position (values and beliefs)
Outcome: Dissonance resolved (accepted/rejected), current values and beliefs system repositioned, reconstructed

Responses of Diverse Teacher Learners/Communities

Following assessment and interpretation of the relevance, usefulness, and cost/benefit, teacher/learner communities do one or more of the following:

- reject/ignore new theory and practice and continue with prior practice;
- continue with prior practice, believing that it is new practice;
- select parts of new theory and practice and adapt to current practice;
- implement as required;
- actively engage with, own, and apply new theory and practice and change practice substantively;
- demonstrate enhanced regulation of own and others' learning.

Impact on Diverse Student Learners

Impacts of PD/PL on a range of outcomes (achievement, attitude, social, identity) for diverse student learners depend on the following:

- no improvement (or decline) in outcomes;
- limited improvement in a narrow range of outcomes;
- substantive improvement in a broad range of outcomes.

4.5 Identifying broad categories

The central question guiding this synthesis is, 'What works in professional learning, how and why, and under what circumstances?' In order to best answer this complex question, it was necessary to first categorise the studies into groups that could potentially provide answers about the different circumstances under which some approaches to professional learning and development work for particular groups of teachers and their students. Initial categorisations considered were based on the demographic characteristics of teachers, such as beginning and experienced, but there were insufficient studies with student outcomes involving beginning teachers for a useful analysis to be made. Also, teachers cannot be categorised so neatly. What does the designation 'experienced' mean? A teacher may be experienced in one subject or with one student population, but much less so in another subject or with another student population. Should a teacher who has many years' experience in English-medium classrooms, for example, be considered experienced or inexperienced when moving to a Māori-medium setting? It is quite possible that some of the assumptions underpinning practice in the former setting may interfere with accepted practice in the latter.

It was decided that it was more useful to group studies according to the content of broad teacher learning goals or professional development focus because these were more likely to be differentially effective under different circumstances. Deciding which category a study belonged to was difficult at times and, as a result, some studies are included in two categories because the focus of the professional development relates to both.

The different learning areas were our first (and obvious) source of different circumstances. There were enough studies focused on interventions intended to develop teachers' understanding of curriculum, pedagogy, and/or pedagogical content knowledge in mathematics, science, and literacy for us to be able to analyse these areas separately. The findings are presented in Chapters 6, 7, and 8.

A second category, reported in Chapter 9, included those projects where teachers came to think differently about the students for whom they were responsible. Typically, the studies in this group sought to re-balance some kind of inequality. Two groups of studies were included in this category. The first group had as an explicit goal that teachers would think differently in some way about students in terms of their social positioning, their expectations, or their abilities. The second group focused on the acquisition of some kind of content or pedagogical knowledge and indirectly addressed the issue of how teachers thought about their students.

Some studies with documented outcomes for students fell outside of these categories, for example, professional development associated with comprehensive school reform, but these studies have been used to inform other aspects of the synthesis and the final section on topical issues.

The analysis of each of the broad categories was undertaken in terms of the framework outlined in Chapter 4 and summarised in Figure 4.1. The findings are brought together at the end of each chapter.

Chapter 10 brings together the evidence related to five topical issues: the multiple roles of assessment in promoting teacher learning, leadership, and professional development, the role of teacher theories and professional learning communities, and an analysis of studies in secondary school education. The analysis of these issues does not follow the same sequence as the earlier chapters but is more theoretical, and organised according to the findings for the topic.

References

1 Haig, B. (2004). *Methodological considerations for generating Best Evidence Syntheses Iterations*. Unpublished paper prepared for the Ministry of Education's Iterative Best Evidence Synthesis Programme. Christchurch, NZ: Department of Psychology, University of Canterbury. Available upon request from adrienne.altonlee@minedu.govt.nz.

Pawson, R. (2002). Evidence-based policy: The promise of realist synthesis. *Evaluation, 8* (3), 340-358.

2 A problem became evident when the studies were analysed. Few studies were found that documented student outcomes other than for subject-based curricula and most of the curricula were in the areas of literacy, mathematics, and science. Curriculum leaders and organisations were contacted for more studies in particular areas, but few additional qualifying studies were located.

3 Earl, L. & Katz, S. (2002). Leading schools in a data rich world. In K. Leithwood & P. Hallinger & G. Furman & P. Gronn & J. MacBeath & B. Mulford & K. Riley (Eds.), *The second international handbook of educational leadership and administration*. Dordrecht, NL: Kluwer.

4 The No Child Left Behind Act of 2001 (Public Law 107-110), commonly known as NCLB, requires States to create an accountability system of assessments, graduation rates, and other indicators. Schools have to make adequate yearly progress (AYP), as determined by the state, by raising the achievement levels of subgroups of students such as African Americans, Latinos, low-income students, and special education students to a state-determined level of proficiency.

5 NEMP (2004). *The National Education Monitoring Project*. Educational Assessment Research Unit, University of Otago. Retrieved from the World Wide Web: http://nemp.otago.ac.nz/i_about.htm

6 Elley, W. B. (2001). *Supplementary tests of achievement in reading.* Wellington, NZ: New Zealand Council of Educational Research.

Hattie, J., Brown, G., & Keegan, P. (2005). *asTTle V4 Manual 1.1*. Auckland, NZ: University of Auckland.

7 Guskey, T. R. (2000). *Evaluating professional development.* Thousand Oaks, CA: Corwin Press.

8 Scott, W. R. (1995). *Institutions and organizations*. Thousand Oaks: Sage Publications.

9 Wiggins, G. & McTighe, J. (1998). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

5. Outcomes for Students

When analysing the impact on student outcomes reported in the selected studies for this synthesis, we examined the nature and magnitude of changes, if any, in student outcomes that occurred during and after teachers' professional learning and development. We defined desirable student outcomes in terms of gains in academic achievement; enhancement of personal identity, self-esteem, self-concept, and attitudes towards learning; and improvement in interactions with, and acceptance by, peers and teachers, as well as attachment to schools. Positive, negative, or null effects were measured by comparing actual outcomes with the intended outcomes of the teachers' new classroom practice. We used effect sizes to assist in judging the impact if sufficient quantitative data were available. If the necessary statistical data were not sufficient for computing effect sizes, or if findings were described in narrative form, we made interpretive judgment of the impact in terms of the educational significance for the targeted groups of students.

It needs to be noted that some studies did not clearly identify the necessary information for the team to be confident that the study was of sound design, with appropriate controls in place and with data clearly specified for the computation of effect sizes. As noted in the methodological description, many studies were not used in the synthesis because the study design information and data were inadequately reported. Those studies that were used provided sufficient details for us to have confidence in the study design and the reporting of data. Details of how we assessed methodology are found in Appendix 2.2. Apart from these basic checks, the data found in the various papers were used as reported, unless further calculations were needed for the purpose of obtaining effect sizes. A member of the team with expertise in quantitative research methodology undertook these effect size calculations. If the presentation of information and data had been more standardised, this would have allowed for more systematic comparisons to be made and more studies to be included in the analysis.

5.1 Effect sizes for quantitative outcomes

Effect size is a common currency for reporting and interpreting the magnitude of an observed treatment effect. It is used to quantify the effectiveness of a particular intervention, compared to some reference point[1]. In educational research, effect sizes can provide a useful indication of a programme's effects on student outcomes, which can be compared across studies and programmes. For our analysis, we used reported effect sizes of student outcomes, if available, or more frequently, calculated effect sizes from the data provided. Appropriate transformations were applied according to the types of data reported, using the formulae in Appendix 2.2.2.

Effect sizes express the increase or decrease in outcome score of a group of students who are exposed to some instructional circumstance, using standard deviation units. This measure is particularly relevant to this synthesis because it takes into account both the mean shift in scores and the amount of variance. If the mean improves for both the middle and lower group of students, for example, a larger effect size will be evident than if the improvement were for the middle group only.

Typically, outcome scores are distributed according to a normal ('bell curve') distribution. The normal distribution has a range of about three standard deviations above and below the mean. In a normal distribution, approximately 68 percent of scores are found within one standard deviation of the mean. Because effect sizes are based on a normal distribution, they can be readily translated into percentile gains and stanines. To give a sense of the scale, an effect size of +1.00 indicates that the mean of the group exposed to one set of circumstances is at the 84th percentile of the group exposed to another set of circumstances. An effect size of +1.00 would be equivalent to two stanines, 15 points of I.Q., or 100 points on the SAT scale.

5.1.1 Issues in interpreting the magnitude of effect sizes

Interpreting the educational significance of any treatment effect is, at best, an inexact science. Reporting in terms of the magnitude of effect sizes is no exception, so effect sizes can be used only as an indicator. Cohen[2] hesitantly defined effect sizes as ‘small, d = 0.20’, ‘medium, d = 0.50’, and ‘large, d = 0.80’, and warned that “there is a certain risk inherent in offering these benchmark figures for use in power analysis in diverse fields of inquiry” (p. 25). In *The Joint Dissemination Review Panel Idea Book* published by the National Institute of Education and the U.S. Office of Education, an effect size of 0.25 or more is considered to be educationally significant[3]. Lipsey and Wilson’s more recent (1993) compendium of meta-analyses concluded that psychological, educational, and behavioural treatment effects of modest values, even from d = 0.10 to d = 0.20, should *not* be interpreted as trivial[4]. Hattie reported a synthesis of 337 meta-analyses: 200,000 effect sizes from 180,000 studies representing more than 50 million students and covering almost all types of innovation in education[5]. His conclusion was that most innovations introduced to schools improve achievement by, on average, 0.40 of a standard deviation. This provides a benchmark by which to judge effects, as it is based on the effects of actual educational innovations.

When making comparative statements between studies on the basis of effect sizes, other cautions need to be noted. For example, some effect sizes were reported for quasi-experimental studies that used control/comparison groups. As would be expected, these studies typically had smaller effect sizes than those studies that used increases over baseline measures because the former studies took into account expected progress. In order to allow the reader to interpret the robustness of the research designs, information on standard aspects of the control/comparison design is provided.

Another issue is the degree of alignment between the test and the new teaching practice. Tests that directly measure desired changes in teaching practice are more likely to result in a larger effect size than those that are less directly aligned. For example, in the Numeracy Development Projects in New Zealand[6], a number framework with stages was developed and then used both for focusing teaching and measuring progress. We do not have a problem with this. The point we make is that, in such circumstances, a larger effect size is to be expected than would be the case if a more general assessment tool, less closely tied to teaching progressions, was used. Indeed, a smaller effect size was obtained when a comparative measure involving TIMSS[7] items was employed.

A related alignment issue needs to be considered when using standardised tests. In the United States, for example, much has been made of the narrowing of the curriculum in many state tests[8]. Several of the studies we analysed used these tests but noted they did not assess the depth and sophistication of knowledge promoted through the professional development[9]. Standardised tests should not, however, be equated with a narrow curriculum because many standardised tests measure both deep and surface knowledge[10].

Other measurement issues relate to the domain measured. Several of the mathematical studies, in particular, showed higher effects for problem-solving and conceptual understanding than for computation. Given that the focus of the professional development was on these former qualities, this does not present a problem. What is a problem is that in several of these studies, students’ attitudes towards mathematics declined. Which of these outcomes matters?

Effect sizes for populations with special educational needs were very high in several instances. This could be accounted for partly by the very low starting points of these students (which meant that they had more scope for improvement) and partly by regression to the mean. We have not attempted to determine which of these biases were operating but have reported the effect sizes, and, where there was a very low pre-test score, have noted this so that readers can interpret the results for themselves. Other measurement issues arise in relation to the number of teachers and students involved. It is easier to obtain a large effect size when a small number of teachers are involved in an intensive intervention than when an intervention applies to tens of thousands of students. This is because it is easier to have an impact on a small than a large group and because sample size can impact on variability. Because of this, we have reported the number of students involved, if known.

For these reasons, we took a relatively conservative but flexible approach when interpreting effect sizes, considering them indicative only. As a general and flexible rule of thumb, an effect size between 0 and 0.20 was considered to represent no-to-weak impact; between 0.20 and 0.40, a small but educationally significant impact; between 0.40 and 0.60, a medium, educationally significant impact; and greater than 0.60, a large, educationally significant impact.

5.1.2 An overview of studies with student outcomes and effect sizes

Among the 97 studies selected for analysis, there were 72 studies (16 New Zealand and 56 international) that reported sufficient statistical data for student outcomes to be calculated in terms of effect sizes. The right-hand column in the table provides information about the control/comparison groups that involved between-group comparisons.

In order to assist the reader to interpret the tables, we list the rules used to categorise studies:

1. Grades K–6 are classified as primary; grades 7–8, intermediate; grades 9+, secondary. Where a majority of grades are of one type (grades 6–8) the study is classified according to the majority. Studies across years 1–8 are classified as primary; those across K–12 as 'all'.
2. All numeracy outcomes are classified as mathematics outcomes.
3. When the number of classes or teachers is reported but not the number of students, study size is estimated by multiplying the number of teachers or classes by 25.
4. All instruments developed by researchers or which required a judgment to be made are classified as researcher/judgment. Those that are published, standardised, objectively scored assessments are objective, standardised. Instruments that involve judgment against published rules are classified as researcher/judgment (e.g. Clay 1993 Observation Survey of Early Literacy Achievement, NumPA diagnostic survey, running record).

Table 5.1. A list of studies with effect sizes (ES) of student outcomes

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
I. Studies from New Zealand				
1. (Absolum 2004a; Absolum 2004b)[11]	Reading (Years: not known) NZ	**0.61** (n = 756), as measured by Running Record **0.54** (n = 756), as measured by asTTle. We have been unable to validate these effect sizes independently because necessary data were not reported.		

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
2. (Alton-Lee, McBride, et al. 1997)[12]	Self-esteem (Years 7–8) NZ	Girls: **0.64**; Boys: **0.42**; (became comparable) All: **0.53** (n = 60), as measured by the Coopersmith Self-Esteem Inventory (CSEI). Duration: 3 months		
3. (Anand & Bennie 2005)[13]	Literacy/ Language Skills (Early primary) NZ	Overall (successful over unsuccessful) 2003: **2.96** (n = 10,875), as measured by a combined score of three tests: the Reading Recovery Instructional Text Level, the Burt Word Reading Test, and the Writing Vocabulary. Duration: 1 year		
4. (Bishop et al. 2005; 2006)[14]	Essential Skills –Information Skills (Years 9–10 Māori) NZ	Māori students in Te Kotahitanga: **0.42** (2004 data) (n = 319) **0.31** (2005 data) (n = 760), as measured by ESA. Duration: 1 year (04–05)		
	Mathematics (Years 9–10 Māori) NZ	Māori students in Te Kotahitanga: **0.76** (n = 236), as measured by asTTle. Duration: 1 year (2004–05)	Compared with Māori students in non-Te Kotahitanga: **0.52** (n = 403), as measured by asTTle. Duration: 1 year (04–05)	Experimental group: Māori students with teachers involved with Te Kotahitanga = **236**; control group: Māori students with teachers not involved = **167**, and asTTle national norms data. Samples compared within schools. Teachers volunteered, and asTTle school results for control samples were made available.
5. (Davis 2006)[15]	Reading (Years 5–9) NZ	**0.31** (n = 1,158), as measured by STAR, a standardised norm-referenced test. Duration: 1 year (2003)	**0.08** (n = 11,164), as measured by STAR, a standardised norm-referenced test.	Experimental group: 146 students; control group: 1018 students. Comparisons made between schools. Staff were asked to volunteer. Lead teachers were identified by principals and/or peers.

6. (English & Bareta 2005)[16]	Reading (Years 3–7) NZ	(2005 over 2004) **0.87** (n = 3,787), as measured by STAR Lowest 20% **1.97** (n = 845) Māori students **0.93** (n = 890) Duration: 2 years		
	Writing (Years 3–7) NZ	(2005 over 2004 – moderated sample) Year 4: **1.29** (n = 347) Year 5: **1.22** (n = 332) Year 6: **1.34** (n = 135) Year 7: **1.27** (n = 244) Overall: **1.27** n = 1064) Lowest 20% **2.05** (n = 212) Māori students **1.16** (n = 189) as measured by asTTle		
7. (Fung, 2006)[17]	Writing		**1.04** (n = 116), as measured by a researcher-developed test Duration: 4–10 weeks	Experimental group: 60 students; control group: 31 students. Teachers who volunteered became part of the programme and teachers who did not volunteer became the comparison group. Classes were compared within the same school.
	Writing – understanding the subject matter		**1.61** (n = 116), as measured by a researcher-developed test Duration: 4–10 weeks	
	Writing		**1.13** (n = 91), as measured by a researcher-developed test Duration: 4–10 weeks	
8. (McDowall, Boyd, et al. 2005)[18]	Literacy/ Language skills	**3.73** (n = 7271), as measured by a standardised test Duration: 1 year		
9. (McNaughton, Lai, et al. 2004)[19]	Reading (Years 4–8) NZ	Year 4: **0.23** (n = 205) Year 5: **0.38** (n = 208) Year 6: **0.24** (n = 265) Year 7: **0.40** (n = 267) Year 8: **0.45** (n = 271) Overall: **0.34** (n = 1,216) as measured by STAR Duration: 2 school years (2003–04)		

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
10. (Phillips, McNaughton, et al. 2001)[20]	Literacy (Years 0–1) NZ	6 years: **0.48** (n = 177), as measured by Clay's (1993) Observation Survey	5 years: **0.29** (n = 72) 5.5 years: **0.55** (n = 227) Overall: **0.48** (n = 478), as measured by Clay's (1993) Observation Survey	Experimental group: 343 students; control group: 135 students. Comparisons made between schools, within schools, and within teachers (multiple baseline). Schools had similar demographics. Experimental and control students were matched by common instructional environment: students were with the same teacher over the same period of time pre- and post-intervention.
11. (Parr, Timperley, et al. 2006)[21]	Writing (Years 4–8)	**1.04** (n = 94), as measured by asTTle		
12. (Thomas & Tagg 2005)[22]	Math (Years 4–6, particularly Māori) NZ		Over NZ TIMSS results: Overall: **0.08** (n = 2995), with Year 4: **0.13**; Year 5: **0.17**; Year 6:**–0.06**, as measured by a 24-item test adapted from TIMSS 1995. Duration: 3 years (2002–04)	Experimental group: 2,995 students, compared with national norms on earlier assessment of TIMMS. Participation voluntary at school level.
13. (Timperley and Phillips 2003)[23]	Reading (Years 0–1) NZ		**0.53** (n = 193), as measured by Clay's (1993) Observation Survey of Early Literacy Achievement.	Experimental group: 193 students compared with national norms. Comparisons made between schools, within schools, and within teachers (multiple baseline). Schools had similar demographics. Experimental and control students were matched by common instructional environment: students were with the same teacher over the same period of time pre- and post-intervention.
14. (Timperley 2005a)[24]	Reading (Years 1–2) NZ		**0.88** (n = 546), as measured by combined Text Level, BURT, & reading scores. Duration: 3 years	Experimental group: 261 students; control group: 285 students. Comparisons made between schools. Schools had similar demographics. Participation voluntary at school level.

15. (Timperley, Bertanees, et al. 2006)[25]	Writing (Elementary) NZ	Overall: **1.03** (n = 96) as measured by asTTle Duration: 4 months		
16. (Young-Loveridge in Higgins et al. 2005)[26]	Math (Years 0–8) NZ		Younger After Over Older Before Y2 over Y3: **0.45** Y3 over Y4: **0.30** Y4 over Y5: **0.32** Y5 over Y6: **0.34** Y6 over Y7: **0.40** Y7 over Y8: **0.27** Overall: **0.34** (n = 70,000), as measured by the diagnostic interview (NumPA), with addition/ subtraction: **0.19**; multiplication/division: **0.40**; proportion/ratio: **0.43**. Duration: 1 year	Experimental group: 70,000. Comparisons made within schools and between schools (multiple baseline). Possible instrument effect that may affect reliability.
II. Studies from the UK				
17. (Adey 2004)[27]	Cognitive Development (Secondary)	Overall **0.64** (n = not known), as measured by the Chelsea Survey		
18. (Earl, Watson, et al. 2003)[28]	Reading (11-year-olds to achieve Level 4 at Key Stage 2) UK	**0.18** (2002 over 1998), as measured by the Key Stage national assessments (n = national 11-year-old student population)		
	Writing (11-year-olds to achieve Level 4 at Key Stage 2) UK	**0.14** (2002 over 1998), as measured by the Key Stage national assessment (n = national 11-year-old student population)		
	Math (11-year-olds to achieve Level 4 at Key Stage 2) UK	**0.09** (2002 over 1999) (n = 10 schools, ranged in size from 115 to 475 11-year-old students)		

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
19. (Rubie-Davies, Baines, et al. 2005)[29]	Participation & Engagement in Classroom Discussions (Key Stages 1–3) UK		**0.21** (n = 60), as measured by a researcher-developed instrument	Experimental group: 7 schools, 10 classes, 31 groups of up to 4 students; control group: 7 schools, 12 classes, 29 groups of up to four students. Comparisons made between groups of students. Permission required from students for filming. Some groups were removed due to technical difficulties or adult-dominated group discussions. Students were unaware of when they were being filmed.
20. (Shayer 1999)[30]	Cognitive Development (Secondary)	**0.85** (n = 63 classes in 8 schools), as measured by the Chelsea Survey Duration: 2 years (1991–93)		
III. Studies from the US				
21. (Appalachia Educational Lab 1994)[31]	Higher cognitive level reflected in classroom discussions (Secondary)		**0.17** (n = 95 classes), as measured by a researcher-developed instrument	Three conditions were developed. No 'no treatment' control was included. Condition A: 37; condition B: 28; condition C: 30. Randomised, pre–post, comparison group design. Teachers either volunteered or taught in a district where participation was mandatory. Some incentives were provided depending on the district. Volunteers were given a choice of treatments. Schools were randomly assigned to a treatment, then 50 teachers from each treatment were randomly selected for further analysis.

22. (Baker and Smith 1999)[32]	Phonemic Awareness Skills (K)	**0.81** (n = 40)	**0.29** (n = 227) **0.55** (n = 227), as measured by a standardised test, the Yopp-Singer Test	Experimental groups: 53 students, 48 students; control group: 56 students, 30 students. The two experimental groups were from the entire population of the same kindergarten for two different years. The first control group was from the same kindergarten before the project began. The second control group was randomly selected from another kindergarten and considered to be the 'benchmark standard' due to a perceived high standard of teaching.
23. (Bianchini 1997)[33]	Science (Grade 6) US	**1.06** (n = 80) (Duration: 4 months), as measured by a researcher-developed test		
24. (Bond et al. 2000)[34]	Depth of understanding evident in student work samples		**0.96** (n = 36 teachers), as measured by researcher-developed protocols tied to unit of instruction. Work samples assessed according to SOLO taxonomy	Experimental group: 19 certified teachers by National Board for Professional Teaching Standards; control group: 17 unsuccessful applicant teachers (10 teachers did not supply student work samples – unclear if from experimental or control groups). Both groups volunteered.
	Writing		**0.13** (n = 55 teachers), as measured by a researcher-developed test	Experimental group: 29 certified teachers by National Board for Professional Teaching Standards; control group: 26 unsuccessful applicant teachers (10 teachers did not supply student writing samples – unclear if from experimental or control groups). Both groups volunteered.

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
25. (Borman, Slavin, et al. 2005)[35]	Success for All Literacy/ Language (K–2) US		**0.18** (n = 41 schools), as measured by the Peabody Picture Vocabulary Test at pre-test and the Woodcock Reading Mastery at post-test. Duration: 2 years (01-03)	Experimental group: 2,260 students (21 schools); control group: 2,254 students (20 schools) Schools were randomly assigned to experimental or control conditions. Schools were recruited using financial incentives, then when a larger sample was needed, all participating schools would receive part of the programme (at a particular grade level) at no cost. 80% majority vote by faculty of schools was required for participation. Schools with grades not in the programme were used as controls for schools with those grades as part of the programme, and vice versa. Comparisons made between schools.
26. (Borman, Slavin, et al. 2005)	Direct Instruction Reading (Primary) US		**0.21** (an effect size derived from a meta-analysis of 182 observations)	
27. (Borman, Slavin, et al. 2005)	School Development Program Reading (Primary) US		**0.15** (an effect size derived from a meta-analysis of 25 observations)	
28. (Cardelle-Elawar 1995)[36]	Math (Grades 3–8)		**4.63** (n = 469), as measured by a researcher-developed test (high ES possible because scores on pre-test between 0–3)	Experimental group: 297 students; control group: 172 students. Sample included all data from 18 classes in grades 3–8 at one elementary school and one junior high school. Comparisons made between classes within schools. Students were randomly assigned to classes at the beginning of the year. 12 classes were randomly assigned to the experimental group. Teachers who chose to participate received one unit of university credit. Control group offered training after experiment was finished.
	Attitudes toward Math (Grades 3–8)		**4.27** (n = 469), as measured by Aiken's (1974) attitudes toward mathematics scales (high ES possible because scores on pre-test very low)	

29. (Carpenter, Fennema et al. 1989)[37]	Math (Grade 1) US		With computation: **0.59**; problem solving: **0.41** as measured by ITBS-Levels 6 & 7 as well as strategies used for problem solving: **0.76**, overall: **0.59** (n = 40), as measured by a researcher-developed test. Duration: 1 year	Experimental group: 20 teachers; control group: 20 teachers. Comparisons made between classes. Teachers assigned randomly by school to treatment conditions. 12 students selected randomly from each class to serve as experimental subjects. Teachers were volunteers and received $100 for each year of the study.
	Attitudes toward Math (Grade 1) US		**0.45** (n = 40), as measured by researcher-developed tests	
30. (Caulfield-Sloan & Ruzicka 2005)[38]	Science (Grade 3) US		**1.27** (n = 120), as measured by a researcher-developed test	Experimental group: 60 students; control group: 60 students. Comparisons made between classes. Teachers were placed in experimental or control groups after being matched on their background and teaching experience. Five student responses randomly chosen from each teacher group. These students were then matched on IQ, academic performance, and whether they qualified for a free or reduced-cost lunch. All teachers were offered training after the experiment had finished. Two teachers were dropped from the experimental group as they did not use the training in their teaching.
31. (Cobb, Wood, et al. 1991)[39]	Math (Grade 2)		Computation: **–0.01** Concepts & applications: **0.3** Overall: **0.15** as measured by ISTEP, a standard norm-reference test Computation: **–0.06** Conceptual understanding: **1.04** Overall: **0.49** (n = 338), as measured by a researcher-developed test	Experimental group: 187 students (10 classes); control group: 151 students (8 classes). Experimental and control classrooms in same school, spread over three different schools. Ratio: 5:2, 3:2, 2:4. Project teachers volunteered. Unclear about control teachers
	Attitudes toward Math (Grade 2)		**–0.23** (n = 338), as measured by a researcher-developed test	

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
32. (Confrey, Castro-Filho, et al. 2000)[40]	Academic Skills (High school-inner city) US	**0.22** (n = 1,650 – one school), as measured by TAAS test. Duration: 3 years		
	Math-Algebra (High school-inner city) US	**0.34** (n = 1,650 – one school), as measured by Algebra I EOC. Duration: 1 year		
33. (Curriculum Research and Development Group. University of Hawaii 2002)[41]	Science (Secondary)		**2.85** (n = 128), as measured by the CTBS Science Level H Form U, a standardised instrument	Experimental group: 66 students; control group: 62 students. Students were randomly selected from 25 experimental classes and 25 control classes. Equivalency of the samples was established on the basis of standardised student achievement scores.
34. (Datnow, Borman, et al. 2003)[42]	Reading for LEP (Elementary) US	**0.62** (n = 867)	**0.33** (n = 1547, in 26 schools), as measured by researcher-developed tests Duration: 4 years	Experimental group: 867 students (13 schools); control group: 680 students (13 schools) Schools were chosen according to whether they were perceived to be exemplary in their implementation efforts. Lowest performing schools were excluded. Participating schools varied in student demographics. 13 matched (by student demographics) comparison schools chosen for control group. All schools considered to be representative.
	Math (for LEP) (Elementary) US	**0.37** (n = 867)	**0.11** (n = 1547, in 26 schools), as measured by researcher-developed tests Duration: 4 years	
35. (Dubner, Samuel, et al. 2005)[43]	Science (High school)	**0.19** (n = 3,481), as measured by Regents Science Exam Pass Rates	**0.16** (n = 17,151), as measured by Regents Science Exam Pass Rates	Experimental group: 3481 students; control group: 13,670 students. Comparisons were made between classes. Teachers were volunteers.
36. (Fishman, Marx, et al. 2003)[44]	Science (Grades 6–8) US	**0.73** (n = 2,925), as measured by a researcher-developed test Duration: 1 year		

37. (Flay & Allred 2003)[45]	Reading (Elementary, and Secondary)		**1.11** (n = 93 schools), as measured by the Florida Reading Test	Experimental groups: group 1 = 45 schools, group 2 = 20 schools, matched sets – 12 of each (24 total); control groups: 28 schools, matched sets – 12 schools. Comparisons were made between schools; schools were matched for student socio-economic status, student turnover, and similar ethnic distributions. Matched sets were groups of three schools. School-level archival data was used.
	Aptitude		**0.64** (n = 93 schools), as measured by FCAT	
	Behavioural improvement		**0.08** (n = 93 schools), as recorded by disciplinary referrals. Duration: 4–9 years	
38. (Goldenberg & Sullivan 1994)[46]	Reading (Grades 1–3: L2-English) US	**0.24**, as measured by CAP Duration: 1 year (1992–93) (n = 800 – total number of students in one district of LA)		
	Writing (Grades 1–3: L2-English) US	**0.16**, as measured by CLAS. Duration: 1 year (1992–93) (n = 800 – total number of students in one district of LA)		
	Reading (Grades 1–3: L1-Spanish) US	**0.27**, as measured by SABE. Duration: 1 year (1992–93) (n = 800 – total number of students in a district of LA)		
39. (Gottfredson, Marciniak, et al. 1995)[47]	Reading (Grades 1–5)	**0.07** (n = 635)	**–0.01** (n = 556), as measured by BSAP, standardised tests	Three schools used. Experimental school A: 306 students; control school A: 329 students; control school B: 250 students. Comparison school B selected because of similarity to experimental school A. School B students selected were a stratified (by grade level) random sample. Comparisons made between schools and within school. Teachers were volunteers.
	Math (Grades 1–5)	**0.10** (n = 635), as measured by standardised tests	**–0.02** (n = 556), as measured by BSAP, standardised tests	

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
	Academic Self-Concept (Grade 5)	**0.04** (n = 122), as measured by standardised tests	**0.09** (n = 166), as measured by a researcher-developed academic self-concept scale	5th graders only used for this analysis
	Attachment to School (Grade 5)	**0.34** (n = 117), as measured by standardised tests	**–0.11** (n = 163), as measured by a researcher-developed scale	
40. (Hamilton & Gingiss 1993)[48]	Attitudes toward sexuality education (Grade 6) US		**0.33** (n = 788), as measured by a researcher-developed attitude scale	Experimental group: 21 schools, 35 teachers, 788 students. Most influential teachers compared with least influential teachers within same schools. Teachers either volunteered or were asked to participate.
41. (Hirshman 1996)[49]	Reading (Grades 2–5) US	**0.38** (n = 1,167), as measured in terms of NCEs. Duration: 3 years (1987–90)		
	Maths (Grades 2–5) US	**0.52** (n = 1,167), as measured in terms of NCEs. Duration: 3 years (1987–90)		
42. (Huffman, Goldberg, et al. 2003)[50]	Physics (High school) US		**0.47** (experienced over beginning) (n = 288) **0.70** (beginning over control) (n = 194) **1.08** (experienced over control) (n = 250) as measured by the Force Concept Inventory Test	Experimental groups: group 1 (experienced) = 9 classes, 4 teachers, 172 students; group 2 (beginning) = 8 classes, 4 teachers, 116 students; control group: 6 classes, 5 teachers, 78 students. Comparisons made within and between schools. Comparison teachers matched to experimental group 2 teachers according to teaching experience and characteristics of students in their classes. Possible effect with class sizes and number of teachers: most teachers had 2 or more classes in the experimental group but control teachers only had 1 or 2 classes each.

43. (Kahle, Meece, et al. 2000)[51]	Science (Grades 6–8) US		**0.39** (n = 374), as measured by a researcher-developed test	Experimental group: 8 teachers; control group: 10 teachers. Schools chosen randomly but had to have at least one SSI (Statewide Systemic Initiative) trained teacher. Then a sub-sample was chosen on the basis that they had at least 30% minority group students enrolled. SSI-trained teachers were randomly selected then matched with the non-SSI-trained teachers from the same school. Control teachers were volunteers.
	Attitudes toward Science (Grades 6–8) US		**0.11** (n = 374), as measured by a standardised test	
44. (Klingner, Vaughn, et al. 2004)[52]	Reading (Grade 4, particularly students with learning disabilities) US		**0.39** (n = 211), as measured by Gates-MacGinitie Level 4) Duration: 1 year	Experimental group: 113 students; control group: 98 students. Teachers were matched on years of teaching and education as well as student demographics. Comparisons made between classes. Permission was asked of students to participate, and 69% agreed.
45. (Maheady & Harper 1991)[53]	Spelling (Grades 4–5) US	**0.31** (n = 198), as measured by weekly spelling tests. Duration: 1 year		
46. (Mason & Good 1993)[54]	Math (Grades 4–6)		Whole class over two-group: **0.29** (n = 1,198) Whole class over control group: **0.27** (n = 1,250) Two-group over control group: **–0.03** (n = 1,024), as measured by the standardised tests of ITBS and the MMAT	Experimental groups: 486 students, 25 teachers, 712 students, 30 teachers; control group: 538 students, 24 teachers. 9 schools were chosen based on mean aptitude and maths scores from the previous year. Schools were matched and then randomly assigned to treatment conditions. 98% of teachers participated by consenting to classroom observation. All groups of students were comparable. Comparisons were made between classes.

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
47. (McKenzie, Sallis, et al. 1993)[55]	Quantity & Quality of Physical Ed Activities (Grade 4) US		**1.22** (n = 26 classes), as measured by a researcher-developed instrument	Two experimental groups: group 1 = 10 classes, group 2 = 8 classes; control group: 8 classes. 7 out of 12 schools from a single district were used. Schools were matched for size and ethnic make-up, then randomly assigned to one of three groups. Comparisons made between classes. School administrators volunteered.
48. (Metcalf, Vontz, et al. 2000)[56]	Civic Knowledge (Adolescent students) US, Latvia, & Lithuania		**1.0** (n = 1,412), as measured by CDI Duration: 1 year	Experimental group: 51 classes, 712 students; control group: 51 classes, 700 students. Individual student data aggregated by class. Comparison and treatment classes were comparable.
49. (Montes 2002)[57]	Reading (Grades 6–8 – a high % of at-risk and ELL students) US		All: **0.05** (n = 1,350) English Language Learners: **0.19** (n = 277) At-risk: **0.05** (n = 1,073) as measured by the Reading Texas Learning Index Duration: I year	Experimental groups: 177 ELL students, 637 at-risk students, 126 ELL and at-risk students;cControl groups: 100 ELL students, 436 at-risk students, 85 ELL and at-risk students. Comparisons made between classes. Programme and non-programme groups of students were similar.
	Maths (Grades 6–8 – high % of at-risk & ELL students) US		All: **0.06** (n = 1,350) English Language Learners: **0.18** (n = 277) At-risk: **0.05** (n = 1,073) as measured by the Mathematics Texas Learning Index Duration: I year	
50. (Mucherah, Lapsley, et al. 2004)[58]	Sociomoral Climate in Elementary School Classrooms (Grades 4–5) US		**0.32** (n = 67), as measured by a researcher-developed test. Duration: 10 weeks	Experimental group: 46 students; control group: 21 students. Comparisons made between classes. Classes randomly assigned to treatment and control groups. Permission slips were required from students.

51. (Palincsar, Magnusson, et al. 2001)[59]	Science – Conceptual Understanding (Grades 4–5)	Normally achieving: **0.49** (n = 60) Low-achieving: **0.66** (n = 31) With learning disabilities and emotional impairment: **0.62** (n = 19), as measured by a researcher-developed test Duration: 1 Year (1998–99)		
52. (Parke & Coble 1997)[60]	Attitudes toward Science (Grades 6–8)		**0.59** (n = 325), as measured by a researcher-developed scale	Experimental group: 205 students; control group: 120 students. Comparisons made between schools. Teachers were volunteers. Experimental group of teachers all came from one school. Control group of teachers came from other schools in the same district.
53. (Phillips 2003)[61]	Academic Skills (Grades 6–8) US	**0.93** (n = 1,425), as measured by TAAS. Duration: 3 years (2000–02)		
54. (Pritchard 1987)[62]	Writing (High school) (US)		Junior High: **0.72** (n = 157); Senior High: **0.06** (n = 236); Overall: **0.39** (n = 393), as measured by researcher-developed tests	
55. (Raghavan, Cohen-Regev, et al. 2001)[63]	Science (Grade 5) US		**0.19** (over national norm) (n = 3,123), as measured by items related to the TIMSS **0.28** (over international norm) (n = 3,123), as measured by items related to the TIMSS	Experimental group: Cohort 1 = 1581 students. Control group: Cohort 2 = 1542 and national norms. One grade 5 teacher randomly selected from each school for analysis. Volunteered at district level.

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
56. (Saxe, Gearhart, et al. 2001)[64]	Math (Grades 4–5) US		Conceptual Understanding: **1.63** Computation: **–1.01**, Overall: **0.31** (n = 23 classes), as measured by researcher-developed tests	Two experimental groups: 9 teachers, 8 teachers; control group: 6 teachers. Sample drawn within a 40 mile radius across UCLA. Data analysed between groups and within groups. Sample teachers were assigned to a group according to specific criteria. Then experimental subjects were stratified and randomised into two groups. These two groups were then matched for the extent of their participation in recent mathematics reform workshops. All subjects were volunteers.
57. (Schacter & Thum 2005)[65]	Total Achievement in Reading, Math & Language (K–6) US		**0.35** (n = 3,123) in 2000–01 **0.41** (n = 2,649) in 2001–02 as measured by Stanford 9th Edition Achievement Tests (Grades 2–6). Duration: 1 year	Experimental group: 1,114 students in 2000–01, 1,277 in 2001–02; Control group: 2,009 in 2000–01, 1,372 in 2001–02. Achievement data were matched. Comparisons made between schools. Comparison schools chosen based on similarities to experimental schools.
58. (Schober 1984)[66]	Economics (Secondary)		**0.68** (n = 642), as measured by a standardised test of economic literacy	Two experimental groups: 7 economics teachers, 143 non-economics teachers (219 students overall); two control groups: 13 economics teachers, 84 non-economics teachers (423 students overall). Control groups were stratified and randomised; they were drawn randomly from all non-participant economics teachers and all non-participant non-economics teachers. Treatment groups were the entire population of participants. In-service workshops (7) were assumed to be similar. Each teacher selected their 'best' class for analysis.
	Attitudes toward Economics (Secondary)		**0.12** (n = 642), as measured by a standardised survey scale	

59. (Stallings & Krasavage 1986)[67]	Reading (Grades 1–4)	**0.09** (n = 102), as measured by the Stanford Achievement Test, and the California Achievement Test		
	Math (Grades 1–4)	**0.11** (n = 102), as measured by the Stanford Achievement Test, and the California Achievement Test		
60. (Stevens & Slavin 1995)[68]	Math (Grades 2–6)		Regular Students: **0.20** Sp Ed Students: **0.47** Gifted Students: **0.39** (n = 873), as measured by the California Achievement Test	Experimental group: 411 students; control group: 462 students. Duration: 2 years. 21 classes (2 schools) were matched by achievement scores, ethnicity, and socio-economic background with 24 classes (3 schools). 75% of faculty in each school needed to agree to participate in order for the school to be a participant. Comparison schools did not need to volunteer; however, schools that were approached to participate but did not volunteer were not used as comparison schools.
	Attitudes toward Math (Grades 2–6)		Regular Students: **0.09** Sp Ed Students: **–0.02** Gifted Students: **0.03** (n = 873), as measured by a researcher-developed scale	
	Perceived math ability (Grades 2–6)		Regular Students: **–0.07** Sp Ed Students: **0.11** Gifted Students: **–0.02** (n = 873), as measured by a researcher-developed scale	
	Reading (Grades 2–6)		Regular Students: **0.25** Sp Ed Students: **0.81** Gifted Students: **0.67** (n = 873), as measured by the California Achievement Test	

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
	Attitudes toward Reading (Grades 2–6)		Regular Students: **–0.01** Sp Ed Students: **–0.10** Gifted Students: **0.08** (n = 873), as measured by a researcher-developed scale	
	Perceived Reading Ability (Grades 2–6)		Regular Students: **0.20** Sp Ed Students: **0.26** Gifted Students: **0.04** (n = 873), as measured by a researcher-developed scale	
	Language Skills (Grades 2–6)		Regular Students: **0.16** Sp Ed Students: **0.50** Gifted Students: **0.30** (n = 1,012), as measured by the California Achievement Test	
	Attitudes toward Language Skills (Grades 2–6)		Regular Students: **0.05** Sp Ed Students: **0.08** Gifted Students: **0.48** (n = 873), as measured by a researcher-developed scale	
	Perceived Language Ability (Grades 2–6)		Regular Students: **0.26** Sp Ed Students: **0.33** Gifted Students: **0.68** (n = 873), as measured by a researcher-developed scale	
	Social Relations (Grades 2–6)		Regular Students: **0.42** Sp Ed Students: **0.86** Gifted Students: **0.46** (n = 873), as measured by a researcher-developed scale	
61. (Taylor, Pearson, et al. 2005)[69]	Oral Reading Fluency (Grades 2–5)	**0.37** (n = 733), as measured by a standardised test		
	Reading (Grades 2–5)	**0.05** (n = 723) as measured by a standardised test		
	Writing (Grades 2–5)	**0.30** (n = 607) as measured by a standardised test		

62. (Vandevoort, Amrein-Beardsely, et al. 2004)[70]	Reading (Grades 3–6) US		**0.14** (n = 243,792), as measured by SAT-9. Duration: 4 years (1999–2003)	Experimental group: 1680 students from early and middle childhood teachers certified by control group: 242,112 elementary students in Arizona. Experimental group volunteered, not the control group. All districts were offered money for cooperation. One accepted but did not cooperate (refused to reveal their SAT scores). Gain scores used.
	Math (Grades 3–6) US		**0.15** (n = 251,859), as measured by SAT-9. Duration: 4 years (1999–2003)	Experimental group: 1,719 students of early and middle childhood teachers certified by National Board for Professional Teaching Standards; control group: 250,140 students of unsuccessful applicant teachers. Both groups volunteered. All districts were offered money for cooperation. One accepted but did not cooperate (refused to reveal their SAT scores). Experimental group numbers much smaller than control group numbers.
	Literacy/ Language (Grades 3–6) US		**0.09** (n = 250,605), as measured by SAT-9. Duration: 4 years (1999–2003)	Experimental group: 1,729 students of early and middle childhood teachers certified by National Board for Professional Teaching Standards; control group: 248,876 students of unsuccessful applicant teachers. Both groups volunteered. All districts were offered money for cooperation. One accepted but did not cooperate (refused to reveal their SAT scores). Experimental group numbers much smaller than control group numbers.

Study	Student outcomes	ES (over baseline)	ES (over control/ comparison groups)	Design characteristics of studies using control/ comparison groups
63. (Villar & Strong 2005)[71]	Reading (Grades 2–6)	**0.26** (n = 2,421), as measured by SAT-9. Duration: 1 year (2001–02)		
64. (Wilson, Darling-Hammond, et al. 2001)[72]	Math (Grades 4, 6, & 8) US	4th Grade: **0.16** 6th Grade: **0.16** 8th Grade: **0.21** Overall: **0.18** as measured by the growth on the Connecticut Academic Performance tests. (n = 389,325 – the total number of students in Connecticut) Duration: 6 years (1993–98)		
	Reading (Grades 4, 6, & 8)	4th Grade: **0.20** 6th Grade: **0.17** 8th Grade: **0.16** Overall: **0.18** (n = 389,325 – the total number of students in Connecticut), as measured by the growth on the Connecticut Academic Performance tests. Duration: 6 years (1993–98)		
65. (Wood and Sellers 1996)[73]	Math (Grade 3)		Computation: **1.49** Concepts & Applications: **0.46** Overall: **0.98** (n = 382), as measured by ISTEP, a standardised, norm-referenced test Computation: **0.45** Conceptual Understanding: **5.1** Overall: **2.78** (n = 382), as measured by a researcher-developed test. (Note: high ES possible because scores on pre-test very low)	Two experimental groups (different conditions): 119 students (6 classes); 129 students (6 classes); one control group: 134 students (7 classes). Teachers volunteered. Three of the participating schools contained both experimental groups in the same school. Two other schools only contained classes from the other control group. Comparisons made between classes.

	Attitudes toward Math (Grade 3)		**–0.73** (n = 248), as measured by a personal-goals-and-beliefs scale.	
IV. Studies from other countries				
66. (Anderson 1992)[74]	Active Reading & Intentional Learning (Grades 6–11 delayed readers) Canada		**2.09** (n = 16 classes), as measured by a researcher-developed instrument	Experimental group: 9 teachers (+ 7 support teachers); control group: 7 teachers. 83 students in total. Teachers randomly assigned to experimental and control groups. All teachers volunteered and control teachers were offered training after experimental period was finished.
67. (Angrist & Lavy 2001)[75]	Reading (L1-Hebrew) (Grade 4) Israel	**0.25** (n = 4,837), as measured by a state test		
	Math (Grade 4) Israel	**0.26** (n = 5,073), as measured by a state test		
68. (Ross 1994)[76]	Attitudes toward Help Seeking (Grades 7–9) Canada	**0.59** (n = 1,228), as measured by Newman (1990) attitude scale. Duration: 6 months between pre- & post-test		
	Attitudes toward Help Giving (Grades 7–9) Canada	**0.26** (n = 1,228), as measured by Newman (1990) attitude scale. Duration: 6 months		
69. (Ross, Roleiser, et al. 1999)[77]	Attitudes toward Peer & Self-evaluation (Grades 1–7) Canada		**0.23** (n = 5 classes), as measured by a researcher-developed scale	Experimental group: 13 teachers selected to participate were nominated as 'exemplary teachers' in their use of 'cooperative learning'. No controls. Five 'teacher-researchers' carried out the study.
70. Rowe et al. (2005)[78]	Reading		**0.31** (n = 10,126), as measured by a standardised test	Experimental group: 34 schools, 889 students; control group: 23 schools, 705 students. Student samples were matched.

71. (Van der Sijde 1989)[79]	Math (Grade 8) The Netherlands		**0.09** (n = 33 classes), as measured by CITO	Classes broken up into conditions 1–4. Condition 1: 13 classes; condition 2: 8 classes; condition 3: 6 classes; condition 4 (control group): 6 classes (with one dropped). Comparisons made between schools. Schools (with the participating teachers) were randomly assigned to a condition. Teachers were volunteers.
	Attitudes toward Math (Grade 8) The Netherlands		**0.37** (n = 33 classes), as measured by a standardised test	
72. (Veenman, Denessen, et al. 2005)[80]	Math (6th Grade) The Netherlands		**0.34** (n = 48), as measured by a researcher-developed test	Experimental group: 15 teachers, 24 students from 4 primary schools; control groups: 2 teachers, 12 students from 2 primary schools; 1 teacher, 12 students from 1 primary school. Comparisons made between groups of dyads (two-pupil groups). Students were stratified (mathematics ability) then randomly selected from each group. Students were paired with differing abilities within each pairing. Teachers then excluded inappropriate pairings. Participation was voluntary.
	High-level Elaboration (6th Grade) The Netherlands		**1.12** (n = 48), as measured by a researcher-developed instrument	

5.2 Summary of findings

The detailed data in Table 5.1 have been averaged in two different ways in Tables 5.2 and 5.3 to provide a reference for interpreting the individual studies. Table 5.2 provides an average effect per study for a particular kind of outcome. For example, all reading effects for one study are combined. In this way each study contributes the same number of effects to each kind of outcome regardless of the number of effects reported. One hundred and fourteen effects were used in this table. The means presented are means of means and so must be interpreted with caution. Table 5.3, on the other hand, provides an average for all effects reported. Two hundred and twenty-seven effects were used in this table.

Where the univariate analysis of variance detected a mean score by category, the F, p, and eta^2 values are indicated. If not statistically significant, 'ns' was entered. Eta^2 indicates the proportion of variance in the effect size explained by the categories; the larger this value, the more the categories explain the effect size. Predictably, the values in Table 5.3 more often reached acceptable levels of significance because of the greater number of effects included in the calculations.

On a cautionary note, the purpose for presenting these tables is to provide a guide for the interpretation of individual studies. Our analyses have not conformed to the requirements of a meta-analysis and these tables are not intended to represent effect sizes that can be expected in specific instances or in general from professional learning and development interventions.

Table 5.2. The range and mean effect sizes of student outcomes averaged for each study

Average Effects per Study								
	N	**M**	**seM**	**95% CI**	**Median**	**SD**	**Min**	**Max**
Total	114	0.59	0.08	0.32	0.34	0.83	−0.73	4.63
Outcome								
Reading	25	0.35	0.06	0.24	0.26	0.28	0.03	1.11
Mathematics	22	0.54	0.21	0.84	0.32	0.99	−0.03	4.63
Attitudes toward Subject	14	0.44	0.31	1.24	0.22	1.15	−0.73	4.27
Literacy/Language Skills	12	0.95	0.38	1.52	0.44	1.33	0.09	3.83
Science	10	1.01	0.27	1.08	0.74	0.86	0.18	2.85
Writing	8	0.81	0.16	0.64	0.97	0.46	0.16	1.28
Other Academic Skills	8	0.86	0.21	0.84	0.81	0.61	0.22	2.09
Cognitive Processing	4	0.70	0.20	0.80	0.75	0.40	0.17	1.12
Self-Efficacy	4	0.17	0.09	0.36	0.12	0.18	0.01	0.42
Social Outcomes	4	0.31	0.10	0.40	0.27	0.20	0.12	0.58
Other Personal Outcomes	3	0.42	0.17	0.68	0.53	0.30	0.08	0.64
Class of outcome								
Academic	89	0.65	0.09	0.36	0.37	0.82	−0.03	4.63
Personal	21	0.38	0.21	0.84	0.20	0.94	−0.73	4.27
Social	4	0.31	0.10	0.40	0.27	0.20	0.12	0.58
Grade level groupings								
Primary	83	0.58	0.10	0.40	0.33	0.89	−0.73	4.63
Secondary	14	0.66	0.18	0.72	0.52	0.69	0.12	2.85
Intermediate	9	0.32	0.08	0.32	0.37	0.23	0.09	0.73
All	7	0.92	0.33	1.32	0.64	0.87	0.08	2.09
Missing	2	0.45	0.14	0.56	0.45	0.19	0.31	0.58
Country								
US	78	0.51	0.09	0.36	0.30	0.81	−0.73	4.63
NZ	22	0.93	0.21	0.84	0.61	0.98	0.04	3.83
The Netherlands	4	0.48	0.22	0.88	0.36	0.44	0.09	1.12
UK	4	0.53	0.13	0.32	0.49	0.27	0.29	0.85
Canada	3	0.92	0.59	2.36	0.43	1.02	0.23	2.09
Israel	2	0.26	0.01	0.04	0.26	0.01	0.25	0.26
Missing	1	0.21			0.21		0.21	0.21
Other country	1	0.31			0.31		0.31	0.31

Number of participants								
‹100	10	0.80	0.18	0.72	0.59	0.55	0.21	2.09
100–999	42	0.65	0.16	0.64	0.38	1.03	−0.73	4.63
›1000	33	0.59	0.15	0.60	0.33	0.88	−0.03	3.83
Type of control								
Control	62	0.58	0.11	0.44	0.33	0.90	−0.73	4.63
Baseline	42	0.63	0.12	0.48	0.38	0.78	0.05	3.83
Both	11	0.51	0.18	0.72	0.24	0.61	0.03	2.09
Type of instrumentation	**$F = 4.65$; $p = .011$; $eta^2 = .08$**							
Objectively Scored	66	0.47	0.08	0.32	0.31	0.65	−0.03	4.27
Researcher	37	0.62	0.15	0.60	0.34	0.89	−0.73	4.63
Verified Judgment	10	1.30	0.43	1.72	0.78	1.35	0.16	3.83

Table 5.3. The range and mean effect sizes for all effects

				All Effects				
	N	**M**	**seM**	**95% CI**	**Median**	**SD**	**Min**	**Max**
Total	227	0.60	0.06	0.24	0.34	0.83	−1.01	5.31
Outcome	**$F = 3.30$; $p = .001$; $eta^2 = .13$**							
Mathematics	62	0.50	0.12	0.48	0.31	0.94	−1.01	5.10
Reading	44	0.34	0.04	0.16	0.26	0.26	−0.01	1.11
Literacy/Language Skills	27	1.18	0.24	0.96	0.55	1.27	0.09	5.31
Attitudes toward Subject	21	0.34	0.21	0.84	0.11	0.95	−0.73	4.27
Science	18	0.94	0.19	0.76	0.68	0.80	0.16	2.85
Writing	16	0.88	0.11	0.44	1.06	0.45	0.06	1.34
Self-Efficacy	11	0.17	0.06	0.24	0.11	0.21	−0.07	0.68
Other Academic Skills	10	0.76	0.18	0.72	0.55	0.57	0.22	2.09
Social Outcomes	7	0.36	0.11	0.44	0.34	0.29	−0.11	0.86
Cognitive Processing	6	0.85	0.18	0.72	0.87	0.44	0.17	1.46
Other Personal Outcomes	5	0.46	0.10	0.40	0.53	0.23	0.08	0.64
Class of outcome	**$F = 3.25$; $p = .041$; $eta^2 = .03$**							
Academic	183	0.66	0.06	0.24	0.39	0.85	−1.01	5.31
Personal	37	0.30	0.12	0.48	0.12	0.73	−0.73	4.27
Social	7	0.36	0.11	0.44	0.34	0.29	−0.11	0.86

Grade level groupings								
Primary	172	0.61	0.07	0.28	0.34	0.90	−1.01	5.31
Intermediate	23	0.36	0.06	0.24	0.27	0.30	0.05	1.27
Secondary	20	0.60	0.14	0.56	0.45	0.61	0.06	2.85
All	9	0.97	0.32	1.28	0.64	0.95	0.08	2.68
Missing	3	0.49	0.09	0.36	0.54	0.16	0.31	0.61
Country								
United States	143	0.48	0.07	0.28	0.27	0.80	−1.01	5.10
New Zealand	68	0.87	0.11	0.44	0.53	0.90	−0.14	5.31
Canada	4	0.79	0.44	1.76	0.43	0.88	0.23	2.09
The Netherlands	4	0.48	0.22	0.88	0.36	0.44	0.09	1.12
United Kingdom	4	0.53	0.13	0.52	0.49	0.27	0.29	0.85
Israel	2	0.26	0.01	0.04	0.26	0.01	0.25	0.26
Missing	1	0.21			0.21		0.21	0.21
Other Country	1	0.31			0.31		0.31	0.31
Number of participants								
‹100	20	0.84	0.13	0.52	0.64	0.57	0.21	2.68
100–999	83	0.69	0.11	0.44	0.42	0.96	−0.73	5.10
›1000	56	0.69	0.13	0.52	0.32	1.00	−0.03	5.31
Type of control	**$F = 5.18$; $p = .02$; $eta^2 = .02$**							
Control	138	0.50	0.07	0.28	0.31	0.81	−1.01	5.10
Baseline	89	0.75	0.09	0.36	0.45	0.85	0.04	5.31
Type of instrumentation	**$F = 18.76$; $p = .000$; $eta^2 = .143$**							
Objectively Scored	119	0.40	0.05	0.20	0.28	0.51	−0.14	4.27
Researcher	80	0.62	0.10	0.40	0.38	0.92	−1.01	5.10
Verified Judgment	28	1.39	0.22	0.88	1.27	1.15	0.16	5.31
Students' prior achievement								
Low/Special	16	0.43	0.13	0.52	0.30	0.53	−0.10	2.09
Regular	12	0.18	0.05	0.20	0.18	0.17	−0.07	0.49
Gifted	10	0.31	0.08	0.32	0.35	0.27	−0.02	0.68
Student ethnicity								
Māori	10	0.37	0.17	0.68	0.23	0.54	−0.14	1.67
Asian	1	0.87			0.87		0.87	0.87
European/other	1	1.37			1.37		1.37	1.37
Pasifika	1	1.86			1.86		1.86	1.86

Student gender								
Female	2	1.09	0.45	1.80	1.09	0.63	0.64	1.53
Male	2	1.03	0.61	2.44	1.03	0.86	0.42	1.64

Even taking into account the limitations discussed above, some trends can be identified and used for the interpretation of individual studies. Firstly, for any given area, the effect sizes show a wide range, typically from a small negative effect to greater than 1.00. Secondly, the mean effect sizes are larger in some areas than others. For example, the effect sizes for writing and science are larger than those for mathematics and reading. These differences, however, need to be interpreted with caution because achievement in science and writing was more likely to be assessed using researcher-developed instruments while studies of mathematics and reading, in particular, were more likely to be assessed using standardised instruments. Effect sizes for researcher-developed assessment tools tend to be higher than for standardised tools.

The very high average effects for literacy/language skills are strongly influenced by the high effect sizes for student populations with special learning needs, for example, those participating in reading recovery, which typically included measures of both reading and writing.

Attitudinal, self-efficacy, social, and other personal outcomes proved more difficult to change than academic outcomes, except in reading. This finding may be partly explained by the lack of specific targeting of attitudes in most studies. They were more a by-product of different instructional approaches. In many cases, particularly in mathematics, attitudes declined in response to new instructional approaches. This finding can be interpreted in different ways.

For many of these aggregated effect sizes, the mean effect size is lower than the median, indicating that the mean effects are influenced by a few very high effects. This problem is particularly apparent in literacy/language skills, where the students in some studies began from a very low baseline, contributing to very high effect sizes.

When effect sizes are categorised by country, only New Zealand and the United States have sufficient studies to allow for the making of any inferences. The higher New Zealand effect sizes may be accounted for by the inclusion of reading recovery studies that had very high effect sizes because the population began from a low baseline.

Not surprisingly, the average and medium effects are higher for studies reporting against a baseline than for those reporting against a comparison or control group. The latter studies take expected gains into account. Also predictable is the larger effect for smaller studies than those involving more than 1000 students. These effect sizes are partly an artefact of the greater variability typically found in studies of larger populations and partly due to the difficulty of developing interventions for larger populations comprising only volunteers.

5.3 Measuring qualitative outcomes

Some studies reported outcomes in qualitative terms or reported numbers in ways that did not allow conversion to effect sizes. The writing team jointly made decisions about the inclusion and exclusion of these studies, based on the educational significance of the impact on students. The rise in status of a child with spina bifida from victim of personal tragedy to valued resource is one such example[81]. Another was the substantial reduction in the percentage of suspensions in a New Zealand secondary school[82]. This reduction in suspensions was more likely to have a greater impact on Māori students. Although not stated in this particular study, national statistics show much higher rates of suspension for Māori than non-Māori students.

References

[1] Lipsey, M. W. & Wilson, D. B. (1993). The efficacy of psychological, educational, and behavioral treatment: Confirmation from meta-analysis. *American Psychologist, 48* (12), 1181-1209.

[2] Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

[3] Tallmadge, G. (1977). *The joint dissemination review panel idea book*. Washington, DC: National Institute of Education and the US Office of Education.

[4] Lipsey, M. W., & Wilson, D. B. (1993), loc. cit. (ref. 1).

[5] Hattie, J. (1990). Performance indicators in education. *Australian Journal of Education, 34* (3), 249-276.

Hattie, J. (1992). Measuring the effects of schooling. *Australian Journal of Education, 36* (1), 5-13.

Hattie, J. (1999). *Influences on student learning.* Paper presented at the Inaugural Lecture, University of Auckland, Auckland, NZ.

[6] Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005). *Findings from the New Zealand Numeracy Development Project 2004*. Wellington, NZ: Ministry of Education.

[7] Thomas, G. & Tagg, A. (2005). Evidence for expectations: Findings from the Numeracy Project longitudinal study. In J. Higgins, K. Irwin, G. Thomas, T. Trinick & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Project 2004* (pp. 21-46). Wellington, NZ: Ministry of Education.

[8] For example, The Texas Assessment of Academic Skills is a high-stakes test in Texas's accountability system.

[9] Bond, L, Smith, T., Baker, W., & Hattie, J. (2000). *The certification system of the National Board for Professional Teaching Standards: A construct and consequential validity study.* Center for Educational Research and Evaluation. The University of North Carolina at Greensboro.

[10] For example, asTTle (University of Auckland and The New Zealand Ministry of Education) systematically tests and reports on both deep and surface features.

[11] Absolum, M. (2004a). *Assess to Learn Project* (Project proposal submitted to the Ministry of Education). Auckland: Evaluation Associates.

Absolum, M. (2004b). *ATOL programme 2004* (Report prepared for company purposes only). Auckland: Evaluation of Evaluation Associates.

[12] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997). *Gendered discourses in social studies: Intermediate students' learning and participation during studies of Antarctic work and survival focused on women* (Report to the Ministry of Education. Understanding Learning and Teaching Project 3.) Wellington: New Zealand Ministry of Education.

[13] Anand, V. & Bennie, N. (2005). *Annual monitoring of Reading Recovery: The data for 2003.* Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 5741&indexid = 1072&indexparentid = 1000

[14] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream education. Phase 2: Towards a whole school approach* (Progress report and planning document). Wellington, NZ: Ministry of Education.

Bishop, R., Berryman, M., Cavanagh, T., & Teddy, L. (2006). *Te Kotahitanga Phase 3 Whanaungatanga: Establishing a culturally responsive pedagogy of relations in mainstream secondary school classrooms.* Report to the Ministry of Education. Wellington, New Zealand.

[15] Davis, A. (2006). *Characteristics of teacher expertise associated with raising the reading comprehension abilities of Years 5-9 students.* Unpublished doctoral thesis, University of Auckland, Auckland, NZ.

[16] English, C. & Bareta, L. (2006). *Literacy professional development milestone report.* Wellington, NZ: Learning Media.

[17] Fung, I. Y. Y. (2006). *Collaborative reasoning: Critical thinking based learning and instruction.* Unpublished doctoral thesis, University of Auckland, Auckland, NZ.

[18] McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005). *Reading Recovery in New Zealand: Uptake, implementation, and outcomes, especially in relation to Māori and Pasifika students.* Report. Wellington, NZ: New Zealand Council for Educational Research.

[19] **McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.**

[20] Phillips, G. E., McNaughton, S., & MacDonald, S. (2001). *Picking up the pace: Effective literacy interventions for accelerated progress over the transition into decile one schools* (Final Report). Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/web/document/document_page.cfm?id = 6444.

[21] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final report). Wellington, NZ: Learning Media.

[22] Thomas, G., & Tagg, A. (2005), loc. cit. (ref. 7).

[23] Timperley, H., & Phillips, G. (2003). Changing and sustaining teachers' expectations through professional development in literacy. *Teaching and Teacher Education, 19,* 627-641.

[24] **Timperley, H. S. (2005a). Distributed leadership: Developing theory from practice. *Journal of Curriculum Studies 37* (6), 395-420.**

[25] **Timperley, H., Bertanees, C., & Parr (2006). A case study: Promoting teacher learning using a needs analysis approach. In J. Parr, H. Timperley, P. Reddish, R. Jesson, & R. Adams (Eds.). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final Report). Wellington, NZ: Learning Media.**

[26] Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 6).
Publishers.

[27] Adey, P. (2004). *The professional development of teachers: Practice and theory*. London: Kluwer Academic Publishers.

[28] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies.* London, UK: DfES.

[29] Rubie-Davies, C. Baines, E., Blatchford, P. (2005). *The SPRinG programme: A social pedagogic approach to group work.* Presentation to the Annual Conference of the New Zealand Association for Research in Education, Dunedin.

[30] Shayer, M. (1999). Cognitive acceleration through science education II: Its effects and scope, *International Journal of Science Education, 21* (8), 883-902.

[31] **Appalachia Educational Lab. (1994a). *Collegial investigations: Shared inquiry through disciplined discussion and action research.* Charleston, WV: Author (ED403229).**

[32] Baker, S., & Smith, S. (1999). Starting off on the right foot: The influence of four principles of professional development in improving literacy instruction in two kindergarten programs. *Learning Disabilities Research & Practice, 14* (4), 239-253.

[33] Bianchini, J. (1997). Where knowledge construction, equity and context intersect: Students learning of science in small groups. *Journal of Research in Science Teaching, 34* (10), 1039-1065.

[34] Bond, L, Smith, T., Baker, W., & Hattie, J. (2000), op. cit. (ref. 9).

[35] Borman, G., Slavin, R. E., et al. (2005). "Success for all: First-year results from the national randomized field trial." *Educational Evaluation and Policy Analysis, 27* (1), 1-22.

[36] Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. *Teaching and Teacher Education, 11* (1), 81-95.

[37] Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

[38] Caulfield-Sloan, M. B. & Ruzicka, M. F. (2005). The effect of teachers' staff development in the use of higher-order questioning strategies on 3rd grade students' rubric science assessment performance. *Planning and Changing, 36* (3/4), 157-175.

[39] Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991). Assessment of a problem-centered second-grade mathematics project. *Journal for Research in Mathematics Education, 22,* 13-29.

[40] Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000). Implementation research as a means of linking systemic reform and applied psychology in mathematics education. *Educational Psychologist, 35* (3), 179-191.

[41] Curriculum Research and Development Group. (2002). Foundational approaches in science teaching (FAST). In J. Killon (Ed.), *What works in the middle: Results-based staff development* (pp. 114-117). National Staff Development Council: University of Hawaii http://www.nsdc.org/connect/projects/resultsbased.cfm

[42] Datnow, A., Borman, G., Stringfield, S., Overman, L. T., & Castellano, M. (2003). Comprehensive school reform in culturally and linguistically diverse contexts: Implementation and outcomes from a four-year study. *Educational Evaluation and Policy Analysis, 25* (2), 143-170.

[43] Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005). Research experiences for science teachers: The impact on students. Paper presented at the Hawaiian International Conference on Education, Hawaii.

[44] Fishman, B. J., Marx, R. W., Besta, S., & Tal, R. T. (2003). Linking teacher and student learning to improve professional development in systemic reform. *Teaching and Teacher Education, 19* (6), 643—658.

[45] Flay, B. & Allred, C. (2003). Long-term effects of the Positive Action Program. *American Journal of Health Behavior, 27,* Supplement 1, S6-21.

[46] Goldenberg, C. & Sullivan, J. (1994). *Making change happen in a language minority school: A search for coherence*. (Educational Practice Report): National Center for Research on Cultural Diversity and Second Language Learning.

[47] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

[48] Hamilton, R. & Gingiss, P. (1993). The relationship of teacher attitudes to course implementation and student responses. *Teaching and Teacher Education, 9* (2), 193-204.

[49] Hirshman, J. (1996). Lingelbach Elementary School: A case study of a Chapter 1 school wide project. *Journal of Education for Students Placed at Risk, 1* (2), 135-146.

[50] Huffman, D., Goldberg, F., & Michelin, M. (2003). Using computers to create constructivist learning environments: Impact on pedagogy and achievement. *Journal of Computers in Mathematics and Science Teaching, 22* (2), 153-170.

[51] Kahle, J., Meece, J., & Scantlebury, K. (2000). Urban African-American middle school science students: Does standards-based teaching make a difference? *Journal of Research in Science Teaching, 37* (9), 1019-1041.

[52] Klingner, J., Vaughn, S., Arguelles, M., Hughes, M., & Leftwich, S. (2004). Collaborative strategic reading: Real-world lessons from classroom teachers, *Remedial and Special Education, 25* (5), 291-302.

[53] Maheady, L. & Harper, G. (1991). Training and implementation requirements associated with the use of a classwide peer tutoring system. *Education and Treatment of Children, 14* (3), 177-199.

[54] Mason, D. A. & Good, T. (1993). Effects of two-group and whole-class teaching on regrouped elementary students' mathematical achievement. *American Educational Research Journal, 30* (2), 328-360.

[55] McKenzie, T. L., Sallis, J. F., Faucette, N., Roby, J., & Kolody, B. (1993). Effects of a curriculum and inservice program on the quantity and quality of elementary physical education classes. *Research Quarterly for Exercise and Sport, 64* (2), 178-186.

[56] Metcalf, K. K., Vontz, T. S., & Patrick, J. J. (2000). Effects of Project Citizen on the civic development of adolescent students in Indiana, Latvia, and Lithuania. In T. S. Vontz & K. K. Metcalf & J. J. Patrick (Eds.), *"Project Citizen" and the civic development of adolescent students in Indiana, Latvia, and Lithuania* (pp. 125-146). Bloomington, IN: ERIC Clearinghouse for Social Studies/Social Science Education.

[57] Montes, F. (2002). Enhancing content areas through a cognitive academic language learning based collaborative in South Texas. *Bilingual Research Journal, 26* (3), 697-716.

[58] Mucherah, W., Lapsley, D., Miels, J., & Horton, M. (2004). An intervention to improve sociomoral climate in elementary school classrooms: An evaluation of Don't Laugh at Me. *Journal of Research in Character Education, 2* (1), 45-58.

[59] **Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001). Making science accessible to all: Results of a design experiment in inclusive classrooms. *Learning Disability Quarterly, 24* (1), 15-32.**

[60] Parke, H. M. & Coble, C. R. (1997). Teachers designing curriculum as professional development: A model for transformational science teaching. *Journal of Research in Science Teaching, 34* (8), 773-789.

[61] **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

[62] Pritchard, R. J. (1987). Effects on student writing of teacher training in the National Writing Project model. *Written Communication, 4* (1), 51-67.

[63] Raghavan, K., Cohen-Regev, S., & Strobel, S. (2001). Student outcomes in a local systemic change project. *School Science and Mathematics, 101* (8), 417-426.

[64] **Saxe, G. B., Gearhart, M., & Nasir, N. (2001). Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support. *Journal of Mathematics Teacher Education, 4*, 55-79.**

[65] Schacter, J. & Thum, Y. (2005). Tapping into high quality teachers: Preliminary results from the Teacher Advancement Program comprehensive school reform. *School Effectiveness and School Improvement, 16* (3), 327-353.

[66] Schober, H. M. (1984). The effects of inservice training on participating teachers and students in their economics classes. *The Journal of Economic Education, 15* (4), 282-295.

[67] Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.

[68] **Stevens, R. J. & Slavin, R. E. (1995). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. *American Educational Research Journal, 32* (2), 321-351.**

[69] Taylor, B., Pearson, D., & Rodriguez. M. (2005). The CIERA school change framework: An evidence-based approach to professional development and school reading improvement. *Reading Research Quarterly, 40* (1): 40-69.

[70] Vandevoort, L.A., Amrein-Beardsely, A., & Berliner, D. (2004). National board certified teachers and their students' achievement. *Education Policy Analysis Archives, 12* (46): 1-117.

[71] Villar, A. & Strong, M. (2005). *Is mentoring worth the money? A benefit-cost analysis and five-year rate of return of a comprehensive mentoring program for beginning teachers.* Presentation to the Annual Meeting of the American Educational Research Association, Montreal.

[72] Wilson, S., L. Darling-Hammond, L., & Berry, B. (2001). *A case of successful teaching policy: Connecticut's long-term efforts to improve teaching and learning.* Center for the Study of Teaching and Policy: University of Washington.

[73] Wood, T. & Sellers, P. (1996). Assessment of a problem-centered mathematics program: Third grade. *Journal for Research in Mathematics Education, 27*, 337-353.

[74] Anderson, V. (1992). A teacher development project in transactional strategy instruction for teachers of severely reading-disabled adolescents. *Teaching and Teacher Education, 8* (4), 391-403.

[75] Angrist, J. D. & Lavy, V. (2001). Does teacher training affect pupil learning? Evidence from matched comparisons in Jerusalem public schools. *Journal of Labor Economics, 19* (2), 343-369.

[76] Ross, J. A. (1994). The impact of an inservice to promote cooperative learning on the stability of teacher efficacy. *Teaching and Teacher Education, 10* (4), 381-394.

[77] Ross, J. A., Roleiser, C., & Hogaboam-Gray, A. (1999). Effects of collaborative action research on the knowledge of five Canadian teacher-researchers. *The Elementary School Journal, 99* (3), 255-274.

[78] Rowe, K., Pollard, J., & Rowe, K. (2005). *Literacy, behaviour and auditory processing: Does teacher professional*

development make a difference? Background paper to Rue Write Memorial Award presented at the Royal Australasian College of Physicians Scientific Meeting, Wellington, New Zealand, 8-11 May 2005.

79 Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

80 Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005). Effects of a cooperative learning program on the elaborations of students during help seeking and giving. *American Educational Research Journal, 42* (1), 115 - 151.

81 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education, 4* (3), 179-210.**

82 **Moxon, J. (2003). *A study of the impact of the Restorative Thinking Programme within the context of a large multi-cultural New Zealand secondary school.* Unpublished masters thesis, The University of Auckland, Auckland, New Zealand.**

6. Professional Learning and Mathematics

We selected the studies in this group on the basis that they all had an explicit focus on promoting student learning and raising achievement in mathematics, typically through programmes that developed teachers' content knowledge and/or their pedagogical knowledge. One of the interventions[1] addressed reading as well as mathematics. Another[2] involved the whole-school implementation of a cooperative learning model across all learning areas but with a specific focus on mathematics. Apart from these, all the studies included in this group were primarily concerned with mathematics. There were other studies[3] that measured student outcomes in mathematics but they were not considered for this analysis because the information they provided about student outcomes or what was involved in the professional development was insufficient to meet our criteria.

6.1 Studies considered

Eleven core and ten supplementary individual studies and groups of studies were included in this analysis. The core studies (Table 6.1) met our methodological criteria and provided evidence of moderate to high academic outcomes for students. The remaining ten studies (Table 6.2) were designated supplementary, either because they reported limited change in student achievement or because they did not provide enough information to meet our methodological criteria.

6.1.1 Core studies

Of the 11 core studies (Table 6.1), nine were from the United States with one each from New Zealand and the United Kingdom. Only one of the core studies discussed professional learning in a secondary school context. In some cases, core studies were made up of groups of studies that did not meet our criteria separately but did collectively. Where this is the case, the lead study is identified in the table and summarised in the text; the other studies in the group are listed in the table, enclosed with brackets.

Table 6.1. Mathematics: core studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
1. Cardelle-Elawar (1995)[4]	Metacognitive instruction	Mathematics, attitudes to mathematics	US	Grades 3–8

Study	Focus of PD	Student outcome assessed	Country	School sector/ year levels
2. Carpenter et al. (1989)[5] & Fennema et al., (1993)[6] (Carpenter, Fennema, & Franke, 1996)[7] (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989)[8] (Carpenter, Fennema, Franke, Levi, & Empson, 2000)[9] (Carpenter, Franke, & Levi, 2003)[10] (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996)[11] (Fennema, Carpenter, & Peterson, 1989)[12] (Fennema, Franke, Carpenter, & Carey, 1993)[13] (Franke & Kazemi, 2001)[14] (Franke, Carpenter, Fennema, Ansell, & Behrend, 1998)[15]	Cognitively Guided Instruction (CGI) – Understanding development of children's mathematical thinking	Computation, strategies for problem-solving	US	Grade 1
3. Cobb et al. (1991)[16]	Problem-centred Mathematics Program – Multiple approaches to problem solving	Computation and conceptual understanding	US	Grade 2
4. Confrey et al (2000)[17]	Student cognition of algebra	Algebra	US	Secondary
5. Earl et al. (2003) [18] (Basit, 2003)[19] (Beard, 1999)[20] (Brown, Millett, Bibby, & Johnson, 2000)[21] (DfES, 2002)[22] (DfES, 2003)[23]	Numeracy	Numeracy	UK	Primary schools
6. Higgins, Irwin, Thomas, Trinick, Young-Loveridge (2005)[24] (Higgins, 2004a)[25] (Thomas & Tagg, 2004)[26] (Thomas & Tagg, 2005a;)[27] (Young-Loveridge, 2004)[28] (Young-Loveridge, 2005)[29]	Numeracy	Addition, subtraction, multiplication, division, proportion, and ratio	NZ	Years 0–8
7. McClain & Cobb (2001)[30]	Problem-centred Mathematics Program – Teachers' role in developing shared mathematical understandings	Conceptual understanding	US	Grade 1

8. Saxe et al. (2001)[31]	Integrated Mathematics Assessment – Conceptual understanding of fractions	Computation and conceptual understanding of fractions	US	Upper elementary
9. Schorr (2000)[32]	Teachers' content knowledge and assessment of students' mathematical thinking		US	Elementary
10. Stevens & Slavin (1995)[33]	Team Assisted Individualization-Mathematics – Cooperative learning	Mathematics, attitudes to mathematics	US	Grades 2–6
11. Wood & Sellers (1996)[34]	Problem-centred Mathematics	Computation and conceptual understanding	US	Grades 2–3

In the first study (Cardelle-Elawar, 1995)[35], the teachers from two different schools learned about teaching approaches designed to develop students' metacognition in mathematics. The professional development consisted solely of a three-day workshop. Students' attitude towards mathematics (ES = 4.27) and their mathematical achievement (ES = 4.63) improved as a result. These high effect sizes were possible because initial scores were very low (0–3 on the pre-test).

The second study (Carpenter et al., 1989; Fennema et al., 1993)[36] relates to a professional development programme known as Cognitively Guided Instruction (CGI). This programme supported teachers in learning to understand the development of children's mathematical thinking. Importantly, the CGI programme does not prescribe or even recommend particular teaching practices. Effect sizes varied between 0.41 and 0.76, depending on the measure used.

The third study (Cobb et al., 1991)[37] involved ten teachers of second-grade mathematics in the United States. The teachers attended a one-week 'summer institute', followed by regular professional development support over one school year. The professional development aimed to foster a socio-constructivist approach to mathematics teaching, in which the emphasis was on students constructing their own approaches to problem solving in order to develop their conceptual understanding of mathematics. The study presented evidence to show that the students of the teachers concerned were able to undertake computation (ES = –0.05 on norm-referenced assessment; ES = –0.06 on researcher-developed assessment) but developed better problem solving and conceptual understanding of mathematics (ES = 0.3 on norm-referenced assessment; ES = 1.04 on researcher-developed assessment). However, attitudes towards mathematics declined (ES = –0.23 on researcher-developed assessment).

The fourth study (Confrey et al., 2000)[38] was the only study in this group set in a secondary school context. Like most of the others, it was based on a constructivist paradigm and addressed issues such as purposeful engagement with higher cognitive thinking and the use of multiple forms of representation. In this case, the primary vehicle for professional learning was the provision of a 'replacement unit' in algebra. This was seen as a transitional strategy, providing teachers with scaffolded support as they taught using the new approach for the first time, but it also created a context in which rich discussions concerning implementation and the underlying theoretical basis of the unit could take place between the teachers and the professional development provider (ES = 0.22). This study is included in the core group in spite of the relatively small effect size because it was the only one we could locate that pertained to a secondary school.

Study 5 (Earl et al., 2003)[39] involved primary schools throughout the United Kingdom implementing the National Numeracy Strategy. Professional development was provided to support the introduction of a nationally mandated one hour per day of mathematics instruction. Learning content focused on aspects such as lesson pace, planning in accordance with objectives, and the use of assessment information to guide teaching decisions. Despite a relatively low effect size (0.18), this study is included as a core study because it related to such a large-scale, systemic reform.

Study 6 (Higgins et al., 2005)[40], related to the New Zealand Numeracy Development Project, a nation-wide project that has involved approximately 460,000 students and 17,000 teachers. This is a system-wide initiative to develop teacher knowledge and raise students' achievement in numeracy. Professional development emphasised the development of students' strategic thinking and mathematical knowledge through discussion of multiple solutions to problems. For a year, nationally trained providers worked with groups of teachers whose students were at similar year levels. Teachers' new practice showed positive impact on student outcomes (ES = 0.34; year levels 2–8), as measured by an instrument referred to as the diagnostic interview.

Study 7 (McClain & Cobb, 2001)[41] was a case study of one first-grade teacher in the United States, Ms Smith, working closely with researchers over the course of one school year. Her professional learning was focused on finding a balance between valuing the mathematical ideas and solutions of her students, and acting in a more directive way that would support the students to come to shared understandings of mathematics without undermining their 'intellectual autonomy'. This qualitative study did not report effect sizes.

Study 8 (Saxe, Gearhart, & Nasir, 2001)[42] focused on a professional development programme called Integrated Mathematics Assessment, which aimed to develop students' conceptual understanding of fractions rather than their computational skills with fraction problems. Teachers participated in one of three conditions. The first, the 'professional learning' condition, involved nine teachers from different schools participating in a five-day summer institute followed by ongoing support over the course of a year. The students of these teachers were able to demonstrate greater conceptual understanding of fractions than those in the other two groups (ES = 1.63 over the control group, and ES = 1.53 over the collegial support group), while maintaining similar scores for computation. The second group participated in a professional learning community of teachers, referred to as the 'collegial support' group, who met regularly to discuss implementation of the reform textbook without any external input from the professional development provider. The third group served as a control group and received the textbook only. The students of teachers in the collegial support condition achieved conceptual understanding scores that were no better than the control group and computation scores that were actually lower (ES = –1.01) than those of the control group who had received the textbook only. The report on the collegial support condition was designated a supplementary study.

Study 9 (Schorr, 2000)[43] involved all the elementary schools in a low-income inner-city school district in the United States. Teachers participated in a programme that focused on developing their content knowledge of mathematics and their ability to make instructional decisions based on ongoing assessment of their students' mathematical thinking. The students of the participating teachers demonstrated a greater ability to solve problems and explain their reasoning, as well as greater confidence in attempting alternative approaches to problem solving and connecting mathematics to their 'real world' experiences. This qualitative study did not report effect sizes.

Study 10 (Stevens & Slavin, 1995)[44] involved a school-wide professional development programme aimed at introducing cooperative learning models across all learning areas in a United States elementary school. Teachers were trained in co-operative learning programmes that focused particularly on reading (Cooperative Integrated Reading and Comprehension) and mathematics (Team Assisted Individualization-Mathematics)—approaches that were applicable across all subjects. This study reported small but significant gains in mathematics computation scores (ES = 0.2), with much larger gains for special education students (ES = 0.49).

In study 11 (Wood & Sellers, 1996)[45], teachers of third grade mathematics from different schools learned how to develop students' conceptual understanding of mathematics by taking a socio-constructivist approach to mathematics teaching. They participated in a one-week summer institute with intensive follow-up support over the course of one school year. Student outcomes improved (average effect size = 0.98 or 2.78, depending on the assessment used). As in the Cobb study, attitudes towards mathematics declined (ES = –0.73).

6.1.2 Supplementary studies

Ten studies (Table 6.2) were designated as supplementary rather than core because they did not meet the criteria for inclusion, either on the grounds of inadequate outcomes or insufficient information about methodology. They were included as supplementary studies because of their value in informing conclusions drawn from the core studies.

Table 6.2. Mathematics: supplementary studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
I. Studies with low, no, or negative student outcomes				
1. Angrist & Lavy (2001) [46]	Numeracy and literacy	State test scores – computation	Israel	Elementary
2. Mason & Good (1993)[47]	Active teaching and Ability Grouping in Mathematics	Computation, concepts, and problem solving	US	Grades 4–6
3. Saxe et al. (2001) – Collegial Support condition[48]	Collegial Support – fractions	Computation and conceptual understanding of fractions	US	Upper Elementary
4. Stallings & Krasavage (1986)[49]	Madeline Hunter's Instructional Theory into Practice	Mathematics	US	Grades 1–4
5. Van der Sijde (1989)[50]	Mathematics and behaviour management	Achievement and attitude to Mathematics	The Netherlands	Grade 8
6. Veenman et al. (2005)[51]	Cooperative learning	Mathematics, high level elaborations	The Netherlands	Grade 6
II. Studies with insufficient information about methodology				
7. Britt et al. (1993)[52]	Professional communities	–	NZ	Intermediate and Secondary
8. Fresko, Robinson, Friedlander, Albert, & Argaman (1990)[53]	Improving Mathematics instruction	Mathematics	Israel	Grades 7–9
9. Trinick & Stephenson (2005b)[54]	Numeracy in kura kaupapa	Numeracy	NZ	Years 1–8

III. Others				
10. Kennedy (1998)[55]	An analysis of existing studies of professional learning in mathematics and science	Various	US	Various

6.1.2.1 *Supplementary studies with low or negative student outcomes*

Six studies with relatively low or negative student outcomes were included as supplementary studies because they provided rich information about circumstances under which professional learning opportunities were unable to achieve the desired differences in outcomes for students.

The first of these studies (Angrist & Lavy, 2001)[56] described a three-year professional development intervention that involved all the teachers in ten elementary schools in Israel learning an approach referred to as 'humanistic mathematics'. Developed by Alvin White, this is an inquiry-based approach in which multiple ways of problem solving are considered and the mathematics situated in 'real world' (includes historical) contexts. The professional development involved a one-week workshop followed by regular meetings in which teachers and a provider would review teaching methods for material to be covered the following week. Participation in the project was mandated and aimed to raise literacy as well as mathematics achievement.

The second of these studies (Mason & Good, 1993)[57] examined professional development that supported the introduction of two new approaches to within-class ability grouping in schools that already streamed students into classes on the basis of ability. One of the within-class ability grouping approaches was called 'two-group' teaching and involved grouping students into two ability groups, based on students' mathematics achievement in the previous year. These groupings then remained fixed for the rest of the school year. The other grouping approach was referred to as 'whole class ad hoc' teaching, with groups adjusted on a daily basis. Students in both the 'two-group' teaching (ES = –0.03) and 'whole class ad hoc' teaching (ES = 0.27) classes achieved higher scores in mathematical computation than students in the control group. Students in the 'whole class ad hoc' classes gained higher scores than those in the 'two-group' teaching classes (ES = 0.29). Although this study showed positive gains for students and might have been included as a core study, the gains were not as great as most others for studies of similar size.

The third study (Saxe et al., 2001)[58] involved one of the treatment conditions, 'collegial support', from the eighth core study. As the name implies, teachers under this condition met regularly to discuss ways to improve students' conceptual understanding of fractions. Unlike the 'integrating mathematical assessment' condition, however, teachers received no external input from professional development providers. The students of teachers in this condition achieved conceptual understanding scores that were no better, and computation scores that were in fact lower, than those of the control group.

The fourth study (Stallings & Krasavage, 1986)[59] involved a three-year project in which all the schools in one district in the United States implemented an instructional model known as Madeline Hunter's Instructional Theory into Practice. This programme sought to improve student outcomes in mathematics and literacy through the introduction of generic pedagogical practices including a set lesson design and strategies for behaviour management, motivation, and giving of instructions. This programme was implemented at a whole-school level and involved extensive ongoing professional development. In this programme, student achievement in both mathematics and reading rose slightly in the first two years, when the providers were intensively involved, but fell dramatically in the third year when the providers withdrew their support.

The fifth of these studies (Van der Sijde, 1989)[60] was set in the Netherlands and involved grade 8 teachers implementing a 'teaching script' aimed at improving students' behaviour as well as their achievement in mathematics. The professional learning opportunity consisted of one day of training followed by eight sessions of classroom observation and feedback from the professional development provider.

Study six (Veenman et al., 2005)[61] supported teachers to develop students' behaviours in terms of their giving and seeking of help in cooperative learning situations, with the intention that this would have a positive impact on their mathematical achievement. The intervention was effective in increasing students' elaborations (ES = 1.12) but had a more modest impact on students' achievement (ES = 0.34).

6.1.2.2 Supplementary studies excluded on methodological grounds

Three other studies (Table 6.2) were classified as supplementary on methodological grounds, either because they provided limited information about the professional learning or about how student outcomes resulting from the professional learning were assessed.

The first (Britt et al., 1993)[62] was set in New Zealand and involved 18 teachers from both intermediate and secondary schools working collaboratively to improve their practice. No student outcomes were reported but the study was included as a supplementary study because it had rich descriptions that were used to inform our discussion of professional learning through participation in professional communities.

The second (Fresko, Robinson, Friedlander, Albert, & Argaman, 1990)[63] involved a four-year project to improve mathematics instruction and learning in two Israeli junior high schools in a low socio-economic urban area with historically low rates of achievement. Some improvements in students' test scores seem to have resulted, although they remained low. Insufficient information was provided to calculate the effect size.

The third study (Trinick & Stephenson, 2005b)[64] involved whole-school professional development of teachers of years 1–8 in a range of Māori-medium schools in New Zealand. The professional development occurred over two to three years and involved ongoing workshops and classroom visits. It was considered supplementary because no student outcomes were reported.

Another study (Kennedy, 1998)[65] was not included as a core study because it was itself an analysis of other studies that had looked into the impact on student outcomes of professional development of teachers in mathematics and science. It is included as a supplementary study because it provides rich descriptions and analysis of professional development interventions that have achieved, or failed to achieve, positive outcomes for students in mathematics.

6.2 What works for whom in changing teaching of mathematics

This section synthesises evidence from studies that addressed teachers' knowledge of mathematics and mathematics teaching. The section is structured according to each aspect of the framework in Figure 4.2: context, professional learning environment, content, activities constructed to promote the learning, and teachers' reactions.

6.2.1 The context of the professional learning opportunities

In this section we identify aspects of the context (Overview 6.1) in which the professional learning opportunities occurred that appeared to be successful/unsuccessful in terms of changing teachers' knowledge of mathematics and mathematics teaching in ways that led to positive outcomes for students.

6.2.1.1 Infrastructural supports

Infrastructural supports such as funding and release time were not reported in many studies and, in others, the use made of these was not described in any detail. However, supports such as funding and time allocations for teachers to work together or with a professional development provider were associated both with core studies[66] and with supplementary studies that had limited student outcomes[67]. This indicates that it was not the funding or support that made the difference so much as how these resources were used.

6.2.1.2 Coherence with wider curriculum trends

The essential ideas about mathematics teaching in all the core studies were aligned with broader policy directions and current discourses from influential bodies (such as national subject associations) about the nature of mathematics, and mathematics learning and teaching within that context. Seven of nine United States studies, for example, directly justified the content of their professional development programmes by making reference to the Standards for School Mathematics, prepared in 1989 by the National Council of Mathematics[68].

Overview 6.1. The context of the professional learning opportunities

Infrastructural supports

- Supports such as funding and time allocations for teachers to work with one another or a provider were associated both with core studies and those with low or no impact.

  What was important was how any additional time or funding was used.

Coherence with policy

- All of the interventions in the core studies offered programmes of professional learning that focused on deepening content knowledge and that was aligned with directions advocated by policy makers or influential bodies such as national subject associations.

Voluntary or compulsory

- Volunteering was associated both with core studies and those that had low or no impact.

  A commitment to engage did not need to be a prior condition; what was more important was that teachers engaged with the learning process at some stage.

Individual or whole-school

- Professional learning involving all teachers from a school, department, or year level was associated both with core studies and those that had low or no impact.

  Some form of collegial support was evident in all studies documenting significant shifts in practice.
  Collegial support involved colleagues and/or providers.

External expertise

- All successful interventions involved expertise from someone external to the group of participating teachers.

School leadership

- Involvement of school leadership was given less emphasis than in other areas.

  Where described, the role of leadership in the core studies was focused on providing a supportive environment for professional learning and its implementation rather than on providing expertise.

Teachers found that adopting leadership roles in professional learning could be challenging.

Time and frequency

- Most, but not all, core studies involved professional learning over an extended period of time.

  Participation for an extended time did not guarantee success.

Prevailing discourses

- Several of the interventions in the core studies were successful despite there being considerable gaps initially between prevailing discourses and the approaches being promoted in the professional learning.

Professional learning goals

- All of the interventions in the core studies communicated clear goals that related specifically to student achievement in mathematics.

Policy makers appeared to be more directly involved in mathematics education than in other curriculum areas. Four of the core studies, for example, reported the involvement of government agencies at a national, state, or district level[69]. Such direct involvement did not necessarily lead to positive outcomes, however—a similar proportion of the supplementary studies that failed to meet our impact size criteria was also directly initiated by policy makers[70]. The pedagogical focus of the only study that was not specifically aligned with policy[71] was informed by an extensive body of research. It appears, therefore, that alignment of policy, research, and practice was considered particularly important in mathematics.

6.2.1.3 Voluntary or compulsory

Whether participation in the professional learning was voluntary or mandatory was not a significant influence on outcomes. Teacher participation in professional development was fully voluntary in six of the eleven core studies[72]. One other study[73] had some characteristics of being voluntary in the sense that 75% of staff had to vote in favour of implementation before the programme developers would work with the school; participation presumably then became mandatory for all staff. The remaining four core studies were fully mandated[74]. Participation in four of the six supplementary studies that had poor student outcomes was also voluntary[75], suggesting that whether participation was mandatory or voluntary had little effect on outcomes. What was more important was that the professional learning engaged teachers at some point. Joining the professional learning with a prior commitment to engage was not a necessary condition.

6.2.1.4 Individual or whole-school

In some of the core studies, teachers participated in professional learning as individuals and in others, alongside colleagues from their department or school. Positive and negative outcomes were associated with each condition, suggesting that neither was a necessary condition. What was important was that participating teachers were able to find some form of collegial support, whether within or from outside their school. In some circumstances, this support came from the professional development providers themselves.

The professional learning described in many of these studies appeared very challenging for at least some of the teachers involved as it required quite major shifts from what might be described as 'traditional' mathematics teaching. In all the core studies, some form of collegial support was available from other participants. Nine of the eleven core studies involved either the entire staff of the school or at least some other teachers from the school who taught at the same year level. We have assumed in all these cases that possibilities existed for collegial interaction and support. In the three other cases involving individual teachers who received professional development independently of colleagues in their school setting[76], all participants received extensive collegial support through relationships with teachers from other schools involved in the project, or through the relationship with a researcher/developer. For example, in the study of the three contrasting conditions, those in the integrated mathematics assessment group[77] may have had the need for collegiality satisfied by the regular meetings at which teachers from different schools met and discussed progress. There were 13 such meetings held throughout the year.

It seems likely that teachers find participation in a group in which they can develop a shared sense of purpose and motivate and support one another highly conducive to professional learning when substantive change is required. It may, however, be a condition that can be satisfied by people other than teachers' immediate colleagues. In the study involving one teacher[78], for example, Ms Smith worked closely with the researcher for extended periods of time in a relationship that was described as a partnership of equals. Box 6.1 illustrates how the teacher–researcher relationship satisfied the collegiality condition.

Box 6.1. An example of a collegial relationship between a teacher and a researcher

As we began to collaborate with Ms. Smith, our interactions evolved into daily meetings after mathematics class during which time we would share informal analyses of the students' developing ways of reasoning and observations about developing classroom norms … In all of these meetings Ms. Smith participated as a full member of the research team. Although Ms. Smith viewed the project team as a resource which she could use in improving her developing practice, she did not view us as the authorities … The discussions in which we developed taken-as-shared interpretations of classroom events constituted a supportive setting in which Ms. Smith could reflect on her practice and develop her pedagogical agenda and we could gain insights from the teacher's perspective.

While collegial support may be a necessary condition, it is not sufficient as is evidenced by the fact that all of the supplementary studies with low outcomes for students also involved teachers participating in professional development alongside at least some colleagues from their school.

6.2.1.5 External expertise

All of the core studies involved expertise from outside the teachers' own schools. The changes promoted in this group of studies typically required major shifts in thinking and practice. Shifts to what were typically more complex and sophisticated notions of mathematics learning required challenge and support from those with appropriate expertise.

In the study by Saxe et al. (2001)[79], for example, students were required to develop a conceptual understanding of fractions that went beyond simple computation. The participating teachers were allocated to one of three conditions. In the control condition, teachers were given a new textbook as a professional resource but no professional development as such. The first of the professional development conditions involved major input from an expert over a considerable period of time. This input and the associated interactions resulted in positive outcomes for learners. The second professional development condition involved teachers working together regularly with the aim of supporting one another to implement the reform approach to teaching of fractions, but without any external input. This condition, referred to as the 'collegial support' condition, resulted in no improvement for students on measures of conceptual understanding, and in scores for computation that were lower than those of the students whose teachers were simply given the textbook.

The teachers whose students made significant gains in their conceptual understandings of fractions were those who had benefited from the input of external expertise. The professional development provider had extended their content knowledge of fractions, challenged beliefs that primarily valued computation, promoted beliefs that valued conceptual understanding, and provided them with a multitude of learning resources that had enhanced their ability to successfully implement the reform. Without the external expertise to challenge their beliefs and provide conceptual and practical tools, the teachers who received only collegial support were unable to implement the changes in ways that impacted positively on student learning.

6.2.1.6 School leadership

The involvement of school leadership in this group of studies was given less weight than was the case in other curriculum areas. This lower profile for leaders may be an artefact of fewer whole-school professional development programmes reported in mathematics and a higher number of instances in which the professional development involved individual teachers or just a small number of teachers from one school.

Even in the whole-school studies, school leaders did not adopt an expert role in relation to mathematics. It may be that what was being asked was as challenging for leaders as for the participating teachers. A key role for school leaders in this group of studies was to provide an appropriately supportive environment in which the professional learning and its implementation could take place[80].

6.2.1.7 Time and frequency

All but two of the studies documented interventions that involved regular, ongoing professional development over an extended time frame of at least a year, with some up to five years. That two took place over a limited period would suggest that an extended time frame is usually but not always necessary to achieve improved student outcomes. One of these interventions[81], a supplementary study that did achieve some gains in test scores, consisted of three 90-minute workshops within the first six weeks of the programme, followed by one observation each fortnight over the following three months. Feedback from these observations appears to have been limited and focused on the collection of data for research rather than the professional learning of the teachers involved.

The other intervention[82] achieved one of the largest effect sizes but took place over one of the shortest periods of time. It is discussed in Box 6.2.

Box 6.2. Achieving a large effect size in a short time

In one study, researchers explored the effects of metacognitive instruction on the mathematics achievement of historically low-achieving students. The professional development provider delivered a three-day workshop, in total, 21 hours of contact time. Teachers were trained in the metacognitive instructional approach using a combination of lectures, demonstrations, open discussion, and simulation exercises. Despite the relatively short time and duration of this intervention the outcomes for this group of students with special learning needs was very positive.

While an extended time frame with frequent ongoing opportunities to learn does seem to be generally associated with professional development that results in positive outcomes for learners, it is not in itself a guarantee of success. Extended time with frequent contact was also a feature of the supplementary studies with poorer outcomes for students. What matters is what occurs within the time.

6.2.1.8 *Prevailing discourses and models of practice*

The interventions documented in the core studies successfully challenged prevailing discourses about mathematics teaching and learning that were often markedly different from those promoted in the professional learning.

Prevailing discourses and models of practice were primarily related to what counted as mathematics learning and teaching. While in some situations, teachers were already partly familiar with the practices being promoted in the professional development and were, to some extent, already sympathetic to the professional development goals[83], this was by no means true in all the studies. In the majority of core studies, there was a clear disjunction between teachers' prevailing discourses about mathematics teaching and learning and those embedded in the professional development. The shift typically involved was from procedures and memorisation to mathematical inquiry and conceptual understanding.

The researchers involved in the New Zealand Numeracy Development Project (2005)[84], for example, described the prior prevailing model of practice as typically involving an emphasis on written mathematical exercises following textbook progressions. In contrast, the practice promoted by the professional development emphasised the development of strategy-based thinking and mathematical knowledge through discussion of multiple solutions to problems. This represented a substantively different approach to teaching.

Box 6.3 illustrates the considerable gap between the prevailing teaching practices before the professional development, and those promoted in a study[85] that was concerned with developing the metacognitive abilities of low-achieving students in mathematics.

Box 6.3. Changing discourse and models of practice

Practices before the professional development

Mathematics was about "focusing on students' getting the right answer. This approach consisted of explaining the topic, lecturing, giving written assignments to students, and correcting these assignments using a check mark indicating the number of questions students answered correctly. For incorrect answers, teachers provided the right answer for the whole class orally or in writing on the chalkboard." (p. 86)

Practices promoted by the professional development programme

The professional development promoted an approach in which students were supported to be much more responsible for monitoring their own learning, whereas previously the teacher had been the sole arbiter of what constituted a right or wrong answer. Teachers learned to encourage students to consider multiple approaches to solving a problem, rather than believing that there was one 'right way'. Because the *process* of problem solving was considered more valuable than the *product*, students were taught the metacognitive skills they needed to monitor their own progress as they problem-solved. In cases where their answer was incorrect they would be guided by their teacher but would be expected to identify where they went wrong and be responsible for finding a method of solving it correctly.

It seems reasonable to assume that the narrower the gaps between existing and promoted beliefs and practices, the more easily bridged they will be. In the core studies, however, substantive changes in teaching beliefs and practices occurred that had a positive impact on students even when the prior prevailing discourses and models of practice were markedly different from those promoted in the professional development.

6.2.1.9 Professional learning goals

All of the core studies communicated clear goals about student outcomes that were specific to mathematics. All focused on mathematics achievement or attitudes towards mathematics learning. Many of the core studies focused particularly on developing students' conceptual understanding of mathematics, typically by focusing on one area of mathematics, such as fractions, numeracy, or arithmetic.

Four[86] of the supplementary studies with lower student outcomes addressed mathematics achievement in a more peripheral manner, typically through programmes that focused on general pedagogies thought to be applicable to all learning areas. The focus on mathematics was more incidental and proved less effective in improving student outcomes.

6.2.1.10 Relationships of respect

Many of the core studies described teacher–provider relationships that could be characterised as positive, respectful, and mutual. In the following example[87], the researchers portrayed the teachers as professionals, capable of applying principles from research (Box 6.4).

Box 6.4. Establishing a relationship of mutual respect

The researchers in this study wrote, "We made a point of communicating that we regarded them [the teachers] as professionals who were making instructional decisions, and that our role was to help them understand what we knew from research about children's thinking. We told them that their role was to help us understand how the research knowledge about children's thinking could be used in instruction." (p. 562)

6.2.1.11 Teachers as diverse learners

While many of the core studies involved professional development for groups of teachers, there were usually opportunities for individual differentiation. The pattern typically consisted of generic training as a group, often in a formal workshop situation, followed by activities that allowed some individualised attention to the specific needs of teachers. These needs were followed up with observations of practice, or one-to-one planning sessions.

Like students, teachers are a diverse group of learners who bring to learning opportunities very different attitudes, knowledge, skills, and experience. Professional learning opportunities that treat teachers as a homogeneous group and do not provide opportunities for differentiation risk alienating some[88], as is illustrated in Box 6.5.

Box 6.5. An example of an undifferentiated professional learning opportunity

In this study, all teachers were required to take part in school-based professional development that involved implementing a specific pedagogical approach called the Hunter Instructional Skills. Researchers found that two of the teachers who participated in extensive professional development were already implementing these skills to a very high level before the training began as they had been trained earlier in their previous school. Their implementation of the programme actually reduced during the mandated professional development at their new school as they became bored with the programme and frustrated with the continued requirement to participate. As the researchers commented, "Given a chance, over the 4 years of this project, they might have learned other useful teaching skills in another staff development program." (p. 134)

6.2.2 The content of the professional learning opportunities

In this section, we identify the kinds of knowledge and skills that were presented during professional learning opportunities that appeared to be effective in terms of changing mathematics teaching in ways that led to positive student outcomes. A summary of the key points from the core studies is provided in Overview 6.2.

> **Overview 6.2. The content of the professional learning opportunities**
>
> **Balance of theory and practice**
>
> - The interventions in all of the core studies had a specifically mathematical focus.
> - In all of the core studies, a strong theoretical basis for the intervention was clearly communicated.
>
>   *No programme that focused solely on a generic pedagogy was successful in raising students' achievement in mathematics.*
>
> **Pedagogical content knowledge**
>
> - Most of interventions in the core studies involved teachers developing their own content knowledge of mathematics.
> - Most of of the interventions in the core studies developed teachers' understanding of how students learn mathematics.
>
> **Assessment**
>
> - Most of the interventions in the core studies directly or indirectly addressed teachers' skills for assessing students' understanding of mathematics, sometimes with reference to developmental progressions.
>
>   *Assessment was important in terms of teachers' commitment to change: when they saw positive changes result for their learners, they became more committed to the new approach.*
>
> **High integration**
>
> - Most of the interventions in the core studies developed teachers' understanding of the interrelationships between their knowledge of mathematics, how children learn mathematics, and their skills to assess students' understanding of mathematics.

The studies discussed in this chapter form a group that is perhaps more cohesive in terms of content than any of the others. All of the 11 core studies had a strong theoretical orientation that was clearly communicated through the professional learning opportunities. In various ways, teachers engaged with the current research findings that underpinned the particular approaches being promoted.

Ten of the 11 studies[89] shared an emphasis on the development of students' conceptual understanding of mathematics in an environment in which multiple approaches to mathematical problem solving were encouraged. In addition to this emphasis, these studies shared some striking commonalities with regard to the content provided through professional learning opportunities.

All provided teachers with learning opportunities that focused on their pedagogical content knowledge of mathematics rather than their ability to implement a particular pedagogy. All developed teachers' understanding of their students' mathematical thinking and their ability to assess it. All helped teachers to evaluate the effectiveness of their teaching on the basis of assessments of students' mathematical thinking, and to make instructional decisions based on deeper knowledge of their learners.

One other core study introduced a more generic pedagogy, but with a specific focus on how that pedagogy applied to mathematics, and included mathematical content knowledge. One was concerned with the introduction of cooperative learning across all areas of an elementary school, but utilised a programme called Team Assisted Individualization-Mathematics[90], which was specific to mathematics, rather than treat cooperative learning as a generic pedagogy.

In clear contrast, four of the six supplementary studies that had lower student outcomes[91] focused solely on pedagogy and provided no evidence that they addressed either teachers' mathematical content knowledge or their assessment skills. Of these four studies, the content of one[92] consisted solely of teachers sharing their existing knowledge in a professional learning community, without further external support. A second focused on the implementation of a generic pedagogy, with no specific focus on mathematics[93]. The remainder, while ostensibly addressing pedagogy within a mathematics context, seemed to lack any real focus on mathematics as a content area[94].

In this section we will look briefly at each of the key content components of professional learning that were associated with particular student outcomes in mathematics, before discussing the interplay between them.

6.2.2.1 Balance of theory and practice

All the studies with substantively improved student outcomes had a strong theoretical underpinning that was clearly communicated to teachers. All the core studies, at the very least, made references to theory and current research findings as a rationale for the new practices. For example, in one study[95], teachers received an "… explanation of the processes and the rationale behind them, and a detailed manual on how to use the program in a classroom" (p. 331). In another[96], the main vehicle for professional learning was a "replacement unit", consisting of activities and resources for a particular topic. Such an approach could lead to a change in teaching practice without a corresponding change in the teachers' understanding or their ability to apply the underlying principles in other situations. The researchers stressed, however, that this approach was "a transitional strategy"[97], not an end in itself, with the intention being that it would scaffold teachers into the new approach by providing them with a higher level of classroom support as they taught a topic using the new approach for the first time. Because the replacement unit was seen as a vehicle for strengthening teachers' pedagogical content knowledge, not as an end in itself, a strong emphasis was placed on conveying to teachers the cognitive dimensions underlying the design of the unit, which they referred to as its "scheme" (p. 184).

In another study[98], much greater weight was given to theory than to practice. Teachers in this case developed theoretical understandings of "… addition and subtraction word problems and how children think about them" (p. 504). In this professional learning opportunity, no instructional practices were prescribed; instead, "teachers discussed principles of instruction that might be derived from the research and designed their own programs of instruction on the basis of these principles" (p. 505).

Of the six supplementary studies that had lower outcomes for learners, three[99] were noticeably less theoretical in their orientation and were focused more on teachers' implementation of prescribed practices than their understanding of the theoretical basis for those practices. One[100] consisted solely of a professional learning community with no external input. The discussions in this case appear to have been confined to particular classroom practices.

The benefits of a theory-oriented approach and the limitations of a practice-oriented approach will be developed further in the remainder of this section.

6.2.2.2 Pedagogical content knowledge

The aim of most studies was to develop an approach that focused on students' conceptual understandings of mathematics and encouraged them to use multiple problem-solving strategies. Such a vision clearly implies the need for a much greater level of pedagogical content knowledge than that which is required to teach students a procedural approach to computation. It is not surprising, therefore, that ten of the 11 core studies addressed teachers' pedagogical content knowledge. Perhaps it is equally unsurprising that four of the six supplementary studies with lower student outcomes did not. This emphasis on content in the core studies indicates that the programme developers shared the belief, expressed by Saxe, Gearhart, and Nasir[101], that "teachers' knowledge of mathematics should be deeper than the content of the curriculum they are teaching" (p. 61).

6.2.2.2.1 Teachers' knowledge of how students learn mathematics

Teachers' understanding of how students learn mathematics was reported as a major component of professional learning in ten of the 11 core cases.[102] This could be expected, given that so many of the studies in this group were concerned with developing students' conceptual understanding of mathematics. In all cases in which this was a major feature of the professional learning, it was associated with the development of teachers' ability to assess students' understanding of mathematics.

Several of the core studies addressed teachers' understanding of student developmental progressions[103]. This understanding was associated both with learning content (where the aim was to help teachers identify developmental problems[104]) and as an aspect of assessment. In the New Zealand Numeracy Development Project[105], for example, developmental progressions were presented in the form of a 'number framework' that described increasingly sophisticated stages of strategy and knowledge. Teachers learned how to conduct a diagnostic interview, which provided a means of establishing where students' thinking fitted on the framework. A teaching model provided teaching approaches matched to each stage of the framework as a guide to teaching increasingly abstract representations of mathematical ideas. The close connection between assessment of students' understanding and teaching activities was a major feature of this professional development project.

6.2.2.3 Assessment

Assessment was also a major component of the professional development in all the core studies: not only the level of assessment, but the way in which it was integrated into cycles of teaching and learning. Their assessment skills allowed teachers to judge the impact of changed practice on their diverse student learners and make ongoing adjustments to practice in order to be more effective.

One explanation for this emphasis on assessment may be that the skills needed to assess students' *computational* skills in mathematics are very different from the skills needed to assess their *conceptual* understandings. Teachers needed support to develop new assessment skills if they were to successfully make the transition to the new approach.

A second explanation may relate to the new approaches taken to mathematical computation. Many of the programmes encouraged students to employ multiple problem-solving strategies rather than follow a fixed set of rules. The range of processes to be assessed was, therefore, far greater and, as a consequence, teachers needed broader and more adaptable assessment skills[106].

Box 6.6 illustrates how one teacher regarded her prior ability to assess students' understanding of mathematics and how the teaching practice of another was enhanced by the learning of new ways to assess understanding. Both these teachers participated in the Cognitively Guided Instruction (CGI) programme[107].

Box 6.6 Learning how to listen

"I have always known that it was important to listen to kids, but before I never knew what questions to ask or what to listen for" (Carpenter et al., 1989, p. 530).

"CGI is real strong and powerful for me because I can get a handle on all my children, from the lowest to the highest … I feel that I can know what they are doing and challenge them where they are and help them to feel successful where they are and where they get to … The more I see children using these strategies, that gives me knowledge to try and see if other children have these strategies, and it helps me to direct them or lead them without telling them" (Fennema, 1993, p. 580).

Only one core study did not directly report the extent to which teachers learned how to assess students' mathematical understandings during the training, but in both, assessment formed the basis of implementation. This study[108] fostered both individual and group accountability in cooperative learning situations. Such accountability requires assessment.

In all these studies, new assessment knowledge and practices allowed the professional learning opportunities to continue when new strategies were applied back in the classroom. As teachers grappled with new practices and new priorities, they were able to assess their impact on students and learn how to adjust their practice accordingly. Aligning assessment with teaching purposes is crucial if assessment is to fulfil this function. Non-aligned assessments cannot.

6.2.2.3.1 Assessment as a component in teachers' commitment to change

In a number of the core studies, assessment was also a significant factor in generating and maintaining teacher enthusiasm for the promoted approach. It is reasonable to expect that new teaching practices will be reinforced when teachers observe that they are having a positive impact on student outcomes. Such reinforcement can only occur, however, when teachers have the assessment tools with which to see these changes in student outcomes, and when they have come to value them. Neither of these conditions can be assumed, especially in cases such as these studies, where the processes and outcomes promoted in the professional learning were fundamentally different from those of prior practice. An example of student outcomes reinforcing teacher commitment[109] is outlined in Box 6.7 and the process is illustrated in Figure 6.1.

Box 6.7. Assessment as a component in one teacher's commitment to change

Teacher: But what really, really convinced me was working that first year with my kids in first grade, and the more problems I asked the better they got … It was the students who convinced me that CGI works, and they went far beyond what I ever expected that they could do (p. 579).

Researcher: When children begin to show increased learning, teachers continue to implement new methodologies that result in improved learning, and so the circle continues … The more she used the knowledge, the more the children learned, and the more she was committed to CGI as an approach to instruction (p. 580).

Figure 6.1. Assessment and teacher commitment

Another significant function of assessment in this group of studies was to problematise current practice and create cognitive dissonance. This function is discussed in the section on learning processes (6.2.4).

6.2.2.4 Studies that focused on pedagogy only

As mentioned above, four of the six supplementary cases that failed to meet our criteria for student outcomes focused solely on pedagogy and did not provide teachers with resources to develop their mathematics content knowledge or assessment skills.

One of the supplementary studies that had negative student outcomes in mathematics achievement[110] encouraged teachers to implement a prescriptive set of teaching behaviours in the form of a 'teaching script'. While the professional development was successful in terms of changing teachers' classroom practices, these practices had negative outcomes for students. In fact, the condition that resulted in the greatest teacher change had the most negative student outcomes.

We suggest that such approaches underestimate the complexity of teaching and just how important it is for teachers to be responsive to their students. Elsewhere we have suggested that teachers base their practice on their personal theories about how to be effective, and that the traditional hallmarks of an expert are a holistic grasp of relationships within a particular context and the ability to fluidly and efficiently solve problems of practice in theoretically consistent ways[111]. Prescribing particular approaches without developing teachers' theoretical understandings or giving them the tools they need to be responsive to the needs of their students is unlikely to be effective.

Under some circumstances, professional learning that was relatively prescriptive in terms of the teaching approaches being promoted had positive, albeit smaller outcomes. The conditions under which such an approach was able to be effective in one supplementary study[112] is discussed in Box 6.8.

Box 6.8. The 'active teaching and active learning' approach

The 'active teaching and active learning' approach to mathematics described by Mason and Good promotes a very structured lesson sequence with specified time frames for reviewing homework, actively teaching new concepts, seatwork, and so forth. What distinguished this approach from other similarly prescriptive approaches that failed to improve outcomes for students was that it encouraged a higher degree of responsiveness to students than was evident in those other studies. The professional development providers emphasised that the approach was not a 'straightjacket' and provided teachers with both the freedom and the tools they needed to modify the approach in response to the particular needs of their own students in their own classroom context. To this end, teachers learned approaches to "actively assess student understanding, and use other methods designed to maintain appropriate classroom management, time-on-task, accountability … Furthermore, teachers were encouraged to be active decision makers and use the models flexibly depending on lesson context" (p. 339).

Such responsiveness to students was made necessary by the grouping of students in the 'whole class ad hoc' approach promoted. In this approach, ability-based groups were adjusted daily on the basis of the teachers' ongoing, largely informal, assessment of students. So, within a well-defined framework, teachers were given both the freedom and the tools they needed to adjust their new practice to their own students in their own context.

6.2.2.5 Integration of content

A notable feature of many of the studies in this group was the high level of integration of the various components of professional learning content. Teachers learned to make instructional decisions on the basis of the interplay between their pedagogical content knowledge, their knowledge of how students learn mathematics, and their ability to assess their students' mathematical understanding. One example of this integration is presented in Box 6.9[113].

Box 6.9. Cognitively Guided Instruction (CGI)

This professional development was focused on developing teachers' mathematical content knowledge, their understanding of students' mathematical problem solving, and ways to assess it. In this professional development, no specific instructional practices were prescribed, but rather, "teachers discussed principles of instruction that might be derived from the research and designed their own programs of instruction on the basis of those principles … Much of the workshop was devoted to giving teachers access to knowledge about addition and subtraction word problems and how children think about them. The initial goal of instruction was to familiarise teachers with research on children's solutions of addition and subtraction problems. Teachers learned to classify problems, to identify the processes that children use to solve different problems, and to relate processes to the levels and problems in which they are commonly used" (Carpenter et al., 1989, pp. 504–505).

In a review of mathematical studies, Kennedy (1989) said of CGI:

"I suspect this type of program content benefits teachers in two ways. First, in order to understand how students understand particular content, teachers also have to understand the content itself, so that subject matter understanding is likely to be a by-product of any program that focuses on how students understand subject matter. Second, by focusing on how students learn subject matter, in-service programs help teachers learn both what students should be learning and how to recognise signs of learning and signs of confusion. So teachers leave these programs with very specific ideas about what the subject matter they teach consists of, what students should be learning about that subject matter, and how to tell whether students are learning or not. This content makes the greatest difference in student learning" (p. 25).

6.2.3 Activities constructed to promote the professional learning

In this section, we synthesise information about the various activities included in the professional learning opportunities that led to improved student outcomes. Our summary of the synthesis is provided in Overview 6.3.

Overview 6.3. Activities constructed to promote the professional learning

Alignment of content and activities

- There was clear alignment between the intended learning content and the professional learning activities provided.

  Many activities served to reinforce a multitude of different understandings.

Professional instruction was followed by multiple opportunities to learn

- The interventions in all of the core studies involved some form of direct instruction from someone with appropriate expertise.
- The interventions in all of the core studies provided information about theoretical principles.
- Instruction was accompanied by multiple opportunities for teachers to construct meaning and translate theory into practice over an extended period of time.

Activities to translate theory into practice

- In all but two of the core studies, teachers participated in a variety of activities to support the translation of theoretical principles into classroom practice over an extended period of time.
- In several core studies, initial activities focused on problematising teachers' existing practice.

Observations and feedback

- Ongoing observation of classroom practice and feedback from a peer or professional development provider was associated both with core studies and those with low or no impact.

Teachers working at own level in curriculum

- Most core studies involved activities in which teachers were positioned as learners, either at their own level of understanding or at the level of the curriculum they were teaching, typically as a vehicle for developing their content knowledge of mathematics and their awareness of their students' mathematical thinking.

Examining student outcomes

- The majority of core studies involved teachers examining student understandings of mathematics and making instructional decisions on the basis of them.

Participating in professional communities

- All studies reported some opportunity for teachers to discuss mutually identified issues.
- Participation in professional communities was not in itself sufficient to change teaching practice in ways that had a positive impact on student outcomes.

In all the core studies, there was a clear alignment between teacher learning activities and teacher learning goals. In many instances, one activity served a number of purposes; for example, teachers developed their content knowledge of mathematics as they watched a particular pedagogical approach being modelled.

The activities described in the different studies varied but there was considerable consistency in the overall structure of the programmes: all core studies but one[114] provided some direct teaching of new content by an external professional development provider in a workshop-type situation early in the professional learning experience and all provided multiple learning opportunities where teachers could translate theory into practice. This structure is shown in diagrammatic form in Figure 6.2.

Figure 6.2. Typical sequence of professional learning opportunities

6.2.3.1 Activities to create dissonance/problematise existing practice

Several of the studies involved professional learning that was specifically designed to create cognitive dissonance. This dissonance typically involved challenging teachers' beliefs about the nature of mathematics, for example, by advocating an approach focused more on conceptual understandings and less on procedural computation or by challenging teachers' assumptions about what their students were capable of achieving. A variety of activities was used to achieve this. For example, in several cases teachers were shown videotapes of students solving problems and explaining the strategies that they used. Some expressed surprise that the students were capable of such high-level thinking. The activities used to foster cognitive dissonance are explored in greater depth in the section on learning processes (6.2.4).

6.2.3.2 Activities that helped teachers translate theory into practice

As discussed in the previous section, this group of core studies with substantive student outcomes had a particularly strong emphasis on theory. Teachers were given multiple learning opportunities to translate theory into practice.

In all the core studies, teachers were able to see examples of the programme in practice, either by viewing videotapes of classroom practice or observing model lessons taught by a peer or professional development provider.

In one study[115], teachers viewed videotapes of expert teachers conducting interviews in order to assess their students' mathematical understanding. In another[116], teachers watched a videotaped lesson demonstrating cooperative learning. One school-based intervention[117] created a model classroom in which teachers would observe and discuss model teaching. In another[118], teachers positioned as students solved mathematical problems and the professional development provider modelled how to give metacognitive feedback. In all these situations, the opportunity to see examples of effective practice served to bridge the theory–practice divide.

In one study[119] (see Box 6.10), a teacher watched a professional development provider take a lesson with her own students. As well as providing opportunities to watch teaching practice, this allowed the teacher to take a back seat and learn more about her own learners, their understandings of mathematics, and what they were capable of.

Box 6.10. Modelling by a professional development provider

I've been watching [the professional development provider] take lessons and actually take kids that step further. Like they give her an answer but she'll always come back and ask them that extra step and I think that's what made teachers realise that we never get to extend the kids to where they're actually at. I think without watching [the professional development provider] in action like that, that would have been hopeless. I think people would have carried on the same way and hope that new concepts would have gone in … you then start realising what your own kids are capable of. If I was watching in another school or another class I think people would automatically say, "My kids can't do that or my kids are actually a step further so that doesn't really mean much" (p. 62).

6.2.3.3 Observations and feedback

Professional discussions and feedback to teachers, based on classroom observations of their implementation of new approaches, are associated both with core studies that had substantive student outcomes and with studies that failed to meet our criteria for student outcomes. Five[120] of the core studies clearly reported situations in which teachers were observed and received feedback from an outside professional development provider. Another[121] reported some observation but it was not clear whether this was for the purpose of professional learning or research. Observation and feedback were also associated with four of the six supplementary studies that had lower student outcomes. In one of these[122], teachers were observed by the trainers at least twice during each two-month interval between training sessions, and by the principal in some cases. The contrasting outcomes suggest that while observation and feedback may support teachers to implement or refine new practices in ways that have a positive impact on students, they do not guarantee it.

6.2.3.4 Providing student activities and materials

The provision of student activities and materials was another means by which teachers were supported to translate their learning into classroom practice, but in no case was this sufficient in itself.

Six of the core studies[123] clearly reported teachers being provided with student activities and materials as part of the professional learning. Such activities and materials were used variously to help make teachers' transition to the new practice less onerous and as a resource to support the translation of theoretical ideas. In one intervention[124], teachers were given an oversupply of instructional activities and notes so that they would be supported but not dependent on the materials as they would have to decide which were most appropriate. In another[125], teachers received detailed instructional activities and resources but how they were used varied from provider to provider. They were sometimes used as a resource in themselves and sometimes as a resource to support theoretical ideas.

In another intervention[126], the main vehicle for professional learning was a unit, consisting of activities and resources, to be used to replace an existing unit that covered topics such as ratio, qualitative motion, slope, linear functions, and simultaneous equations. This replacement unit was seen as a transitional strategy (p. 184) that would scaffold teachers into the new approach by providing them with a high level of classroom support as they taught a topic using the new approach for the first time. It was also seen as a means of building teachers' pedagogical content knowledge as they met with other teachers and a professional development provider to discuss and analyse their experiences.

In no study was the provision of such materials sufficient in itself to bring about changes in teacher practice that led to improved student outcomes. The one intervention that attempted this was unsuccessful[127]. In all the other core studies in which activities were provided, they were just one component of professional learning that sought to develop theoretically-based and coherent practice.

6.2.3.5 Teachers working at own level in curriculum

Teacher participation in the kinds of activity that they were being encouraged to use with their students was reported in a range of studies and served a variety of purposes. Such activities were used to model new approaches, deepen teachers' own mathematical knowledge, give them insight into the learning processes and experiences of their students, and provide a vehicle for discussions about practice. Five of the core studies[128] described activities in which teachers participated in activities positioned as students. In five[129], the activities were set at the teachers' level rather than that of their students so that, as well as providing an opportunity for the professional development provider to model a particular approach, the teachers' own mathematical content knowledge would be extended, giving them greater insight into their own—and consequently their students'—mathematical thinking. In one example[130] (see Box 6.11), teachers worked in pairs to develop their knowledge of fractions.

Box 6.11. Teachers working at own level in mathematics

Teachers were asked to play the role of a pizza store manager and propose a strategy for distributing leftover pizza to the homeless each evening; teachers worked in pairs to partition sets of partially eaten pizzas (sets of fractional parts of units such as 3/4 of a circle or 2/3 of a rectangle) into fair shares. This activity was a more challenging version of the lessons for elementary students, where students partition a whole number of cookies (circles) or brownies (squares) into fair shares. After the activity, the professional development provider engaged the teachers in reflection on part—whole relations, and relationships among different representations of fractions. At the conclusion, teachers were invited to step back into their roles as teachers and to reflect on practices they had just participated in as learners (p. 61).

In another study[131], teachers engaged in activities that aimed to develop students' cognition in mathematics. In this case, teachers solved the same problems as their grade 2 students, but only after they had been converted to base 8 to make them more challenging. One benefit of such activities is that they provided a context in which teachers could collaboratively analyse a wide range of issues related to mathematics teaching practice. An example[132] is described in Box 6.12.

Box 6.12. Teachers' thinking as a source of mathematical ideas

As they worked on the problem activities, they were encouraged to share ideas about the mathematical content. In discussions immediately after, the teachers would share their mathematical thinking and reflect on the mathematical thinking of their peers. This provided a context for rich discussions about important mathematical ideas and, subsequently, the pedagogical implications for implementing these ideas in their own classrooms. In follow-up meetings, teachers were encouraged to analyse and assess the mathematical ideas that were elicited from their students when these activities were implemented in their own classrooms (p. 210).

6.2.3.6 Examining student outcomes and understandings

Perhaps surprisingly, only one of the studies[133] in this group explicitly reported that teachers analysed quantitative student achievement data as part of the professional learning opportunities. In that case, teachers engaged with disaggregated data from reports of national assessments and were expected to collect data routinely and analyse it against curriculum targets. This is not to suggest, however, that assessment in a wider sense was not an important feature in core studies of professional learning. A large proportion of the core studies[134] had teachers participating in activities in which they analysed students' mathematical understanding by means such as watching videotaped interviews with students articulating their problem-solving strategies and interviews that they conducted themselves with their students. A major focus of most core studies was the promotion of practice based on sound knowledge of students' mathematical understanding.

6.2.3.7 Participation in professional communities

Participation in some form of learning community was a necessary but not sufficient condition. All of the core studies involved teachers working with others in some form of collegial relationship, usually with members from their own school community, but in some cases, in professional learning communities comprised of teachers from other schools[135], or even just the teacher and the provider[136]. Despite the apparent need for teachers to have a shared purpose if they are to successfully implement new approaches in ways that impact positively on learners, not all professional learning communities had positive outcomes for students. The one case[137] in this group of studies where teachers worked only with each other in a professional community failed to meet our outcomes criteria. This case is discussed in Box 6.13.

Box 6.13. A case of professional learning communities not working to improve student outcomes

In this study, researchers investigated the impact that different professional development models had on students' conceptual understanding of fractions. Teachers were assigned to one of three different treatment conditions. The Integrated Mathematics Assessment (IMA) group received extensive professional development. A second was a Collegial Support group, which met nine times in the course of one year. The third was set up as a control group in which no professional development was provided other than the 'reform' textbook.

The teachers in the Collegial Support condition were offered none of the focused help with subject matter, understanding of children's mathematics, or reform-minded approaches to instruction offered to those in the IMA group. Rather, they self-selected areas and topics for exploration. The professional development provider attended the meetings but did not set the agenda or give advice in regard to curriculum or pedagogy.

Under this condition, students performed no better in terms of conceptual thinking about fractions than did the students in the control group and they actually performed worse than the control group in terms of solving fraction problems.

Professional learning communities that lack external expertise are necessarily restricted to the collective understandings in the room. The following case[138], however, shows that even when expertise exists within a group, it is not necessarily used to address issues of content knowledge (Box 6.14).

Box 6.14. Professional learning communities

This study involved a professional learning community made up of mathematics teachers from both intermediate and secondary schools. As a general rule, the researchers found that these two groups had different professional development needs. In general, the intermediate teachers were stronger in pedagogy and had less mathematical content knowledge, while the reverse was true of the secondary teachers. The professional learning community was effective in developing pedagogy but was not effective in developing teachers' mathematical content knowledge: "Whereas the secondary school teachers seemed to gain pedagogical content knowledge from their association with the intermediate school teachers, the converse was not often true. The mathematical activities provided at group sessions had a divisive effect in that secondary school teachers dominated discussion of the mathematics … Professional conversations enabled teachers to gain insight into the mathematics of their students and effective teaching methods but they were not particularly useful in extending conceptual or connected knowledge of mathematics" (p. 149).

6.2.4 Learning processes

As we have noted elsewhere, written accounts of professional development do not generally report clearly on teacher learning processes and reactions, yet it is these that constitute the ‘black box’ between professional learning opportunities and teacher outcomes (see Figure 2.1). This omission is also true of professional learning in mathematics, particularly with regard to the extent to which teachers’ own prior knowledge is cued, retrieved, or consolidated. There is considerable evidence, however, that for many teachers, engagement in professional development in mathematics creates dissonance with existing beliefs about mathematics and how to teach it. Part of the process for resolving such dissonance involves understanding new information. These processes are summarised in Overview 6.4.

> **Overview 6.4. Learning processes**
>
> **Creating dissonance with current beliefs about mathematics teaching and learning**
>
> - Many of the interventions in the core studies involved challenging teachers’ existing beliefs about what was most important in mathematics and what their students were capable of.
>
>   *Teachers whose student outcomes improved resolved their dissonance and implemented new approaches to the teaching of mathematics.*
>
> **New information**
>
> - In all the core studies, new information to deepen understandings and refine skills consistent with the new position was part of the professional learning opportunities.
>
> **Consolidating prior knowledge**
>
> - The extent to which prior knowledge was cued, retrieved, or consolidated was not clearly reported in the core studies.
>
>   *Cueing, retrieving, and consolidating prior knowledge was evident only in those studies in which no change in student outcomes was evident.*

6.2.4.1 Creating dissonance with current position

As might be expected, considering the difference between prevailing discourses about mathematics and the approaches being promoted, a degree of dissonance with teachers’ current positions was a feature of many of the studies. In others, the extent of the changes to practice that followed the professional learning suggests that there must have been earlier cognitive dissonance.

In addition, there were parallels between the dissonance created for teachers and the dissonance advocated with regard to student learning. Most of the core studies had aspects of a cognitive constructivist perspective, which Wood and Sellers[139] described as “a process in which children attempt to overcome obstacles or contradictions that arise from engaging in purposeful activity[140]. From this point of view, social interaction is viewed as a means by which opportunities are created for transformations to occur in the individual’s thinking. In this respect, the conflict that arises between differing points of view, along with the individual’s resolution, creates situations in which changes in thought may occur” (p. 338).

In a number of the studies, ‘conflict’ followed surprise on the teachers’ part, typically in response to what their students did or did not understand about some aspect of mathematics. Surprises of this kind occurred during the formal professional learning opportunities, for example, when teachers viewed videotapes of children solving problems, and later in teachers’ own classrooms, particularly as they applied new methods of assessment that helped them better appreciate their students’ mathematical understanding. Sometimes the surprise was at the unexpected sophistication of students’ problem solving; sometimes the reverse was true as teachers discovered just how superficial their students' understanding was of concepts that they had assumed had been mastered. Several examples[141] of such dissonance are illustrated in Box 6.15.

Box 6.15. Creating dissonance

"In fact, some of the results really blew me away, it was the processes, what they knew … I had children who I had expected to do better, but they didn't, and I had some children who I had expected to be at a certain level and [they] ended up quite high up in terms of their cognitive processes, but because they didn't give me the answer, I just assumed, oh no, you're this level … It got rid of all my pre-conceived ideas about where they were. Yeah, there are things that I have changed that I would never have done before if it wasn't for the testing and finding out exactly where my children were at. Yeah, things have changed." (Higgins et al., 2005, p. 35)

"Some of the findings blew me out of the water. Place value, keeping track of five places, we had taken for granted. Students had a veneer of knowledge … Schools have to respond to kids wherever they are." (Irwin & Niederer, 2002, p. 90)

"I think going through the workshop last summer helped, because I have never done these kinds of problems in my life and again, it was exposure and knowledge, you know? And then I cemented it this year when I saw the kids could do it. Well, if they (children on the videotapes during the workshop) can do it, my kids can do it, too. So, I started right away and I was really amazed how much (my kids) knew." (Fennema et al., 1993, p. 579)

Dissonance in these cases was very important in terms of problematising aspects of teachers' current practice and engendering support for the new practice. This approach contrasted with one in which teachers were introduced to new pedagogical practices without a rationale that arose from their own practice context. Box 6.16 describes how professional development providers problematised one teacher's current practice[142] and then supported her to construct new practice.

Box 6.16. Problematising current practice

In another study (McClain & Cobb, 2001, pp. 8–9) the professional developers observed that one teacher "would allow all her students to share their solution methods. In addition, she accepted all their contributions equally and did not attempt to contrast solutions or to indicate that some were particularly valued." The professional development providers saw this practice as problematic because they felt that the teacher should play a more proactive role in guiding students' understanding of what an adequate solution would be, and also because students' participation in these discussions "appeared to involve waiting quietly for their turn to explain, but without listening to others' explanations." The professional development providers worked with the teacher to explore her reasons for pursuing this practice. She "justified her role in these discussions by explaining that she did not want to be an authority in the classroom. She made it clear that judging the worth of students' contributions violated basic tenets of her non-impositional educational philosophy." In an attempt to problematise her current practice, the professional developers "asked her to watch a videotape recording of one of the whole-class discussions and to focus on the learning opportunities that arose for the listening students. In doing so, she became aware that the listening students were not engaged and thus that the discussions did not contribute to their intellectual welfare."

6.3 Bringing it all together

The majority of the interventions documented by the studies in this group promoted ideas about the nature of mathematics and mathematics teaching that were fundamentally different to what might be termed ‘traditional’ approaches to mathematics. As such, the shifts that teachers were asked to make were challenging and, in all cases, significant external support was required to make them happen. By definition, the interventions described in the 11 core studies were all successful in supporting teachers to change their practice in ways that had positive outcomes for students. So it is clear that significant and positive shifts in teaching practice are possible when the right content is provided with the right kinds of support in the right kinds of circumstances. The purpose of this section is to summarise what we have learned about these ‘right’ conditions.

The interventions documented in the core studies all shared a focus that was specific to mathematics, clearly articulated goals to teachers that related specifically to student outcomes in mathematics, and provided teachers with a range of mathematics-based content. Attempts to improve student achievement through implementation of a pedagogy that lacked a mathematics focus were not successful in improving mathematics outcomes for students. This finding is consistent with a recent meta-analysis of the impact of professional development on student outcomes[143]. While there may well be pedagogical principles that apply to all subjects, attention to these was not sufficient to have a positive impact on students’ achievement in mathematics. All the core studies had, at minimum, some tailoring of generic pedagogy to a mathematical context. See, for example, the study of a school-wide cooperative learning approach that included a mathematics module[144]. But in most cases, the approaches taken were specific and exclusive to mathematics.

Whether teachers volunteered or were obliged to participate and whether participation involved a whole school or an individual teacher appear to be less important than a positive professional learning environment, the provision of sufficient time, and consistency within the professional learning experience and the wider social and educational context.

Given the significant shifts that were asked of teachers in the core studies, it is not surprising that the professional learning took place in environments that were supportive. Most programmes took place over an extended period of time and provided ongoing support with multiple opportunities to learn. All the interventions documented in the core studies engendered a sense of shared purpose among the participants, and the relationships between teachers and professional developers, when described, struck a balance between being supportive and being challenging. In several instances, professional developers specifically stressed that they viewed teachers as peers and the professional learning experience as a reciprocal one.

All of the core studies with positive outcomes for students were of interventions that promoted approaches consistent with those of the wider mathematics community. They were either initiated by policy makers or directly influenced by bodies such as national subject associations. They had strong internal consistency and the opportunities provided for teacher learning were consistent with the principles of student learning being promoted. In one case, for example, the promotion of cooperative learning in the classroom was mirrored by the creation of cooperative leadership structures[145], ensuring that the medium did not contradict the message.

The content of the learning was far and away the most influential factor in determining whether professional learning would result in improved mathematical outcomes for students. The differences between the programmes that led to substantive student outcomes and those that had a much lower (or even negative) impact related mainly to learning content. Neither the overall context in which the professional learning took place or the types of activities in which teachers participated were markedly different in the successful and the less successful cases. What distinguished the learning activities was not their form, but their content. The successful programmes focused deliberately on mathematics and provided teachers with a range of knowledge, understandings, and skills that related directly to mathematics, while the unsuccessful programmes took a more generic approach. Successful programmes developed teachers' content knowledge of mathematics and their understanding of students' mathematical thinking, while the unsuccessful programmes focused exclusively on pedagogy.

In no case was it sufficient for teachers to simply learn how to implement prescribed teaching practices. In all successful interventions, the content served to develop teacher understanding of the theoretical basis for the practices being promoted, as well as the complex relationship between the key elements of teacher subject knowledge, pedagogy, assessment, and how students learn. In contrast, in the four supplementary studies that failed to meet our criteria for student outcomes, the focus was on pedagogy only.

One explanation for the limited (in one case, negative) impact of such approaches is quite simply that they underestimate the complexity of teaching and learning. Teachers need tools that allow them to be responsive to the needs of their own students and there is a risk that in prescribing teaching practices without providing such tools, the focus can shift off students and on to programme implementation fidelity. It could be argued that this is no more than a short-term effect of implementing something new and that, as teachers gain confidence in the new approach, their responsiveness to students will be restored, but the study involving Madeline Hunter's Instructional Theory into Practice model suggests otherwise[146]. In this study, student achievement in mathematics initially increased slightly but dropped again after two years of implementation. Instead of familiarity with the pedagogy leading to a restoration of responsiveness, familiarity may be associated with monotony. Kennedy[147] has suggested that this may be due to these instructional models being "simply more boring to implement, for they prescribe an almost invariant daily routine … it may well be that both teachers and students need more variety than these models allow" (p. 19). Clearly, one can never assume that the implementation of supposedly effective teaching strategies will automatically result in positive outcomes for students, for it is unlikely that any particular teaching strategy will be effective for every learner in every context.

Core studies addressed assessment in a number of different ways, none of which was apparent in those studies that had less impact on student outcomes. Assessment provided the initial challenge to existing practice, the basis for instructional decisions, and the motivation to continue with the professional development as teachers saw their students make accelerated progress. It is hardly suprising that assessment should be such an important component of teacher professional learning as teachers need the skills to understand the impact of their instruction on students if they are to be able to tailor their instruction to meet diverse student needs.

It is the interchange between the various components of mathematical learning content that appears to be crucial. Successful professional learning offered well-developed conceptual understandings of mathematics so that teachers could, in turn, develop the conceptual understandings of their students. Teachers were then able to assess their students' understandings, knew how to interpret the implications, and were able to base instructional decision making on them.

Box 6.17 gives an example of how the various components of a 'cognitively oriented approach' combined to impact on one participant's teaching[148].

Box 6.17. Applying knowledge in the classroom

When asked what knowledge was important to her as she made instructional decisions, one teacher who had participated in professional learning in Cognitively Guided Instruction (CGI) replied:

"The knowledge of the content of the problem solving, the problem types and the solution strategies and you have to have the foundation yourself, before you can impart it for your kids … (CGI is) a philosophy versus a recipe … You as a teacher have to take the knowledge that CGI is about problem types, about solution strategies, about how children develop cognitively, and you have to apply that to your own teaching styles. Then, the outcome of that is, as a teacher you have to be a supreme listener to kids, and not only do you learn to just listen, but then you learn what to listen for and what might be some possible next steps you might want to take" (p. 580).

Kennedy's analysis of professional learning in mathematics identified the most successful programmes as being "more cognitively oriented, interested in how students come to understand mathematical ideas, and interested in student reasoning, analysis, and problem solving in mathematics."[149] She concluded that "a strong case can be made for attending more to the content of inservice teacher education and for attending less to its structural and organizational features." This synthesis supports Kennedy's view.

References

1 Angrist, J. D. & Lavy, V. (2001). Does teacher training affect pupil learning? Evidence from matched comparisons in Jerusalem public schools. *Journal of Labor Economics, 19* (2), 343-369.

2 **Stevens, R. J. & Slavin, R. E. (1995). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. *American Educational Research Journal, 32* (2), 321-351.**

3 **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

Montes, F. (2002). Enhancing content areas through a cognitive academic language learning based collaborative in South Texas. *Bilingual Research Journal, 26* (3), 697-716.

4 Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. *Teaching and Teacher Education, 11* (1), 81-95.

5 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

6 **Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30* (3), 555-583.**

7 Carpenter,T., Fennema, E., & Franke, M. (1996). Cognitively guided instruction: A knowledge base for reform in primary mathematics instruction. *Elementary School Journal, 97* (1), 1-20.

8 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

9 Carpenter, T., Fennema, E., Franke, M., Levi, L., & Empson, S. (2000). *Cognitively guided instrucation: A research-based teacher professional development programme for elementary school mathematics*. Research report. Madison, WI: National Center for Improving Student Learning and Achievement in Mathematics and Science (ED470472).

10 Carpenter, T., Franke, M., & Levi, L. (2003). *Thinking mathematically: Integrating arithmetic and algebra in elementary school*. Portsmouth, NH: Heinemann.

11 Fennema, E., Carpenter, T., Franke, M., Levi, L., Jacobs, V., & Empson, S. (1996). A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Education, 27* (4), 403-434.

12 Fennema, E., Carpenter, T., & Peterson, P. (1989). Learning mathematics with understanding: Cognitively guided instruction. *Advances in Research on Teaching, 1,* 195-221.

13 Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6)

14 Franke, M. & Kazemi, E. (2001). Learning to teach mathematics: Focus on student thinking. *Theory into Practice, 40* (2), 102-109.

15 Franke, M. L., Carpenter, T. P., Fennema, E., Ansell, E., & Behrend, J. (1998). Understanding teachers' self-sustaining, generative change in the context of professional development. *Teaching and Teacher Education, 14* (1), 67-80.

16 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991). Assessment of a problem-centered second-grade mathematics project. *Journal for Research in Mathematics Education, 22,* 13-29.

17 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000). Implementation research as a means of linking systemic reform and applied psychology in mathematics education. *Educational Psychologist, 35* (3), 179-191.

18 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies*. London, UK: DfES.

19 Basit, T. (2003). Changing practice through policy: Trainee teachers and the National Numeracy Strategy. *Research Papers in Education, 18* (1), 61-74.

20 Beard, R. (1999). *National Numeracy Strategy: Review of research and other related evidence.* Leeds, UK: University of Leeds.

21 Brown, M., Millett, A., Bibby, T., & Johnson, D. (2000). Turning our attention from the what to the how: the National Numeracy Strategy. *British Educational Research Journal, 26* (4), 457-471.

22 Department for Education and Skills (2002). *Targeting support: Managing NNS/NLS intervention programmes. A guide for headteachers and senior managers.* London, UK: DfES.

23 Department for Education and Skills (2003). *Best practice: Teaching literacy and mathematics to children with emotional and behavioural difficulties*. London, UK: DfES.

24 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005). *Findings from the New Zealand Numeracy Development Project 2004*. Wellington, NZ: Ministry of Education.

25 Higgins, J. (2004a). *An evaluation of the Advanced Numeracy Project 2003.* Wellington, NZ: Ministry of Education.

26 Thomas, G. & Tagg, A. (2004). *An evaluation of the Early Numeracy project 2003.* Report to the Ministry of Education: Wellington, New Zealand.

27 Thomas, G. & Tagg, A. (2005). Evidence for expectations: Findings from the Numeracy Project longitudinal study. In J. Higgins, K. Irwin, G. Thomas, T. Trinick, J. Young-Loveridge (Eds.). *Findings from the New Zealand Numeracy Development Project 2004* (pp. 21-46). Report to the Ministry of Education: Wellington, New Zealand.

28 Young-Loveridge, J. (2004). *Patterns of performance and progress on the Numeracy Projects 2001-2003: Further analysis of the numercy project data.* Report to the Ministry of Education: Wellington, New Zealand.

29 Young-Loveridge, J. (2005). Patterns of performance and progress on the Numeracy Projects: Analysis of 2004 data. In J. Higgins, K. Irwin, G. Thomas, T. Trinick, J. Young-Loveridge (Eds.). *Findings from the New Zealand Numeracy Development Project 2004* (pp. 5-20, 115-127). Report to the Ministry of Education: Wellington, New Zealand.

30 McClain, K. & Cobb, P. (2001). An analysis of development of sociomathematical norms in one first-grade classroom. *Journal for Research in Mathematics Education, 32* (3), 236-266.

31 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001). Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support. *Journal of Mathematics Teacher Education, 4,* 55-79.**

32 Schorr, R. Y. (2000). Impact at the student level: A study of the effects of a teacher development intervention on students' mathematical thinking. *Journal of Mathematical Behavior, 19*, 209-231.

33 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

34 Wood, T. & Sellers, P. (1996). Assessment of a problem-centered mathematics program: Third grade. *Journal for Research in Mathematics Education, 27*, 337-353.

35 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

36 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6)

37 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

38 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

39 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

40 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

41 McClain, K., & Cobb, P. (2001), loc. cit. (ref. 30).

42 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition a, (ref. 31).**

43 Schorr, R. Y. (2000), loc. cit. (ref. 32).

44 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

45 Wood, T. & Sellers, P. (1996), loc. cit. (ref. 34).

46 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1).

Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.

47 Mason, D. A. & Good, T. (1993). Effects of two-group and whole-class teaching on regrouped elementary students' mathematical achievement. *American Educational Research Journal, 30* (2), 328-360.

48 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).**

49 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

50 Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

51 Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005). Effects of a cooperative learning program on the elaborations of students during help seeking and giving. *American Educational Research Journal, 42* (1), 115-151.

52 Britt, M. S., Irwin, K., Ellis, J., & Ritchie, G. (1993). *Teachers raising achievement in mathematics. Final report for the research division of the Ministry of Education*. Auckland, NZ: Centre for Mathematics Education, Auckland College of Education.

53 Fresko, B., Robinson, N., Friedlander, A., Albert, J., & Argaman, N. (1990). Improving mathematics instruction and learning in the junior high school: An Israeli example. *School Effectiveness and School Improvement, 1* (3), 170-187.

54 Trinick, T. & Stephenson, B. (2005b). An evaluation of Te Poutama Tau 2004. In J. Higgins & K. Irwin & G. Thomas & T. Trinick & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Project 2004* (pp. 56-65). Wellington, NZ: Ministry of Education.

55 **Kennedy, M. M. (1998). *Form and substance in inservice teacher education*. Research Monograph No. 13. Madison, WI: National Institute for Science Education (NISE) Publications, University of Wisconsin-Madison.**

56 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1)

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

57 Mason, D. A. & Good, T. (1993), loc. cit. (ref. 47).

58 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).**

59 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

Robbins, P. & Wolfe, P. (1987). Reflections on a Hunter-based staff development project. *Educational Leadership, 44* (5), 56-61.

Hunter, M. (1976). *Prescription for improved instruction*. El Segundo, CA: TIP.

60 Van der Sijde, P. (1989), loc. cit. (ref. 50).

61 Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005), loc. cit. (ref. 51).

62 Britt, M. S., Irwin, K., Ellis, J., & Ritchie, G. (1993), op. cit. (ref. 52).

63 Fresko, B., Robinson, N., Friedlander, A., Albert, J., & Argaman, N. (1990), loc. cit. (ref. 53).

64 Trinick, T. & Stephenson, B. (2005b), loc. cit. (ref. 54).

65 **Kennedy, M. M. (1998), op. cit. (ref. 55).**

66 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

67 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

68 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition a, (ref. 31).

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

Wood, T. & Sellers, P. (1996), loc. cit. (ref. 34).

Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

69 Young-Loveridge, J. (2005), loc. cit. (ref. 29).

Thomas, G. & Tagg, A. (2005), loc. cit. (ref. 27).

Schorr, R. Y. (2000), loc. cit. (ref. 32).

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

70 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1)

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

71 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

72 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).

Wood, T., & Sellers, P. (1996), loc. cit. (ref. 34).

73 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

74 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

Schorr, R. Y. (2000), loc. cit. (ref. 32).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

75 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).**

Van der Sijde, P. (1989), loc. cit. (ref. 50).

Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005), loc. cit. (ref. 51).

Mason, D. A. & Good, T. (1993), loc. cit. (ref. 47).

76 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).

77 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition a, (ref. 31).**

78 McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

79 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).**

80 Schorr, R. Y. (2000), loc. cit. (ref. 32).

81 Mason, D. A. & Good, T. (1993), loc. cit. (ref. 47).

82 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

83 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991). Assessment of a problem-centered second-grade mathematics project. *Journal for Research in Mathematics Education, 22*, 13-29.

84 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

85 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

86 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1)

Mason, D. A. & Good, T. (1993), loc. cit. (ref. 47).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 59).

Van der Sijde, P. (1989), loc. cit. (ref. 50).

87 Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

88 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

89 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit (ref. 18).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).

Schorr, R. Y. (2000), loc. cit. (ref. 32).

Wood, T. & Sellers, P. (1996), loc. cit. (ref. 34).

90 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

91 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1)

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).

Van der Sijde, P. (1989), loc. cit. (ref. 50).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 59).

92 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).**

93 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

94 Van der Sijde, P. (1989), loc. cit. (ref. 50).

Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005), loc. cit. (ref. 51).

95 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

96 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

97 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit., p. 184 (ref. 17)

98 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

99 Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 1)

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

Van der Sijde, P. (1989), loc. cit. (ref. 50).

100 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).**

101 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).**

Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Schorr, R. Y. (2000), loc. cit. (ref. 32).

Thomas, G. & Tagg, A. (2005), loc. cit. (ref. 27).

Wood, T. & Sellers, P. (1996), loc. cit. (ref. 34).

Young-Loveridge, J. (2005), loc. cit. (ref. 29).

103 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

104 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).**

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

105 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

106 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

107 Ibid.

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

108 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

109 Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

110 Van der Sijde, P. (1989), loc. cit. (ref. 50).

111 Earl, L. & Katz, S. (2005). *Learning from networked learning communities (phase 2): Key features and inevitable tensions*. Phase 2 Report of the Networked Learning Communities External Evaluation. London: DfES.

112 Mason, D. A. & Good, T. (1993), loc. cit. (ref. 47).

113 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

Kennedy, M. M. (1998), op. cit. (ref. 55).

114 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

115 McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

116 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

117 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

118 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).

119 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

120 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

Schorr, R. Y. (2000), loc. cit. (ref. 32).

Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).

121 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

122 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

123 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).

Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).

124 McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

125 Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).

126 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

127 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition c, (ref. 31).**

128 Cardelle-Elawar, M. (1995), loc. cit. (ref. 4).
Schorr, R. Y. (2000), loc. cit. (ref. 32).
Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).

129 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).
Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).
Schorr, R. Y. (2000), loc. cit. (ref. 32).
Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).
Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).
Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).

130 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition a, (ref. 31).**

131 McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

132 Schorr, R. Y. (2000), loc. cit. (ref. 32).

133 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). op. cit. (ref. 18).

134 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).
Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 5).
Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 17).
Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).
Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).
McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).
Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 31).
Schorr, R. Y. (2000), loc. cit. (ref. 32).

135 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition a, (ref. 31).**

136 Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991), loc. cit. (ref. 16).

137 **Saxe, G. B., Gearhart, M., & Nasir, N. (2001), op. cit., condition b, (ref. 31).**

138 Britt, M. S., Irwin, K., Ellis, J., & Ritchie, G. (1993), op. cit. (ref. 52).

139 Wood, T. & Sellers, P. (1996), loc. cit. (ref. 34).

140 von Glasersfeld, E. (1983). Learning as a constructive activity. In N. Herscovices & J. C. Bergeron (Eds.), *Proceedings of the 5th Annual Meeting of the Psychology of Mathematics Education - North America* (pp. 41-69). Montreal: University of Montreal.

141 Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).
Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 24).
Irwin, K., & Niederer, K. (2002). *An evaluation of the Numeracy Exploratory Study Years 7-10 2001.* Wellington, NZ: Learning Media.

142 McClain, K. & Cobb, P. (2001), loc. cit. (ref. 30).

143 Scher, L.S. & O'Reilly, F.E. (2007). *Understanding professional development for K-12 teachers of math and science: A meta-analysis*. Paper presented to the American Educational Research Association Annual Meeting, Chicago.

144 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 2).**

145 **Stevens, R. J. & Slavin, R. E. (1995), ibid.**

146 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 46).

147 **Kennedy, M. M. (1998), op. cit. (ref. 55).**

148 Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 6).

149 **Kennedy, M. M. (1998), op. cit. (ref. 55).**

7. Professional Learning and Science

We selected the studies in this group because all had an explicit focus on promoting student learning in science or improving student attitudes towards science. They illustrate a variety of approaches to promoting professional learning, including formal workshops, working alongside practising scientists, and providing curriculum materials. Most studies focused on general science, with one specific to physics.

7.1 Studies considered

Eight individual and groups of core studies were included in this category (Table 7.1). The core studies were those that met our methodological criteria and had evidence of moderate to high outcomes for students, either in terms of achievement in science or attitudes to science. Some of the studies we consulted did not meet our methodological criteria but were able to provide further information relating to the core studies; these are identified by brackets in the table. Seven of the core studies were from the United States and one from the United Kingdom. In addition, five supplementary studies were included in the synthesis. These were considered supplementary either on the grounds of inadequate outcomes or insufficient information about methodology. Three were from the United States and one each from New Zealand and the United Kingdom.

7.1.1 Core studies

All the core studies were of interventions that specifically targeted science.

The first (Adey, 1999, 2004, 2006)[1] comprised a group of studies referred to as Cognitive Acceleration through Science Education (CASE) in the United Kingdom. This science programme targeted the higher-level thinking skills of year 7–8 students to order to "increase the intellectual capability of students to deal with complex scientific concepts"[2] (p. 4). The CASE professional development typically involved entire science departments in eight days of workshops and five or six half-days of in-school support from professional development providers, spread over two years. Positive outcomes in terms of students' cognitive development were reported, with an effect size of 0.64.

The second (Bianchini et al., 1995; Bianchini, 1997)[3] involved two studies in science, based around the Program for Complex Instruction. Complex instruction involved three components: group tasks requiring multiple intellectual abilities, centred around a big idea; a classroom management system of cooperative norms and procedural roles; and treatments used by the teacher to equalise rates of student interaction[4]. The professional development described in Filby[5] involved an initial two-week training programme that presented the underlying theory, modelled lessons, and gave participants opportunities to practise components and whole lessons. According to Cohen[6], the first week of a typical Complex Instruction workshop was devoted to theory presentation, analysis of situations, and practice by the workshop participants. During the second week, participants were videotaped while practising with groups of students. They then reviewed the tapes with a trainer. Teachers were then observed nine times in the first year of implementation and were given feedback on three of these occasions. Positive student outcomes were reported, with an effect size of 1.06 (n = 80).

Table 7.1. Science: core studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
1. Adey (1999[7], 2004[8], 2006[9])	Cognitive Acceleration through Science Education (CASE) Increasing intellectual capability of students to deal with complex scientific concepts	Cognitive development / scientific reasoning	UK	Years 7–8
2. Bianchini (1997[10]); (Bianchini, Holthuis, & Nielsen, 1995[11]) (Cohen & Lotan, 1997a[12]) (Cohen & Lotan, 1997b[13]) (Good, Burross, & McCaslin, 2005[14]) (Cohen, Lotan, Abram, Scarloss, & Schultz, 2002[15])	Program for Complex Instruction Developing conceptual and higher-order scientific thinking through open-ended problem solving in cooperative learning situations	Scientific knowledge and understanding	US	Grades 6–8
3. Curriculum Research and Development Group, University of Hawaii (2002)[16] (Yamamoto, 1997)[17]	Foundational Approaches in Science Teaching (FAST) Developing an inquiry-based approach to science through professional development based around a comprehensive curriculum programme	Scientific knowledge and understanding	US	Grades 7–9
4. Huffman, Goldberg, & Michelin (2003)[18]	Constructing Physics Understanding (CPU) in a Computer-Supported Learning Environment	Understanding concepts of force and motion in physics	US	Secondary school
5. Kahle, Meece & Scantlebury (2000)[19]	Developing teachers' content knowledge of science in a standards-based approach	Analysis and interpretation of scientific data, extrapolating from one situation to another, utilising conceptual understanding	US	Grades 7–8

6. Palincsar, Collins, Marano, & Magnusson (2000)[20] (Buysse, Sparkman, & Wesley, 2003)[21] (Cutter, Palincsar, & Magnusson, 2002)[22] (Palincsar, Magnusson, Collins, & Cutter, 2001)[23] (Palincsar, Magnusson, Marano, Ford, & Brown, 1998)[24] (Magnusson & Palincsar, 1995)[25]	Guided Inquiry supporting Multiple Literacies (GIsML) Inquiry-based approach to science learning	Understanding scientific concepts	US	Grades K–5
7. Parke & Coble (1997)[26]	Transformational Science Teaching Problem-based learning in authentic contexts	Attitudes to science	US	Grades 6–8
8. Raghavan et al. (2001)[27]	Local Systemic Change initiative of National Science Foundation Promoting hands-on, inquiry-based science instruction	Understanding scientific concepts and processes	US	Grades K–6

The third study (Curriculum Research and Development Group, University of Hawaii, 2002; Yamamoto, 1997)[28] in this group took place in the United States and is referred to as Foundational Approaches in Science Teaching (FAST). The programme has been used by 6,000 teachers in 36 states and 10 countries[29], and focused mainly on grades 7–9. The professional development involved a two-week course, followed by monthly meetings for a year, and provided a comprehensive curriculum consisting of resources, activities, lesson plans, and lists of materials. The teaching programme focused on developing inquiry-based approaches to science learning, with an emphasis on developing students' critical thinking. Very positive outcomes for students were reported in this relatively small-scale study (ES = 2.85, n = 128).

The fourth study (Huffman et al., 2003)[30] was from the United States and was referred to as the Constructing Physics Understanding in a Computer-Supported Learning Environment Project (CPU). Secondary school teachers who participated in this programme learned how to use computer-based activities, software, and pedagogy developed for a variety of topics. Training took place over a year, with five days' training per topic. Using the Force Concept Inventory test as a measure of students' understanding of the topics of force and motion, outcomes were positive: ES = 0.47 (experienced over beginning, n = 288), ES = 0.70 (beginning over control, n = 194), and ES = 1.08 (experienced over control, n = 250).

The fifth study (Kahle et al., 2000)[31] involved eight teachers from different schools and aimed to raise the science achievement of their urban, African-American, middle-school students. The professional learning opportunities focused on developing standards-based teaching practices and consisted of a six-week summer institute followed by six seminars held over the following 12 months. Positive achievement outcomes were reported for students whose teachers had participated in the professional learning compared to those whose teachers had not. The effect size was 0.39 (n = 374), measured by a researcher-developed assessment tool.

The sixth study (Palincsar et al., 1998, 2000, 2001)[32] was actually a group of studies, referred to as Guided Inquiry supporting Multiple Literacies (GIsML), which promoted inquiry-based approaches to science teaching and learning. These studies involved United States teachers of grades K–5. The professional learning consisted of a two-week summer institute followed by twice-weekly after-school meetings held throughout the year and a one- to two-week block in which professional development providers would visit teachers to observe, provide feedback, and plan collaboratively. Positive gains in students' conceptual knowledge, as measured by a researcher-developed test, were reported, with effect sizes for regular students of 0.49 (n = 60), low-achieving students of 0.66 (n = 31), and for students with learning disabilities and emotional impairment, 0.62 (n = 19).

The seventh science study (Parke & Coble, 1997)[33] was referred to as Transformational Science Teaching and was concerned with improving students' attitudes to science by developing problem-based approaches to science learning, in authentic contexts. Teachers in this United States-based intervention examined state and national goals for science education and current research into science teaching and learning and then collaborated with professional development providers to construct their own practice in ways that connected new knowledge with their own values and experiences. The intervention involved all the science teachers of grades 6–8 in one district, and took place over one year. Positive outcomes in terms of students' attitudes to science were reported, with an effect size of 0.59 (n = 325).

The eighth study (Raghavan et al., 2001)[34] in this group was of a large-scale reform that eventually involved 30 school districts in the United States. The programme was referred to as Local Systemic Change and was an initiative of the National Science Foundation, targeting grades K–6. The goal of the project was to promote hands-on, inquiry-based science instruction. Assessments of student understanding of scientific concepts and processes showed effect sizes of 0.19 (n = 3,123) over national and 0.28 over international (n = 3,123) rates. Although these effect sizes are lower than those typically considered 'moderate', the large number of students involved makes this an important study.

7.1.2 Supplementary studies

Five studies (Table 7.2) were designated as supplementary rather than core because they did not meet the criteria for inclusion on the grounds of either inadequate outcomes or insufficient information about methodology.

Table 7.2. Science: supplementary studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
1. Bell (2005)[35]	Inquiry-oriented science education	N/A	NZ	Various
2. Caulfield-Sloan & Ruzicka (2005)[36]	Using higher-order questioning strategies to develop students' understanding of scientific concepts	Understanding of single topic (taught in one lesson)	US	Grade 3
3. Dubner, Samuel, Silverstein, & Miller (2005)[37] (Samuel, Silverstein, & Dubner, 2004)[38]	Teachers working as scientists in university-based research teams	Scientific knowledge and understanding	US	Secondary

4. Fishman et al. (2003)[39]	Standards-based, inquiry-oriented science education	Map reading skills related to watersheds	US	Grades 6–8
5. Leat (1999)[40]	Analysis of Thinking Skills Programmes	N/A	UK	Various

The first study (Bell, 2005)[41] in this group was referred to as The Learning in Science Projects (LISP). This was a series of five major research projects conducted in New Zealand between 1979 and 1998. The five projects shared a constructivist philosophy and all emphasised an inquiry-based approach to science learning. This group of studies is included in the supplementary category because, although the studies provided rich data about the professional learning experiences of participating teachers and convincing evidence that these did lead to significant shifts in teacher practice, evidence of student outcomes was not reported.

The second supplementary study (Caulfield-Sloan & Ruzicka, 2005)[42] had positive outcomes for students but were in too narrow a domain to be included as a core study. Caulfield-Sloan and Ruzicka investigated the impact of professional development in the use of higher-order questioning strategies on third grade students' understanding of scientific concepts and processes. The professional development was limited to one workshop and involved teachers learning how to apply higher-order questioning strategies in one specified lesson. Teachers were then observed teaching the lesson and a rubric assessment of students' understanding was conducted. The students of teachers who had participated in the workshop performed better than those who had not, with an effect size of 1.27 (n = 120).

The third study (Dubner et al., 2005; Samuel, Silverstein, & Dubner, 2004)[43] involved teachers working as fully contributing members of university research science teams over the course of two summers. Positive outcomes for the students of participating teachers were reported, with higher pass rates in the Regents Science Examination than those of a control group (ES = 0.16, n = 17,511) but the gains were not sufficiently large for this study to be designated a core study.

The study by Fishman et al. (2003) was based in the United States and involved a large-scale, systemic education reform but the outcomes assessed were restricted to map reading skills related to watersheds. An effect size of 0.73 (n = 2,925) was achieved. Although the effect size was high, it related to only one lesson in a very narrow range of skills.

The fourth supplementary (Leat, 1999)[44] study was included because, although it did not report student outcomes, it provided a rich analysis of cases in which professional development in scientific thinking skills failed to influence teacher practice. This study was directly relevant to our analysis of another study discussed in this chapter[45] as well as informing our understanding of barriers to changing teaching practice in ways that impact positively on student outcomes.

7.2 What works for whom in changing student outcomes in science

This section synthesises evidence from studies of interventions that addressed teachers' knowledge of science and science teaching in ways that had positive outcomes for students. It is structured according to the five aspects of the framework set out in Figure 4.2: context, professional learning environment, content, activities provided, and teacher reactions.

7.2.1 The context of the professional learning opportunities

The context in which the professional learning opportunities occurred that appeared to work in terms of changing the teaching of science in ways that led to positive outcomes for students is identified in this subsection. A summary of the synthesis is provided in Overview 7.1.

Overview 7.1. The context of the professional learning opportunities

Infrastructural supports

- The core studies provided too little information about infrastructural supports such as funding or release time for any conclusions to be drawn.

Coherence with policy

- The interventions in all the core studies promoted approaches to science teaching that were consistent with both current research findings and with their policy contexts.

Voluntary or compulsory

- Volunteering was not a necessary condition for successful professional development, neither was it a guarantee of change.
- The content and form of the professional learning opportunities were more important than volunteering in achieving teacher 'buy-in'.

Individual or whole-school

- A similar proportion of studies involved teachers participating in professional development independently of their school colleagues, and teachers participating as part of a whole science department or school.

  Core studies in which teachers participated independently of their school colleagues developed collegial groups among participants.

External expertise

- All the core studies involved expertise from outside the participants' school environments.
- 'Cascading' models of professional development in which external providers trained teachers as trainers had mixed outcomes but could be successful under certain circumstances.

School leadership

- Insufficient information was provided to draw conclusions about school leaders' involvement.

Time and frequency

- All core studies involved professional development over extended periods of at least one school year, with some up to five years, with relatively frequent input, particularly in the initial stages.

  One-off learning opportunities may be sufficient to bring about changes that are of limited scope, but not substantive changes in practice and outcomes.

Prevailing discourses

- Some cases of professional development were successful despite initial differences between the prevailing discourses of the teachers and the ideas being promoted.

Professional learning goals

- In all the interventions in the core studies, professional learning goals specific to science were explicitly shared with teachers.

7.2.1.1 Infrastructural supports

The core studies provided too little information about infrastructural supports such as funding or release time for any conclusions to be drawn about the impact of their presence or absence. In an intervention documented in one of the core studies, teachers attended a six-week, content-based, summer institute followed by six seminars during the following year and earned graduate credit on completion of the professional development[46]. Teachers involved in Guided Inquiry supporting Multiple Literacies (GIsML) were given limited amounts of release time to work with a professional development provider during a two-week block at their school. In the study of CASE, teachers identified a lack of time for post-observation feedback sessions as a constraint[47], but this professional development still achieved positive outcomes for learners. No other examples of infrastructural supports were identified in the core studies but the supplementary study involving teachers working over two summers as part of university-based scientific research teams involved considerably more support. These teachers were paid $US6,000 per summer plus $2,000 for materials. Although other benefits accrued from teacher participation in the scheme, its impact on student outcomes was relatively small for the funds invested.

7.2.1.2 Coherence with policy

Seven out of the eight core studies[48] were from the United States and were consistent with a policy environment that reflected the notion that "virtually all contemporary educational reform documents call for the teaching of science to be inquiry based. The assumption guiding this mandate is that as students engage in inquiry activity, they acquire the knowledge, skills, and habits of mind that will enable them to come to deep understanding of the big ideas in science and to become skilled in the process of engaging in scientific reasoning."[49] Each of these studies[50] claimed that their intervention was consistent with *The National Science Education Standards*[51]. "In addition to improving content knowledge," this reform document "recommended the use of varied types of instruction, including cooperative groups, open-ended questioning, extended inquiry, and problem-solving. Further, they recommended that assessments be embedded in instruction and that students be provided with multiple ways to demonstrate content understanding and process skills, such as by portfolios, exhibitions, and performance tasks" (p. 1020)[52]. Of these seven studies from the United States, two were directly initiated by the National Science Foundation[53], one received funding from this body[54], and the remainder claimed that their intervention was consistent with the 1996 standards[55]. The only core study to come from the United Kingdom[56] also promoted an inquiry-based approach, with the aim of developing students' thinking skills. The extent to which this focus was consistent with policy in its wider context was not reported.

It is significant that all cases of professional development that led to positive outcomes for students were part of wider and coherent movements in science teaching and learning that were underpinned by strong research bases. No core study took place in a policy or research vacuum.

7.2.1.3 Voluntary or compulsory

The extent to which professional development in the core cases was voluntary or compulsory varied. Two of the studies related to interventions that were fully voluntary[57] and three to interventions that were compulsory[58]. In the remaining three core studies, the extent to which participation was voluntary was either not reported[59] or varied, sometimes involving whole departments and sometimes individual teacher volunteers.[60]

It cannot be assumed that what works for a teacher who volunteers will necessarily work for a teacher who is compelled. In one supplementary study[61], for example, teachers volunteered (and were paid) to spend 16 weeks of summer vacation time participating in professional learning with scientist colleagues. It is unlikely that teachers could be compelled to make this level of commitment. There is some indication that these volunteers were more enthusiastic than their peers prior to this professional learning experience because they had three times as many students involved in after-school science clubs as non-participating teachers[62]. Their commitment to such activities increased further as a result of their participation in the programme.

In short, volunteering is neither a necessary condition for, nor a guarantee of, positive outcomes for students. As we have argued in the synthesis of other categories, what is important is that teachers 'buy in' at some point. Buy-in is related more to the content and form of the professional development than to whether teachers do or do not volunteer.

7.2.1.4 *Individual or whole-school*

Four of the eight core studies involved professional development in which all the teachers of a particular school or department participated together[63], while the others involved only individual teachers[64] or pairs of teachers from any one school[65]. The success of the outcomes for individual participants calls into question the frequently heard claim that effective professional development *must* involve whole staff or departments[66].

On the other hand, networking and collegiality among participating teachers does seem to be an important condition because this was noted specifically in two of these latter three studies. One[67], for example, involved a six-week summer institute followed by six meetings held at intervals throughout the year. The teachers involved came from the same urban area and similar type of school, but not the same school. Another study[68] described the development of a community of practice that involved teachers from different schools learning together in two week-long summer institutes and then meeting regularly for half a day twice-monthly during the school year. Conditions for collegiality were created by networking with participants from other schools. In another supplementary study, teachers participating in scientific research work experience[69] developed collegial relationships with university faculty both during their time at the university and at monthly meetings held over the course of the following year.

7.2.1.5 *External expertise*

All of the core studies involved expertise from outside the participants' own school environments. Although, in several situations, the participants themselves were regarded as a significant resource,[70] there was only one situation[71] in which external expertise was complemented by internal expertise in a structured way.

External expertise was probably necessary because the approaches promoted in these science interventions involved significant changes in practice for many of the teachers concerned. Such change required extensive support in terms of extending theoretical knowledge and translating it into practice. External input, however, did not equate to dictation or prescription. In this group of studies, two involved communities of practice in which teachers had considerable autonomy but were constrained in how they exercised it by sets of principles that underpinned the approaches advocated. In both, the external 'expert' challenged teachers' theories of action. In one[72], teachers discussed issues and were able to design their own curriculum, reflecting their own beliefs about teaching. These beliefs were challenged in a variety of ways by the presence of the external provider and through discussion of a wide body of research concerning teaching and learning in general, and science in particular.

In one core study[73], a cascading model was used whereby teachers were 'trained to be trainers', able to take responsibility for the ongoing professional development of their colleagues at school. As discussed in Chapter 6, a change in role of this kind can be very challenging. This was the experience of teachers in one study of a whole-school reform: "A comment we frequently heard from these teachers was that this project required them to relate to their colleagues in different—and not altogether comfortable—ways. For the first time, they were being asked to have fellow teachers change what they did in the classroom. Many teachers found this new role challenging and even unsettling" (p. 9)[74]. The challenges and potential benefits of such an approach, as discussed in one of the science studies[75], are outlined in Box 7.1.

Box 7.1. Cascading models: training the trainers

Teacher-tutors were trained to support their colleagues to implement the CASE thinking skills programme. They received five additional days of training, organised and delivered a session at a national Cognitive Acceleration convention, and were accompanied on their initial visit to schools by local education authority officers or university staff.

Many of the teacher-tutors initially felt uncomfortable about taking on this 'expert' role. One said, "In a way, at the start, I almost avoided my tutees because I felt awkward, I didn't know where I stood. When you see the other tutors, you know where you stand, but when you go in to other teachers' classes, you feel that you are supposed to know more than everybody else." Another teacher-tutor commented, "The tutor's role is to do with supporting the teachers and developing their expertise, and that is a difficult skill. It's not just being the teacher's friend." The teachers identified the same issue, with some commenting that the teacher-tutors may have been too diffident about identifying areas that needed attention and giving constructive feedback.

As well as coping with the demands of a 'challenging and unsettling' new role, teacher-tutors also had practical considerations to deal with that arose from their being away from their own classes for 10 days.

Despite these challenges, the researchers concluded that the professional development programme involving teacher-tutors was perceived as exceptionally successful in enhancing teachers' pedagogy and children's learning skills. In addition, many of the tutor-teachers felt that as well as developing a new set of skills in professional leadership, their role in observation and feedback had had a positive impact on their own teaching.

Professional development interventions of this kind, which involve external providers training teachers within the school to train teachers, need to take account of the interpersonal challenges that the teacher-trainees will inevitably face. In this situation the approach seemed successful for it was associated with positive outcomes for students.

7.2.1.6 Time and frequency

All the core studies involved professional development over extended periods of at least one school year and up to four or five years[76]. One of the supplementary studies[77] was an exception in that the professional development consisted solely of one workshop, yet it appeared to have positive outcomes for students. In this case, however, the workshop was focused on applying higher-level questioning strategies to one particular lesson and the student outcomes pertained only to that lesson. While the principles that the teachers learned may have been applicable to other lessons, there was no evidence provided to suggest that such transfer did in fact take place.

As well as being implemented over significant periods of time, in all the studies with a positive impact on students[78] that provided the information, the professional development was scheduled at relatively frequent intervals. In some situations, this was two meetings per month[79], in another, six sessions during the year [80], and, in the study that took place over five years, it was approximately 70 hours per teacher. Significantly better student outcomes were reported for studies where teachers participated for longer periods of time, indicating that, when complex change is required, participation in a professional learning opportunity is more effective for those teachers who participate in it for longer.

Time may also be required to embed the professional learning. In one case[81], high school physics teachers engaged in learning about computer assisted learning. Three groups of teachers were studied: 'experienced' teachers who had participated in similar professional development some years earlier, 'beginning' teachers who had been trained within the past two years, and a control group who had had no training at all. While the students of the beginning and experienced teachers achieved significantly higher scores than those of the control teachers in assessments of their understanding of force and motion, the students of experienced teachers achieved significantly better results than those of the beginning teachers.

This finding does not, of course, mean that lengthier professional development is necessarily more effective. As our synthesis of other categories has established, instances of professional development, involving extended periods of time and ongoing, frequent, professional learning opportunities, have resulted in negligible or worse outcomes for students. What matters more is the content and form of the learning. By definition, time and frequency need to be 'sufficient', but what is 'sufficient' will depend on other factors such as the complexity of the learning and the degree of change required. As we have shown in this section, a one-off workshop may be sufficient to train teachers to apply a particular pedagogical approach to a prescribed lesson, but it is not sufficient to bring about deeper, sustainable shifts in teacher practice.

Adey (2006) claimed that "The classic 1-day INSET is a total waste of money, except for simple technical instruction such as how to use an interactive whiteboard" (p. 54)[82]. Our synthesis of science studies would largely support this view.

7.2.1.7 Prevailing discourses and models of practice

As discussed earlier, all interventions documented in the core studies had similarities in that they promoted some form of 'inquiry-based' approach to science teaching and learning, which placed the student at the centre of learning and valued the development of problem-solving processes over memorisation of scientific facts. In some situations at least, the prevailing discourses of teachers before the professional development were at considerable odds with those promoted by the providers. One study went so far as to claim that a "pedagogy of poverty" prevailed in many of the urban schools in which the professional development took place—pedagogy that was characterised by low teacher expectations, teacher-centred instruction, and limited opportunities for experiment/inquiry[83]. In another study, teaching prior to the intervention was focused on the rote learning of science facts instead of scientific problem solving or conceptual understanding[84].

Clearly, at least in some situations, prevailing discourses can be successfully challenged and new practices put into place.

7.2.1.8 Professional learning goals

In all the core studies, professional learning goals and underpinning, theoretical principles specifically related to the teaching and learning of science were made explicit to teachers. None of the interventions concerned attempted to effect improved outcomes in science through a generic pedagogical approach. In one, the goals extended to developing students' thinking skills in general, but the researchers stressed that the focus on a science context was essential. These authors posed and answered the question: "Can we not address high-level thinking skills directly, context-free? I think the answer is no, because we have to think about something, we need matter to think about"[85]. Another intervention aimed to develop higher-order thinking skills and social skills with general applicability, but again, this professional development took place within a science context.

7.2.2 The content of the professional learning opportunities

In this section we synthesise the evidence from this group of studies as it relates to the content of the professional learning opportunities provided to the participating teachers. The key points are summarised in Overview 7.2.

Overview 7.2. The content of the professional learning opportunities

Content to support a particular programme

- The interventions in many of the core studies provided detailed science content related to particular instructional programmes.

Integration of theory and practice

- All the core studies involved the development of theoretical understandings that went beyond immediate practice.

Pedagogical content knowledge

- The interventions in most of the core studies developed teachers' content knowledge of science.
- The process of teachers learning science content appears to have been more important than the new content knowledge itself.
- All interventions that developed teachers' content knowledge also developed their understanding of pedagogy.

Knowledge of assessment

- Improving assessment was closely related to learning science content.
- An increased focus on students' conceptual understanding of science necessitated a change in both assessment content and use.

7.2.2.1 Content to support a particular programme

One distinctive feature of this group of studies was that much of the professional learning content related to a particular programme or curriculum. Five[86] of the eight core studies involved professional learning that was focused on a complete science programme in which teachers were provided with substantial support in the form of instructional materials such as unit and lesson plans, worksheets, and detailed instructions for activities. In another, teachers received a complete series of one-off lessons that could be incorporated into an existing science programme in order to develop students' thinking skills[87].

7.2.2.2 Integration of theory and practice

The interventions documented in all of the core studies struck some balance between providing teachers with practical teaching approaches and materials and developing their deeper theoretical understanding of the principles underlying the subject matter, related pedagogy, and how students learn. None went so far as the Cognitively Guided Instruction professional development in mathematics[88], in which teachers were *only* given theoretical principles and were themselves largely responsible for translating them into practice.

Although many of the studies related to the implementation of pre-planned programmes, in no case were the instructional materials regarded as sufficient in themselves to bring about changes in teaching practice. All the successful interventions provided teachers with learning content that went beyond a 'how-to' guide. In one study[89], the project initially focused on supporting teachers to use the instructional materials provided, but the researchers found this approach problematic as it meant that "sessions on pedagogy were isolated from each other and from the context of the instructional modules. Although this approach allowed for focus on one pedagogical principle in depth, it did not facilitate easy transfer into classroom practice … To advance teachers' understanding of science content and the inquiry process, professional development sessions were redesigned to explicitly link module content, instructional strategies, and assessment" (p. 424)[90].

While the weight given to theory and to practice was different in the various core studies, all involved the development of theoretical understandings that went beyond immediate practice. Foundational Approaches in Science Teaching (FAST) was one of the more 'practice focused' of the studies. In this highly structured programme, teachers received extensive support in the form of curriculum materials, detailed unit and lesson plans, and worksheets. But teachers wishing to use this programme were required to participate in professional development to develop their understanding of the theoretical basis of the programme, with "an emphasis on inquiry as a whole teaching philosophy, distinct from simply using hands-on activities."[91]

In other cases, theory was given greater emphasis. The intervention involving Complex Instruction[92], for example, provided teachers with pedagogical strategies aimed at raising the status, participation, and achievement of their 'low status' students. Teachers learned practical approaches designed to achieve this, as well as an understanding of 'expectation states theory', in which these approaches were grounded. This theory contends that "an individual's access to materials, participation, and influence in a group is determined by his or her status" (p. 3)[93]. Status characteristics can include academic ability, gender, ethnicity, social class, and popularity. It seems unlikely that providing teachers with practical strategies to change the status of some students would be effective without first developing a theoretical understanding that socially constructed notions of status affect student participation and achievement, and that a teacher can influence the assignment of status in his or her classroom.

See Box 7.2 for a rationale from one study[94] for the development of theoretical understandings.

Box 7.2. A rationale for theory that goes beyond immediate practice

Teachers who participated in the CASE thinking skills programme received a complete set of activities to use with their students. These were structured, stand-alone, one-off lesson plans. The researcher involved in this study stressed that the provision of such materials alone would be inadequate to effect change in student outcomes. "Teaching for cognitive acceleration is not a straightforward process. As with any approach to the teaching of thinking, the teachers need to have an understanding of the underlying principles and almost always need to re-engineer their classroom methods, I suggest that any approach to the teaching of thinking which offers a 'quick fix', or a set of simple tactics that a teacher can follow from printed material alone is underestimating the subtlety of the pedagogy required to enhance students' thinking … cognitive acceleration requires teachers to inspect their own assumptions about the nature of teaching and learning, and gradually come to terms with quite new approaches in the classroom" (Adey, 2006, p. 45). Three central 'pillars' of the programme: cognitive conflict (developed from Piaget), social construction (based on Vygotsky), and metacognition formed the theoretical basis for much of their re-engineering.

One teacher who had participated in this professional learning commented, "Obviously I couldn't have done it without the PD days. All of it is valuable really, but particularly the theory and actually how you do the activities. Without the theory it wouldn't really mean that much, you would just be doing it by rote" (p. 129).

7.2.2.3 Teachers' content knowledge

Five[95] of the eight core studies in this group reported components of the professional development that were explicitly aimed at raising teachers' content knowledge of aspects of science. Two of the studies[96] reported that teachers' content knowledge was developed through the teaching materials provided, while in another[97], teachers were given professional readings. These readings both developed teachers' content knowledge of light and informed their understanding of children's conceptions of light and light-related phenomena[98]. In another study, teachers' content knowledge of science was the primary focus, based on the rationale that "when teachers cover topics about which they are well-prepared, they encourage student questions and discussions, spend less time on unrelated topics, permit discussions to move in new directions based on student interest, and generally present topics in a more coherent way" (p. 1022)[99].

One explanation for this emphasis on teachers' content knowledge in science is that inquiry-based approaches to teaching science demand a greater depth of content knowledge than more traditional approaches. In one situation, for example, a teacher realised that, while she had been a successful science student herself, the *kind* of content knowledge she had was not necessarily the *right* kind for an inquiry-based approach, which valued understanding over memorisation. When she reflected on her own education, she realised that "I did well in school because I was a good memoriser. No one ever really assessed my understanding, and consequently there was a lot that I didn't understand. When I started re-examining the practice of teaching, I realised … I couldn't teach it to students if I didn't understand it. Understanding is more than just asking someone to define a particular term. It is easy to give definitions if you have memorised them, but now I ask my students, 'Can you apply the idea, can you think of an example, can you give me an analogy, can you relate the idea to anything else other than just the definition?'" (p. 780)[100]

The *process* of developing teachers' content knowledge of science may be more significant in influencing positive changes in practice than the new content knowledge itself. Box 7.3 describes a supplementary study in which teachers deepened their content knowledge of just one highly specific aspect of science, but this specific acquisition was associated with a *general* increase in students' scientific content knowledge. Although the effect sizes were relatively low, they were positive. The authors of this study propose that, as teachers learn new science content, they may also develop stronger identities as scientists and science teachers and greater empathy with their students as fellow learners.

Box 7.3. 'Practice what you teach'

'Practice What You Teach' is the slogan of Columbia University's Summer Research Program for Science Teachers. Science teachers commit eight weeks in each of two consecutive summers to work as full-time members of university research teams. Teachers work in a particular department, gaining content knowledge and technological skills in aspects of a scientific discipline, such as organic chemistry, molecular biology, oceanography, or astrophysics. "What is common to all of these work experiences is that all teachers are treated as professionals, challenged to think independently and creatively, and engaged in the study of authentic contemporary scientific problems. These experiences stretch teachers intellectually and personally, and enable them to understand the way successful scientists practice science." Teachers in the programme meet weekly for seminars during each summer to discuss teaching practices. "While teachers who participate in the program gain substantial content knowledge, we do not believe increased content knowledge explains their students' increased achievement … At best, teachers enhance their content knowledge of material covered in a one to two week segment of a year-long high school science course. Such material is unlikely to be the focus of more than one or two questions on a standardized test."

Rather than content knowledge per se being the reason for improved achievement, the researchers believe that "program participation increases teachers' confidence, problem-solving skills, professional abilities, and identity as teachers; and that these factors elevate their ability to stimulate student interest in science." A research experience encourages and empowers teachers to focus on student understanding and reasoning, not on facts and rote memorisation. For example, by the end of their first summer at Columbia, teachers report that "… they reduce the frequency with which they say to students 'That's right,' or 'That's wrong,' and increase the frequency with which they say, 'Why do you think that?' … They have gained the confidence to tell students, 'I don't know the answer to that question, but I do know how you and I could find it out.'"

7.2.2.4 Pedagogical content knowledge

Five core studies documented interventions that developed teachers' content knowledge in science; the same interventions also developed teachers' understanding and ability to implement an associated pedagogy. These pedagogies were all closely aligned with the *National Science Education Standards,* published by the National Research Council in 1996, and all could be characterised as 'inquiry-based' approaches that promoted a move away from passive absorption of information towards active or interactive approaches including cooperative groups, open-ended questioning, extended inquiry, and problem solving[101].

In one of these interventions, content knowledge was a more important focus than pedagogy[102], while in another two, the reverse was true[103]. Whatever the balance, in none of the core studies was teachers' content knowledge in science developed independently of an aligned pedagogy. Even the supplementary study involving the summer science work experience for teachers[104] (see Box 10.5) included a pedagogical component in the weekly seminars, in which programme organisers and participants shared ideas for implementing their learning in the classroom.

7.2.2.5 Emphasis on pedagogy only

Three of the eight core studies concerned interventions that did not directly develop teachers' content knowledge of science, focusing instead on developing their ability to implement a particular pedagogy. The first of these, CASE[105], was concerned with developing students' higher-level thinking. The second, Complex Instruction[106], involved a pedagogical approach designed to address the participation of 'low-status' students in science classrooms and develop their higher-order thinking. The third[107] involved the use of a computer-based pedagogy in physics classrooms.

In each of these studies, the pedagogy was strongly grounded in theoretical principles and in no case did the professional learning amount to little more than a 'how-to' guide for good practice. Furthermore, in each study the pedagogy was either specifically developed for a science context[108] or a generic pedagogy adapted to science[109]. In no core study was the implementation of a generic pedagogy, devoid of a science focus, sufficient to impact positively on student outcomes in science. Adey, one of the authors of the CASE study, comments: "It might be asked whether any subject matter is necessary. Can we not address high-level thinking skills directly, context-free? I think the answer is no, because we have to think about something, we need matter to think about" (p. 38)[110].

7.2.2.6 Teachers' knowledge of how students learn

Content aimed at developing teachers' understanding of how students learn was explicitly reported in only two of the core studies[111] and one of the supplementary studies[112] but was implicit in the others through the provision of a theoretical rationale for the constructivist, inquiry-based approach that each promoted. This approach presupposes a greater focus on student thinking and understanding. One of the two interventions to explicitly address this issue was CASE[113], which focused on developing teachers' understanding of students' cognitive processes and accelerating their development. The other involved teachers engaging with current research findings about how students learn. The researchers in this case noted that "The teachers' dialogue, which in the beginning conversations of Phase 1 focused on the numerous problems and barriers that plagued them in their classrooms, shifted to conversations about how students learn, how students know when they have learned, and what is important to learn" (p. 777)[114].

7.2.2.7 Knowledge of assessment

Learning about assessment was reported as a significant component of content in six of the eight core studies[115]. In each of these, assessment was closely aligned to the inquiry-based approaches being advocated. Teachers needed tools to assess their students' understanding of scientific concepts and processes rather than their knowledge of facts. Assessment was seen to be an integral part of a continuous learning cycle for both teachers and students. The general shift from an emphasis on knowledge of facts to an emphasis on processes for inquiry was paralleled by a corresponding shift from summative to formative assessment.

Inquiry-based approaches put more responsibility on students to monitor their own progress and on their teachers to encourage them to try different approaches and test their usefulness. Just as students engaged in inquiry-based science learned to evaluate the worth of their processes and findings, their teachers learned to evaluate the impact of their practice on their students' understandings. The following description of the professional learning in FAST shows just how similar inquiry-based approaches for students and for teachers can sound: "Evaluation was multidimensional and a dynamic part of teaching. The dialogue between teacher and student was intended to help the student assess strengths and weaknesses and identify what needed to be learned. In essence, evaluation built on student strengths as learners, was ongoing and continuous. The ongoing formative process included observation of student participation in class and small-group discussions, critiques of student projects and performance of laboratory investigations and tests, interviews, and self-rated scales completed by each student" (Young 1991)[116].

Implementation of inquiry-based approaches appeared to be dependent on aligned assessment. Raghavan et al. (2001), for example, focused initially on teachers' implementation of particular instructional strategies, but soon found that this was not enough to enable teachers to enact an inquiry-based approach. They then redesigned the professional learning to explicitly link module content, instructional strategies, and assessment[117].

Increased teacher responsiveness to students was also dependent on aligned assessments. In CASE, which aimed to develop students' thinking skills, teachers needed tools with which they could assess student understandings so that they would be "able to 'read' an individual's response or the progress of a whole lesson in terms of the levels of understanding exhibited and the challenge provided" (p. 25)[118]. The importance given to assessment in this intervention is discussed in Box 7.4.

Box 7.4. The importance of assessment in a thinking skills programme

"What are teachers of thinking required to do? Teaching for the development of reasoning in children is the antithesis of teaching for the recall of factual content. The development of critical thinking, or higher-level reasoning, in children requires by definition that children be given an opportunity to exercise their own minds, to engage in critical appraisal, to risk opinions in a sympathetic atmosphere and then have the opinions challenged in a rational but respectful manner … To create such an atmosphere, the teacher needs to have … an intimate understanding of the range of reasoning and arguments displayed by his or her pupils … mastery of a range of techniques such as leading questions, suspending judgement, setting challenges appropriate to particular children, and the ability to interpret children's utterances in terms of the type of thinking they are using" (p. 25).

Box 7.5 describes a situation in which teachers who were engaged in learning how to implement an inquiry-based approach to science realised that the change in pedagogy demanded a change in assessment.

Box 7.5. New assessment approaches for a new pedagogy

In one project, assessment was a major aspect of the professional development and, as a result, teachers began to rethink the purpose of assessment and to design assessments that provided continuous feedback about student understanding. These assessments were embedded within the science lessons so that they became part of the learning process. As a result of the professional learning experience, one teacher realised that traditional assessment approaches were not appropriate to inform an inquiry-based approach that valued understanding over memorisation:

"There are different ways to assess other than 'here is your paper with your questions, write the answer.' We have talked about different kinds of assessment which has brought home to me that the testing which I have been doing really doesn't tell me a lot … you know what they have taken in their notes and studied because they can fill in the blanks, or they can memorise the definition. But when you ask them, 'What does this mean?' instead of writing down what they really think it means, all they're doing is writing the definition that they have memorised …" (p. 778)

One teacher described her different perspective on assessment as a result of participation in this professional development:

"In the old way I used to assess, using fill-in-the-blank, multiple choice, and short answers, I would look at it and think, 'Okay, I did a good job teaching this topic or concept.' But once I really started looking at my assessment and at the way I was teaching, and when I started changing my assessment, I found that my students were not understanding the content. I was too focused on low-level knowledge.'

7.2.2.8 Equity

In addition to providing learning content aimed at improving science outcomes for all students, the interventions described in two studies provided teachers with learning content aimed at specific groups of students. The Complex Instruction project[119] aimed to increase the participation of 'low-status' students in group work and, therefore, their achievement.

According to the theoretical framework of this programme, some groups of students have high status on the basis of characteristics such as academic ability, gender, ethnicity, social class, and popularity. Participation in groups is determined by status, and in accordance with the expectations of teachers, peers, and the students themselves. In the professional learning situation, teachers were trained in strategies designed to address issues of status and equalise student participation in group work. One such strategy, referred to as the 'multiple abilities treatment', involved teachers challenging students' notions of what it means to be 'smart' by emphasising the diverse skills demanded by designated tasks and stressing that no one student had all the skills required. 'Assigning competence' was another 'status treatment', in which teachers gave public and specific recognition for the contributions made by low-status students. Achievement rose accordingly. Another intervention[120] focused particularly on raising the achievement of African-American students in urban settings. Most of the professional development related to teachers' pedagogical content knowledge of science, but a module related to gender and ethnic equity[121] was also included. Although this programme was recognised by the Educational Testing Service as exemplary for minority and female, middle-level students[122], no specific details relating to its content or achievement outcomes were provided.

7.2.3 Activities constructed to promote the professional learning

In this section, we synthesise the evidence concerning the types of activities that promoted professional learning in ways that the providers intended. See Overview 7.3 for a summary.

Overview 7.3. Activities constructed to promote the professional learning

Sequencing of activities

- All the studies had some direct teaching of new concepts in the initial stages of the professional learning, followed by activities designed to support their transfer to practice.

Activities to translate theory into practice

- In all the studies, participants were provided with at least two different types of professional learning activities, but no particular type was universal.

Demonstrations of classroom practice

- Most of the interventions provided teachers with opportunities to see particular approaches implemented in real or simulated classroom situations.

Receiving instructional materials

- Most of the interventions provided teachers with substantial amounts of support in the form of instructional materials.

  In no case were the supplied materials believed to be sufficient in themselves.

Being observed and receiving feedback

- Most of the interventions documented in the core studies did not provide opportunities for teachers to be observed and receive feedback.

Teachers taking part in learning activities positioned as students

- Only two studies reported such activities (which were more common in mathematics, for example).

  When used, such activities served a multitude of roles.

  While useful in certain circumstances, it is clear that such activities were not essential.

Comparing own theories with new theories

- Three studies reported the active involvement of teachers in a process in which their own beliefs about teaching and learning were engaged.

  In these situations, teachers had considerable input into the construction of new practice.

Participating in professional communities

- The interventions described in all the core studies involved teachers participating in some form of learning community in which they shared their ideas, experiences, and challenges in order to support each other to implement changed practice.

7.2.3.1 Sequencing of activities

Elsewhere in this synthesis (see Chapter 6), we noted that activities were typically sequenced so that ‘front-loading’ of the content of the new learning was followed by a range of activities designed to translate the new knowledge into practice. This group of studies also followed this pattern.

All the core studies in this group had some direct teaching of new concepts in the initial stages of the professional learning, followed by multiple opportunities for teachers to translate this learning into practice. All provided at least two forms of ‘translation’ activity but no one activity was common to all. The range of learning activities included direct instruction, modelling, observation and feedback, sharing of instructional materials, and discussion.

7.2.3.2 Demonstrations of classroom practice

Many of the studies[123] reported that teachers were provided with opportunities to see particular approaches implemented in real or simulated classroom situations, either through modelled or videotaped lessons. The thinking skills programme, CASE[124], for example, presented simulated demonstrations of lessons in off-site centre-based situations as well as model lessons delivered by teacher-tutors in authentic classroom situations. These were "… cited by 86% of teachers as some of the most useful aspects of the PD programme. They were clear that it would not have been sufficient just to read about the activities and that it was crucial to see them demonstrated or simulated. Modelling the teacher's language, particularly questioning techniques, played an important part in increasing teachers' confidence to carry out activities" (p. 127)[125]. Demonstrations in teachers' own classrooms were also well received, with one teacher commenting that "Demonstrations are more helpful than anything, because they are actually specific to your class and because whoever it is who is demonstrating can choose your most difficult group and you can see what they do" (p. 130)[126].

The study described in Box 7.6 illustrates how such modelling, and the rich discussions that followed, helped teachers to develop an understanding of the complexity of implementing an approach that fitted the GIsML orientation.

Box 7.6. Modelling

In one case, teachers experienced the programme GIsML as learners. Each morning in a week-long workshop, teachers would work on an area of scientific inquiry similar to one they may use with their students. The professional development provider assumed the role of the teacher and modelled teaching practices that reflect the spirit of GIsML; e.g. calling students' attention to particular phenomena that were emerging … introducing questions for reflection, opportunistically introducing certain scientific conventions that would aid the inquiry (e.g. the use of a light meter to measure brightness), and identifying the scientific language for ideas the 'students' were generating. ("Since we are using the word 'flow', scientists would call that 'current'.") In the afternoon, teachers would question the professional development provider about her practice during that morning's instruction. "For example, the group raised questions regarding Shirley's decision making about when to answer a question and when to encourage the students to pursue the question themselves … It became clear that there were numerous practices associated with this orientation to teaching, and that the decisions Shirley made relative to these practices reflected features of the context, few of which could be captured as algorithms. The richness of educational practice was revealed as teachers commented on the broad range of features regarding Shirley's teaching to which they were attuned: her facial expressions, her careful choice of words, her differential responses to different participants, and the continuous decision making in which she was engaged."

7.2.3.3 Receiving student activities

A significant feature of studies in this group, unlike for those with a mathematics focus, was that the interventions in all but two of the nine core studies provided teachers with substantial amounts of support in the form of instructional material such as unit and lesson plans, worksheets, and detailed instructions for activities and experiments that they could directly use in their classrooms. In five of these studies[127], these materials constituted a complete science programme; in another, they served as a series of one-off lessons that could be incorporated into an existing science programme in order to develop students' thinking skills[128]; and in one other, they were designed not to be used as ready-to-go resources but as samples of what could be done[129]. The intervention that did not provide detailed teaching materials involved teachers designing their own science curriculum[130].

In none of these studies were the supplied instructional materials regarded as sufficient in themselves to bring about changes in teaching practice. In every core study, the intervention provided teachers with learning content that was more than a 'how-to' guide to implementing provided programmes, and all gave teachers theoretical understandings of principles that went beyond what immediate practice required. The Learning in Science Projects, for example, provided teachers with activities that they could use as "technicians and novices rather than experts" and which would "lead to better learning conditions, better classroom management, 'feeling better about myself as a teacher', and to better learning outcomes" (p. 185)[131]. The activities served to deepen teachers' understanding in wider ways by providing common teaching experiences that then became the focus of professional conversations about issues such as assessment and understanding student thinking.

As noted above, one of the interventions documented in these studies[132] initially focused on supporting teachers to use the instructional materials provided, but the researchers found this approach problematic because it meant that "… sessions on pedagogy were isolated from each other and from the context of the instructional modules. Although this approach allowed for focus on one pedagogical principle in depth, it did not facilitate easy transfer into classroom practice … To advance teachers' understanding of science content and the inquiry process, professional development sessions were redesigned to explicitly link module content, instructional strategies, and assessment" (p. 424)[133].

7.2.3.4 Being observed and receiving feedback

Three studies describe how observation and feedback was offered to teachers as a means to help them translate their professional learning into classroom practice. While this appears to have contributed to the success of these interventions, observation and feedback is not a necessary condition for improved student outcomes—most of the core studies did not, in fact, report such opportunities.

In two of the studies, the cycles of observation and feedback appeared limited. In the case of Complex Instruction[134], teachers were typically observed nine times over the course of a year but received feedback on only three occasions. In the case of GIsML[135], teachers in the initial one-week summer institute observed one another teaching students in a holiday programme. These lessons were videotaped and then shared and discussed with the other participants. A small number of classroom observations of 'authentic' lessons in the teachers' own schools were made by university staff over a one- to two-week programme of visits. The process in this case was unusual in that the observer provided feedback on the same lesson on three separate occasions. Feedback was provided by the professional development provider during and then after the lesson, using a videotape. The videotapes were then discussed by other participants in the community of practice. This process is described in Box 7.7.

Box 7.7. A triangulated approach to classroom observation and feedback

During their delivery of a unit on light using the GIsML approach, "… all teachers had a University-based member present during some portion of the teaching, providing feedback during the course of the instruction. The amount and nature of the feedback varied significantly, depending largely on how the teaching activity unfolded and the nature of the context. The feedback ranged from sharing an observation with the teacher about comments a small group was making in their investigation that might be fruitful to monitor, to contributing questions to a class or small group discussion, to suggesting an instructional move the teacher might wish to consider. Virtually all GIsML teaching was videotaped, with a remote microphone placed on the teacher" (p. 15). The teacher and professional development provider analysed the videotape together after the lesson, and in many cases presented it for discussion at meetings of the 'community of practice' that operated as part of the ongoing professional learning. Therefore, lessons were observed by the professional development provider, by other members of the professional community, and by the teachers themselves.

Teachers in another study reported that they found a cycle of classroom observation and feedback helpful in supporting their implementation of new practices. Their responses indicate that while an observation and feedback cycle may not be a necessary activity, it may nevertheless be useful. See Box 7.8.

Box 7.8. Teacher reactions to classroom observations to support thinking skills

Teachers involved in the thinking skills programme, CASE, reported that the feedback they received from professional development providers was not only useful in helping them identify difficulties they were experiencing in implementing the new approaches, but that it also helped to boost confidence and reassure them that they were "on the right lines and that they were making progress" (p. 131). One teacher, for example, said: "When my teacher-tutor came in it was good, lots of positive feedback and just a couple of things to work on. That was helpful because sometimes you don't realise what you are saying or what you are actually doing, unless someone says, 'that was a really good question'." (p. 132)

Another teacher reported that the feedback she received challenged her to move beyond merely delivering the activities, and supported her to use them in a way more consistent with their theoretical basis: "I think when I was first doing 'Let's Think!', I was doing the activities without actually thinking about it in theory terms … I have found it much more helpful now that I can put the two together. I can say to myself, 'Right, I need to think about asking them if this reminds them of anything,' so they are doing some sort of bridging … Just to actually be able to think about it more in terms of the theory, rather than just doing the activity, that's why the observations have been helpful." (p. 131)

7.2.3.5 Teachers taking part in learning activities, positioned as students

Only two core studies[136] reported teachers participating in learning activities as students. This is perhaps surprising, given the significantly greater incidence of this activity in the group of mathematics studies discussed in Chapter 6. In both of the studies, the activity served simultaneously as an opportunity to observe the modelling of a particular instructional approach; as the basis for rich conversations about what was observed; to familiarise teachers with instructional materials; and to afford greater insight into the learning experiences of students. An example of this type of activity (from GIsML[137]) was described in Box 7.6. One of the benefits of such activities is that they help teachers to understand the learning experience from their students' point of view. In The Learning in Science Projects, for example, a teacher who had participated in learning activities positioned as a student commented that it was these activities that had given her the confidence to implement the new approach in the classroom and had helped her to support her students as they faced demands posed by the new approach. "I said to them, 'I know what you are going through, I did exactly the same thing, just give it a bit of time, give it a try and I know it is going to work'. And they went through the same process. That was the initial thing that got me on to it." (p. 34)[138]

7.2.3.6 Engaging with professional readings

Four[139] of the eight core studies involved teachers in professional readings related to science, or to science teaching and learning. These studies focused more on readings related to science teaching and students' learning, and literature about science reform.[140] In one[141], a Vygotsky reading group developed from the wider community of practice. In another[142], reading was a major focus of the professional learning. Teachers used their readings of current research as the starting point for the development of their own curriculum, which incorporated learning from the readings, and their own experiences and values. This study is discussed further in the two sections which follow.

7.2.3.7 *Comparing own theories with new theories*

Only one of the documented interventions[143] actively engaged teachers in a process in which their own theories were engaged and used for the co-construction of new approaches to teaching. What distinguished this study from the others in this group was the high level of input teachers had in shaping the new practice. Exploring and challenging teachers' theories of action can deepen their understanding of new practices, and promote greater 'buy-in'. In Box 7.9, the researcher noted that engaging with a teacher's theory of action is a more respectful approach than simply prescribing practices.

Box 7.9. Treating teachers as skilled professionals

This researcher commented that because the teachers were very well qualified, "One cannot treat such people as technicians, asking them to perform certain actions in the classroom without providing them with an opportunity to study the theory underlying the actions, to argue about alternative approaches, and to build their own new skills on the basis of ownership rooted in understanding" (p. 26).

In Box 7.10, the researcher makes the point that addressing teachers' theories of action or orientation is of key importance because they shape all instructional decisions. Addressing specific practices without attending to the beliefs that underpin them may be counter-productive.

Box 7.10. 'Orientation' determines teaching decisions

In the case of GIsML, a teacher's theory of action was known as their 'orientation'. Orientation is thought of as a 'conceptual map' that guides instructional decisions on such matters as daily objectives, the content of student assignments, and the use of textbooks and other curricular materials. "We submit that a teacher's orientation, because it reflects knowledge and beliefs regarding a particular epistemology, provides enough common points with other individuals with the same orientation to facilitate working together in a community and yet leaves room for individual variation in practice due to context differences. Thus, one guiding principle that we have employed in constituting our community of practice is to focus at the level of orientation, and have as a common goal the development of practice consonant with this orientation, rather than promoting a particular set of strategies or a particular pedagogical model … A corollary to this principle is that a teacher's orientation influences all the other elements of PCK: student understanding, curriculum, instruction, and assessment" (pp. 7–8).

Professional learning opportunities that genuinely engage teachers' theories will not necessarily be able to achieve consensus on a new theory or approach. In the situation described in Box 7.11, the process changed the beliefs and practices of some, but not all, of the participating science teachers.

Box 7.11. Challenges in engaging teachers' theories

In one project, teachers discussed current research literature and their own beliefs about science teaching and learning. "As teachers spoke about their practice during these seminars, they observed how ideas from research gave them other ways to think about their classrooms, a process which they commented was quite different from previous experiences with staff development, in which they were told and trained or simply given fun activities to entertain students. From these conversations teachers rethought their beliefs about teaching and learning … For some teachers, ideas from research conflicted with their personal beliefs to such an extent that they were unable to incorporate them into their belief system. These teachers were allowed to voice disagreement with research, citing personal belief to support their views. They were provided opportunities and encouraged to stay in conversations with other teachers and university faculty over the academic year and to continue to share their personal observations about effective teaching. The goal was not to try to convince all teachers of some truth, but rather to maintain open communication about teaching and learning." (p. 778)

7.2.3.8 Participating in professional communities

All core studies involved teachers participating in some form of learning community in which the participants' ideas, experiences, and challenges were shared in order to support each other to implement the changed practice. Sometimes[144] these operated simply as discussions that took place within other learning opportunities, while in three[145], the use of groups was more formalised and played a much larger role in the professional development. At its most basic, nevertheless important, level, the value of such collegial support is summed up by this teacher's comment: "What is really useful is getting together with everybody else and being able to talk about the problems … That support, it really lifts the weight from your shoulders" (p. 129)[146]. This feeling was echoed by a teacher in The Learning in Science Projects, who said, "If we are developing a new method of teaching then I think we are going to all need support from each other and I can turn around and say 'that didn't work for me, it was a disaster and I really don't want to try it again' and somebody will say, 'Well, I went well, I did this and this,' and maybe you will see something that they have done that might be different that might change it." (p. 36)[147]

The active participation of the external provider was a feature of the professional community in all core science studies. In one case the professional development provider worked initially to establish a shared orientation amongst the teachers, which then became the basis for the community of practice. In another, the provider introduced current research findings and national policy statements and these became the basis for the development of the teachers' own curriculum.

7.2.4 Learning processes

Overall, this group of science studies provided too little information about teachers' learning processes and their reactions to the professional development for generalisations to be made about the learning processes involved—other than that all core studies involved teachers becoming aware of new information and skills and implementing or adapting these for classroom practice. This omission means that what happens in the 'black box' between professional learning opportunities and teacher outcomes (Figure 2.1) remains uninterpreted. See Overview 7.4 for our summary of this aspect of the synthesis.

Overview 7.4. Learning processes

New information

- In all the core science studies, information to deepen understandings and refine skills, consistent with the new position, was part of the professional learning opportunities.

Creating dissonance with current position (values and beliefs)

- Only two core studies explicitly reported the creation of dissonance but the difference between traditional approaches to science and those advocated in the professional development indicates that dissonance was likely to have been a common feature.

Consolidating prior knowledge

- Cueing, retrieving, and consolidating prior knowledge was reported explicitly in only two studies.

Only one study reported that the learning process resulted in teachers experiencing dissonance with their previous beliefs about practice[148]. In this intervention[149], dissonance was created by exposing the tensions between the current research literature on science teaching and learning and the teachers' existing beliefs. This led most of the teachers to rethink their beliefs about teaching science and to make substantive changes to their practice. The process described in this study illustrated several features of dissonance as a learning process. It involved active engagement and ownership of change because the teachers did not simply implement an approach to science teaching, they designed a curriculum that was consistent with their changed beliefs. Creating dissonance, however, is a risky business because, for other teachers, "the ideas from research conflicted with their personal views to such an extent that they were unable to incorporate them into their belief system" (p. 779)[150]. Creating cognitive dissonance is unlikely to be a useful process for a professional provider who is primarily interested in achieving implementation fidelity.

Creating dissonance or cognitive conflict was one of the 'pillars' of the study involving a thinking skills programme[151]. The researcher in this case stressed the importance of achieving consistency between the learning approaches being promoted for students and those experienced by teachers in the professional development opportunity, and acknowledging emotive as well as cognitive conflicts.

> If you want to promote the use of cognitive conflict, then present your teacher audience with some cognitive conflict at their own level. Anne Robertson (professional development provider) has a quiver full of problems which really make teachers think, after which she asks them not just metacognitive questions—"How did you solve that?", but also meta-emotive questions: "How did you feel when faced with the problem?" Responses such as "panicky" and "I'd hate to have to do that if I wasn't surrounded by sympathetic colleagues" open the way to a discussion about how their students are likely to feel in similar situations. (p. 162)[152]

Changing underlying theories about teaching and learning is a challenge and the learning processes involved are necessarily complex. One of the supplementary studies presented evidence of a teacher changing her beliefs about science teaching as a result of trying to implement new practice and then seeing the benefits for her students. This situation is discussed in Box 7.12.

Box 7.12. Learning through teaching

A teacher involved in The Learning in Science Projects described how challenging it was to change the way she saw her role: from that of expert who supplied the right answers to rather less of an expert who probed her students to come up with their own explanations. "Although my intentions were good I found it wasn't easy to let go of the control. The speed at which the children asked the questions had me answering instinctively, and my other instinct is to ask questions which lead to the 'right' answer. It was only in hindsight (and using a tape recorder, a great help) that I saw missed opportunities, and saw that the assumptions I was making in some of my questions could have inhibited a child's willingness to give an answer if it was different from where my question was leading."[153] Despite these difficulties, the teacher persisted because she found that: this approach gave her greater insight into the way her students were thinking; it led them to monitor their own understanding and take increased responsibility for their learning; and they responded to the new approach with enthusiasm and interest. She concluded, "In spite of the fact that everything possible that could go wrong with the unit did go wrong, I am a convert."

7.3 Bringing it all together

There were many similarities in the programme aims of the eight core studies related to science. All promoted some kind of inquiry-based approach to science, which was grounded in constructivist theories of learning and emphasised the development of students' conceptual understanding of science rather than memorisation of scientific facts.

All the professional learning discussed in our studies took account of the influence of the wider context, with all the United States studies citing the influence of the same set of standards. All the interventions described in the studies promoted approaches to science teaching that were consistent with current research literature and policies, suggesting that it may be difficult to attempt changes that are not supported by research or consistent with policy trends. All the core studies involved some measure of collegiality between participants. All involved the engagement of external expertise that provided learning content, some form of challenge to the status quo, and some of the support needed for change. All those that led to substantive changes in practice took place over a period of at least one year and provided relatively frequent, ongoing support throughout that time. Although it was possible to change specific, narrowly defined practices in a one-off professional development, it seems that substantive changes take much longer. In all the core studies, explicit, science-related professional learning goals were shared with the participants.

On the basis of these studies, the other specific contextual conditions considered cannot be said to be essential to success, though, by themselves or in combination, they may have played an important role in particular programmes. There was no evidence to support the claim that school or departmental leadership, or infrastructural supports such as funding and release time, are, or are not, necessary to effect positive changes in science teaching practice. Whether the professional learning was voluntary or compulsory; whether it involved whole departments, schools, or individual teachers only; and whether or not teachers were already sympathetic to the programme goals were true of the successful interventions in roughly equal proportions. The conditions that were most closely associated with success were those that related to the content and form of the professional learning experiences.

An important feature of this group of studies was the extent to which the professional development served to support the implementation of particular instructional programmes, rather than develop teachers' ability to independently plan programmes, units, lessons, and activities. One researcher noted that "materials come as a complete package and the inherent danger is in taking something off the shelf that looks as if it will stand alone, but in fact it is suffused with the need to think carefully about implementation" (p. 395)[154]. One teacher echoed this thought, saying, "The danger is people think that you don't have to plan because you are told what to do … but without it you panic" (p. 395)[155]. All interventions involving programmes that were to some extent 'pre-packaged' avoided this trap by providing professional development opportunities alongside the materials—in one case making participation in professional learning a condition of purchase of the materials[156]. In all studies the professional development participants were encouraged "to think carefully about implementation" and sought to develop teachers' theoretical understanding of the materials and the recommended practice. In no study was the provision of instructional materials, in itself, sufficient to change teacher practice in ways that resulted in improved outcomes for students.

The interventions detailed in the core studies provided a variety of learning content, addressing many different aspects of science and reflecting different, but in no cases contradictory, theoretical perspectives. Some programmes focused most on teachers' content knowledge and others on pedagogy, but all were specifically tailored to a science context and all developed theoretical understandings that went beyond practice. It may be a tautology, but in all the successful interventions, teachers were provided with the content they needed to implement new approaches to science teaching in ways that resulted in positive outcomes for students. When, for example, a programme required increased focus on students' higher-order thinking skills, teachers were given the skills to assess their students' scientific understandings instead of just their recall facility. Given that influential scientific bodies are promoting such higher-order knowledge, we take these results as evidence of improvement in instructional practices.

All the interventions in the studies involved a similar sequence of learning activities in which direct teaching of new concepts was followed by activities designed to reinforce the learning and support its transfer into practice.

While it appears to be necessary to have a variety of activities, no one particular activity was shown to be essential. All programmes provided at least two different types of learning activity but no one activity was common to all. Activities included opportunities to see particular approaches implemented in real or simulated classroom situations, being observed and receiving feedback, and taking part in learning activities positioned as students.

All the core studies involved teachers participating in some form of learning community in which the participants shared their ideas, experiences, and challenges in order to support each other to implement the changed practice, but the specific activities that teachers engaged in to achieve this varied considerably.

References

1 Adey, P. (2004). *The professional development of teachers: Practice and theory*. London: Kluwer Academic Publishers.

2 Ibid. p. 4.

3 Bianchini, J., Holthuis, N., & Nielsen, K. (1995). Cooperative learning in the untracked middle school science classroom: A study of student achievement. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA (ED389515).

Bianchini, J. (1997). Where knowledge construction, equity and context intersect: Students learning of science in small groups. *Journal of Research in Science Teaching, 34* (10), 1039-1065.

4 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

5 Filby, N. N. (1997). A viewpoint on dissemination. In E. G. Cohen & R. A. Lotan (Eds.), *Working for equity in heterogeneous classrooms: Sociological theory in practice* (pp. 277-285). New York: Teachers College Press.

6 Cohen, E. G. (1991). Classroom management and complex instruction. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago.

7 Adey, P. (1999). T*he science of thinking, and science for thinking: A description of Cognitive Acceleration through Science Education (CASE).* Innodata Monographs 2. Geneva, Switzerland: International Bureau of Education(ED442622).

8 Adey, P. (2004), op. cit. (ref. 1).

9 **Adey, P. (2006). A model for the professional development of teachers of thinking. *Thinking Skills and Creativity, 1* (1), 49-56.**

10 Bianchini, J. (1997), loc. cit. (ref. 3).

11 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

12 Cohen, E. G., & Lotan, R. A. (1997a). Creating equal status interaction in heterogeneous classrooms: Evidence from complex instruction. In R. Ben-Ari & Y. Rich (Eds.), *Enhancing education in heterogeneous schools* (pp. 249-280). Israel: Bar-Ilan University Press.

13 Cohen, E. G. (1997b). *Complex Instruction*. Keynote speech for Cooperation and Diversity: Cooperative Learning in Intercultural Education Conference (August, 1997), organized by the International Association for Intercultural Education Co-sponsored by IASCE. Sodertalje, Sweden.

14 Good, T., Burross, H., & McCaslin, M. (2005). Comprehensive school reform: A longitudinal study of school improvement in one state, *Teachers College Record, 107* (10), 2205-2226.

15 Cohen, E., Lotan, R., Abram, P., Scarloss, B., & Schultz, S. (2002). Can groups learn? *Teachers College Record, 104* (6), 1045-1068.

16 Curriculum Research and Development Group (2002). Foundational Approaches in Science Teaching (FAST). J. Killon (Ed.). *What works in the middle: Results-based staff development* (pp. 114-117). National Staff Development Council: University of Hawaii http://www.nsdc.org/connect/projects/resultsbased.cfm

17 Yamamoto, K. N. (1997). *Against all odds: Tales of survival of the Foundational Approaches in Science Teaching (FAST) Project*. Presentation at the Annual Meeting of the American Educational Research Association, Chicago, ILL.

18 Huffman, D., Goldberg, F., & Michelin, M. (2003). Using computers to create constructivist learning environments: Impact on pedagogy and achievement. *Journal of Computers in Mathematics and Science Teaching, 22* (2), 153-170.

19 Kahle, J., Meece, J., & Scantlebury, K. (2000). Urban African-American middle school science students: Does standards-based teaching make a difference? *Journal of Research in Science Teaching, 37* (9), 1019-1041.

20 **Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000). Investigating the engagement and learning of students with learning disabilities. *Guided Inquiry Science Teaching. Language, Speech, and Hearing Services in Schools, 31 (3), 240-251.***

21 Buysse, V., Sparkman, K., & Wesley, P. (2003). Communities of practice: Connecting what we know with what we do. *Exceptional Children, 69* (3), 263-277.

22 Cutter, J., Palincsar, A., & Magnusson, S. (2002). *Learning Disabilities: Research & Practice, 17* (3), 186-200

23 **Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001). Making science accessible to all: Results of a design experiment in inclusive classrooms. *Learning Disability Quarterly, 24* (1), 15-32.**

24 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998). Designing a community of practice: Principles and practices of the GIsML community. *Teaching and Teacher Education, 14* (1), 5-19.**

25 Magnusson, S. & Palincsar, A. (1995). The learning environment as a site of science education reform. *Theory into Practice, 34* (1), 43-50.

26 Parke, H. M. & Coble, C. R. (1997). Teachers designing curriculum as professional development: A model for transformational science teaching. *Journal of Research in Science Teaching, 34* (8), 773-789.

27 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001). Student outcomes in a local systemic change project. *School Science and Mathematics, 101* (8), 417-426.

28 Curriculum Research and Development Group, University of Hawaii (2002). Foundational Approaches in Science Teaching (FAST). In J. Killion (Ed.), *What works in the middle: Results-based staff development* (pp. 114-117): National Staff Development Council. http://www.nsdc.org/connect/projects/resultsbased.cfm.

Yamamoto, K. N. (1997), op. cit. (ref. 17).

27 National Staff Development Council (2002). Foundational Approaches in Science Teaching. In J. Killion (Ed.), *What works in the middle: results-based staff development* (pp. 114–117).

30 Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

31 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

32 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

33 Parke, H. M., & Coble, C. R. (1997), loc. cit. (ref. 26).

34 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

35 Bell, B. (2005). *Learning in science: The Waikato research.* London: Routledge Falmer.

36 Caulfield-Sloan, M. B., & Ruzicka, M. F. (2005). The effect of teachers' staff development in the use of higher-order questioning strategies on 3rd grade students' rubric science assessment performance. *Planning and Changing, 36* (3/4), 157-175.

37 Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005). *Research experiences for science teachers: The impact on students*. Paper presented at the Hawaiian International Conference on Education, Hawaii.

38 Samuel, C., Silverstein, M., & Dubner, J. (2004, p. 9). *Columbia University's summer research program for science teachers.* Paper presented at the American Chemical Society National Meeting, Anaheim, CA.

39 Fishman, B. J., Marx, R. W., Besta, S., & Tal, R. T. (2003). Linking teacher and student learning to improve professional development in systemic reform. *Teaching and Teacher Education, 19* (6), 643–658.

40 Leat, D. (1999). Rolling the stone uphill: Teacher development and the implementation of thinking skills programmes.

Oxford Review of Education, 25 (3), 387-403.

41 Bell, B. (2005), op. cit. (ref. 35).

42 Caulfield-Sloan, M. B., & Ruzicka, M. F. (2005), loc. cit. (ref. 36).
Fishman, B. J., Marx, R. W., Besta, S., & Tal, R. T. (2003), loc. cit. (ref. 39).

43 Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

44 Leat, D. (1999), loc. cit. (ref. 40).

45 Adey, P. (2004), op. cit. (ref. 1).

46 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

47 Adey, P. S. & Shayer, M. (1994). Really raising standards: Cognitive intervention and academic achievement. London: Routledge.

48 The remaining study by Adey and colleagues was from the United Kingdom.

49 **Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), op. cit., p. 2000, (ref. 20).**

50 See Table 7.1 for the list of the core studies from the US.

51 National Research Council (1996). *National Science Educational Standards.* Washington, DC: National Academy Press.

52 Kahle, J., Meece, J., & Scantlebury, K. (2000), op. cit., p. 1020, (ref. 19).

53 Ibid.
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

54 Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

55 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Yamamoto, K. N. (1997), op. cit. (ref. 17).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).
Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).
Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

56 Adey, P. (1999), op. cit. (ref. 7).
Adey, P. (2004), op. cit. (ref. 1).
Adey, P. (2006), loc. cit. (ref. 9).

57 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).
Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).
Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

58 Adey, P. (1999), op. cit. (ref. 7).
Adey, P. (2004), op. cit. (ref. 1).
Adey, P. (2006), loc. cit. (ref. 9).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

59 Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).
Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).
Bianchini, J. (1997), loc. cit. (ref. 3).

60 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Yamamoto, K. N. (1997), op. cit. (ref. 17).

61 Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).
Samuel, C., Silverstein, M., & Dubner, J. (2004), loc. cit. (ref. 38).

62 Samuel, C., Silverstein, M., & Dubner, J. (2004), op. cit., p. 9, (ref. 38).

63 Adey, P. (1999), op. cit. (ref. 7).
Adey, P. (2004), op. cit. (ref. 1).
Adey, P. (2006), loc. cit. (ref. 9).
Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Yamamoto, K. N. (1997), op. cit. (ref. 17).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

64 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).
Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

65 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**
Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

66 Adey, P. (2006), loc. cit. (ref. 9).

McLaughlin, M. (1994). Strategic sites for teachers' professional development. In P. Grimmett & J. Neufeld (Eds.), *Teacher development and the struggle for authenticity: Professional growth and restructuring in a context of change* (pp. 31–51). New York: Teachers College Press.

Stoll, L., & Fink, D. (1996). *Changing our schools: Linking school effectiveness and school improvement.* Buckingham: Open University Press.

67 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

68 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

69 Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

Samuel, C., Silverstein, M., & Dubner, J. (2004), loc. cit. (ref. 38).

70 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

71 Adey, P. (1999), op. cit. (ref. 7).

Adey, P. (2004), op. cit. (ref. 1).

Adey, P. (2006), loc. cit. (ref. 9).

72 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

73 Adey, P. (1999), op. cit. (ref. 7).

Adey, P. (2004), op. cit. (ref. 1).

Adey, P. (2006), loc. cit. (ref. 9).

74 Goldenberg, C., & Sullivan, J. (1994). *Making change happen in a language minority school: A search for coherence.* (Educational Practice Report): National Center for Research on Cultural Diversity and Second Language Learning. (see p.9)

75 Adey, P. (2006), loc. cit. (ref. 9).

76 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

77 Caulfield-Sloan, M. B., & Ruzicka, M. F. (2005), loc. cit. (ref. 36).

78 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

Samuel, C., Silverstein, M., & Dubner, J. (2004), loc. cit. (ref. 38).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Adey, P. (2006), loc. cit. (ref. 9).

Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

79 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

80 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

81 Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

82 Adey, P. (2006), op. cit., p. 54, (ref. 9).

83 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

84 Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

85 Adey, P. (1999), op. cit. p. 38, (ref. 7).

86 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Yamamoto, K. N. (1997), op. cit. (ref. 17).

Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

Bianchini, J. (1997), loc. cit. (ref. 3).

87 Adey, P. (1999), op. cit. (ref. 7).

Adey, P. (2004), op. cit. (ref. 1).

Adey, P. (2006), loc. cit. (ref. 9).

88 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30* (3), 555-583.

89 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

90 Ibid.

91 Yamamoto, K. N. (1997), op. cit. (ref. 17).

92 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

Bianchini, J. (1997), loc. cit. (ref. 3).

93 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), ibid.

94 Adey, P. (2004), op. cit. (ref. 1).

95 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Yamamoto, K. N. (1997), op. cit. (ref. 17).

Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).

Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).

96 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Yamamoto, K. N. (1997), op. cit. (ref. 17).

97 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

98 **Ibid.**

99 Kahle, J., Meece, J., & Scantlebury, K. (2000), op. cit., p. 1022, (ref. 19).

100 Parke, H. M., & Coble, C. R. (1997), loc. cit. (ref. 26).

101 Kahle, J., Meece, J., & Scantlebury, K. (2000), op. cit., p. 1020, (ref. 19).

102 Ibid.

103 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Yamamoto, K. N. (1997), op. cit. (ref. 17).

Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

104 Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

Samuel, C., Silverstein, M., & Dubner, J. (2004), loc. cit. (ref. 38).

105 Adey, P. (1999), op. cit. (ref. 7).

Adey, P. (2004), op. cit. (ref. 1).

Adey, P. (2006), loc. cit. (ref. 9).

106 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

Bianchini, J. (1997), loc. cit. (ref. 3).

107 Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

108 Adey, P. (2006), loc. cit. (ref. 9).

Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).

109 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

Bianchini, J. (1997), loc. cit. (ref. 3).

110 Adey, P. (1999), op. cit. (ref. 7).

111 Adey, P. (2006), loc. cit. (ref. 9).

Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

112 Bell, B. (2005), op. cit. (ref. 35).

113 Adey, P. (2004), op. cit. (ref. 1).

114 Parke, H. M. & Coble, C. R. (1997), op. cit., p. 777, (ref. 26).

115 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

116 Young, D. B. (1991). Toward multidimensional assessment. *The Kamehameha Journal of Education, 2* (2), 1-7.

117 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), op. cit., p. 424, (ref. 27).

118 Adey, P. (1999), op. cit. (ref. 7).

119 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).
Bianchini, J. (1997), loc. cit. (ref. 3).

120 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).

121 Kahle, J., Meece, J., & Scantlebury, K. (2000), op. cit., p. 1025, (ref. 19).

122 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

123 Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).
Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Yamamoto, K. N. (1997), op. cit. (ref. 17).
Adey, P. (1999), op. cit. (ref. 7).
Adey, P. (2004), op. cit. (ref. 1).
Adey, P. (2006), loc. cit. (ref. 9).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).
Palincsar, A. S., Collins, K. M., Marano, N. L., & Magnusson, S. J. (2000), loc. cit. (ref. 20).
Palincsar, A. S., Magnusson, S. J., Collins, K. M., & Cutter, J. (2001), loc. cit. (ref. 23).
Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).
Bianchini, J. (1997), loc. cit. (ref. 3).

124 Adey, P. (2006), loc. cit. (ref. 9).

125 Adey, P. (2004), op. cit., p. 227, (ref. 1).

126 Ibid. p. 230.

127 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).
Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).
Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

128 Adey, P. (2006), loc. cit. (ref. 9).

129 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

130 Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

131 Bell, B. (2005), op. cit., p. 185, (ref. 35).

132 Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

133 Ibid.

134 Bianchini, J., Holthuis, N., & Nielsen, K. (1995), op. cit. (ref. 3).
Bianchini, J. (1997), loc. cit. (ref. 3).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

136 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

137 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

138 See page 34 in Bell, B. & Pearson, J. (1991). I know about LISP but how do I put it into practice? *Research in Science Education, 21,* 30-38.

139 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Adey, P. (2004), op. cit. (ref. 1).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

140 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Adey, P. (2004), op. cit. (ref. 1).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

141 **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).**

142 Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

143 Adey, P. (1999), op. cit. (ref. 7).

144 Bianchini, J. (1997), loc. cit. (ref. 3).

Curriculum Research and Development Group (2002), loc. cit. (ref. 16).
Huffman, D., Goldberg, F., & Michelin, M. (2003), loc. cit. (ref. 18).
Kahle, J., Meece, J., & Scantlebury, K. (2000), loc. cit. (ref. 19).
Raghavan, K., Cohen-Regev, S., & Strobel, S. A. (2001), loc. cit. (ref. 27).

145 Adey, P. (2004), op. cit. (ref. 1).
Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).
Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998), loc. cit. (ref. 24).

146 Adey, P. (2004), op. cit., p. 129, (ref. 1).

147 Bell, B., & Pearson, J. (1991), op. cit., p. 36, (ref. 138).

148 Parke, H. M. & Coble, C. R. (1997), loc. cit. (ref. 26).

149 Ibid.

150 Ibid.

151 Adey, P. (2004), op. cit. (ref. 1).

152 Adey, P. (2004), op. cit., p. 162, (ref. 1).

153 Dalzell, D. (1986). Interactive teaching: On first using the approach. SET: *Research Information for Teachers. No 2.* Wellington, NZ: NZCER.

154 Leat, D. (1999), op. cit., p. 395, (ref. 40).

155 Ibid.

156 Curriculum Research and Development Group (2002), loc. cit. (ref. 16).

8. Professional Learning and Literacy

The studies in this group were of interventions focused on developing teachers' understandings of curriculum, pedagogy, and/or pedagogical content knowledge within the context of enhancing literacy achievement for diverse learners. Literacy has been variously defined. In a narrow sense, literacy is knowing how to read and write text. In a broader sense, it is being able to use and understand the written, spoken, and visual texts expected by society and valued by individuals and communities[1]. The emphasis of the professional development was mostly on reading or writing. Ten core studies with a primary focus on reading (five also involved writing) and three with an exclusive focus on writing were identified for the analysis. These studies all demonstrated substantive positive outcomes for students. Nine of the ten core reading-focus studies reported student outcomes for primary school students, while the tenth reported outcomes for middle school students. Of the three studies with a writing focus, two reported outcomes for primary school students and one for secondary. All the studies involved formal, structured professional development rather than incidental professional learning.

Most of the studies were from New Zealand and reflected the priority given to literacy since 1999, following the publication of the Report by the New Zealand Literacy Experts Group[2]. This report noted the high average literacy achievement of New Zealand students but expressed concern about the wide disparities that were described in the introduction to this synthesis. The drive to reduce disparities has led to a focus on schools situated in communities with the lowest levels of income and employment and the highest percentages of Māori and Pasifika students. As a result, many of the New Zealand studies were of professional development structured around whole-school interventions, funded directly by the Ministry of Education, with the goal of building teaching capacity.

8.1 Studies considered

The 13 core studies and groups of studies that met our criteria for methodology and outcomes for students were primarily from New Zealand and the United States, with one large study from the United Kingdom and a smaller study from Canada (Table 8.1). A number of related studies that provided further information about the core studies were also consulted; these are denoted by brackets in Table 8.1. Eleven studies that did not meet our methodological and/or outcomes criteria are listed in Table 8.2 as supplementary studies; all were from New Zealand and the United States.

8.1.1 Core studies with a mainly reading emphasis

Of the ten core studies that had a reading emphasis, five measured reading outcomes only and five measured both reading and writing achievement.

Table 8.1. Literacy: core studies

	Study	Focus of PD	Student outcome assessed	Country	School sector/ year levels
I. PD/PL with a reading emphasis					
1	Anderson (1992)[3] (Anderson & Roit, 1993)[4]	Collaborative 'Transactional Strategies' for reading comprehension: special education students	Reading comprehension	Canada	Grades 6–11

2	Earl et al. (2003)[5] (Basit, 2003)[6] (Beard, 1999)[7] (Brown, Millett, Bibby, & Johnson, 2000)[8] (DfES, 2003)[9] (DfES, 2002)[10]	National Literacy Strategy	Reading and writing	UK	Primary
3	English & Bareta (2006)[11] (Parr et al., 2006)[12]	Reading and writing	Reading and writing	NZ	Primary
4	Jinkins (2001)[13]	Responding to individual needs	Reading and writing	US	Multi-age levels K–2
5	McDowall, Boyd, Hodgen, & van Vliet (2005)[14] (Schmitt, Askew, Fountas, Lyons, & Pinnell, 2005)[15]	Literacy for lowest achievers: reading and writing	Reading and writing	NZ/US	Years 1–2, lowest achievers
6	McNaughton et al. (2004)[16]	Reading comprehension	Reading comprehension	NZ	Years 4–8
7	Phillips & Smith (1997) [17]	Teacher self-monitoring and child achievement in reading and writing	Reading and writing	NZ	Years 2–3, lowest achievers, low socio-economic population
8	Phillips et al. (2001)[18]	Early literacy	Reading	NZ	Years 0–1, low socio-economic population
9	Timperley (2005a)[19] Timperley & Robinson (2001)[20] Timperley & Wiseman (2003)[21]	Literacy: progressing students' literacy achievement	Reading	NZ	Years 0–1, low socio-economic population
10	Timperley & Phillips (2003)[22]	Literacy: challenging expectations and progressing students' literacy achievement	Reading	NZ	Years 0–1, low socio-economic population
II. PD/PL with a writing emphasis					
11	Pritchard (1987)[23]	Writing (and reading)	Writing	US	Grades 7–12
12	Parr et al. (2004) [24]	Writing	Writing	NZ	Primary
13	Fung (2006) [25]	Critical thinking, reading, and writing	Critical thinking and writing	NZ	Year 6

The first study (Anderson, 1992)[26] was of an intervention that involved 16 teachers in grades 6–11 special education classes. The focus of the intervention was on the use of strategies to help struggling adolescent readers take an active approach to reading informational texts. The professional development treated reading as a cognitive problem-solving process. Teachers were presented with a list of 'transactional strategies' for reading comprehension, designed to help students make their thinking explicit and develop their metacognitive skills. Teachers' current practice was evaluated against this list and areas for change were identified. Overall, students in the experimental group demonstrated more use of cognitive strategies for active reading and intentional learning than students in the control group. Results on the Stanford Diagnostic Reading Comprehension Test also favoured experimental students (ES = 2.09).

The second study (Earl et al., 2003)[27] concerned implementation of the National Literacy Strategy and involved all the primary school teachers in England and Wales. Teachers were required to change their practice in response to government initiatives aimed at increasing the percentage of 11-year-olds reaching level 4 (the 'expected level') in the national assessment for English. Strategies for literacy teaching were given to teachers, who then adapted them to their own contexts. Teacher reactions to the mandatory nature of the project were mixed, as many did not accept that there was a teaching problem; but most reluctantly accepted its value when positive outcomes for students were confirmed. Although the student achievement gains over the four-year period, 1998–2002, were relatively small (ES = 0.18 for reading, and 0.14 for writing), this study was included as a core study because of the systemic changes involved.

The third study (English & Bareta, 2006; Parr et al., 2006)[28] involved teachers from 91 schools participating in the national professional development in literacy project initiated by the New Zealand Ministry of Education. Schools selected either a reading or a writing focus. The professional development began with an analysis of teacher and student learning needs, which was followed by focused instruction designed to address those needs over a two-year period. After two years of implementation, participating students, particularly the lowest-achieving ones, demonstrated substantial gains in writing: average ES = 1.27 (ES = 2.05 for lowest 20%), as measured by asTTle; and in reading: average ES = 0.87 (ES = 1.97 for lowest 20%), as measured by STAR. Māori students benefited with higher than average gains in reading (ES = 0.93) and average gains, similar to those of the rest of the cohort, for writing.

The fourth study (Jinkins, 2001)[29] promoted an approach to literacy that was balanced, assessment driven, and based on a coherent theory of teaching and learning. Three teachers designed individualised teaching programmes for three low-achieving students in each of their classes. The goal of the programme was to raise the reading levels of these students to national norms or above. Teachers used student assessment data to determine individual strengths and needs and drew from a range of teaching strategies. The students were reassessed after 12 weeks. Over the period, seven out of nine students made accelerated reading gains of between two months and a year. The achievement data provided did not allow us to calculate effect sizes but the gains were clearly substantive for this group of students with special needs.

The fifth study (McDowall, Boyd, Hodgen, & van Vliet, 2005)[30] concerned teachers being trained in Reading Recovery, an early-intervention programme for the lowest-achieving readers and writers after one year at school. The goal of the programme was to accelerate the reading levels of these students to national norms or above. The professional development (described in Schmitt et al.[31]) developed teachers' knowledge of a variety of teaching practices that would support them to implement individually designed sequences of instruction and provided training in the use of assessment tools to determine individual students' specific learning needs. Students with the lowest achievement at the start of the programme made the greatest gains (ES = 3.73).

The sixth study (McNaughton et al., 2004)[32] concerned an intervention designed to raise the reading comprehension of year 4–8 students from schools serving low socio-economic communities with high proportions of Māori and Pasifika students. The intervention aimed to develop quality research-based teaching practices that would be effective with linguistically and culturally diverse students. The professional development strategy was to use assessment information to identify students' strengths and needs and then design teaching practices that improved student outcomes. After implementation for two school years (2003–04), reading outcomes improved, with overall ES = 0.34, as measured by STAR.

The seventh study (Phillips & Smith, 1997)[33] involved an intervention aimed at raising the reading and writing attainment of low-achieving six- to eight-year-old students. All had already had intensive remedial instruction (Reading Recovery) but had not made sufficient progress. The professional development focused on developing teachers' skills in observing students and using a flexible range of strategies. Of the 23 students who completed the programmes, 18 were able to read text at or above their age-equivalent level as measured by a running record. Effect sizes could not be calculated from the data provided but substantive improvements were evident.

The last group of studies[34] from New Zealand concerned different but closely related aspects of professional development. The study by Phillips, McNaughton and MacDonald (2001) involved six months of professional development in literacy, focused on teachers' careful observation of their students at entry and on accelerating their reading progress by the use of specific approaches at each level. It was appropriately called *Picking up the Pace*[35], because most participating students (all from low-income communities) showed significant gains in a range of reading and writing skills (ES = 0.48, as measured by Clay's Observation Survey), compared with the non-participating members of their cohort.

The remaining studies in this group are related to this initial study (Phillips et al., 2001). The group of three studies[36] analysed the learning opportunities in a variety of schools once the initial professional development in early literacy had finished. Findings showed that, in all but one school, the teachers' professional learning continued, with concomitant gains in student achievement (ES = 0.88). The case of the school where the teachers attended the professional development but did not engage is included as a supplementary study. In the final study, Timperley and Phillips (2003) examined how teachers' expectations of student achievement changed over the course of the professional development.

8.1.2 Core studies with a writing emphasis

Three studies that focused on writing were included as core studies (Table 8.1). One was from the United States and two were from New Zealand. The United States study involved middle and high school students; those from New Zealand involved primary school students.

The United States study (Pritchard, 1987)[37] was part of the National Writing Project (NWP). The NWP emphasised the writing process first and control of the language second. The professional development consisted of an intense three- to five-week summer institute during which teachers wrote at their own level and discussed their work with their colleagues. Applying the model in their classrooms, teachers encouraged students to work in their pre-writing and peer response groups when doing writing work. After three years of implementation, students of the participating teachers significantly outperformed students of non-participating teachers, although junior high students benefited more (ES = 0.72) than senior high students (ES = 0.06), as measured by a researcher-developed writing test.

The second study (Parr, Timperley, Reddish, Jesson, & Adams, 2006)[38] was a case study of a New Zealand primary school where a needs analysis approach was taken to writing. Five teachers of students in years 2–6 participated. As part of their involvement in the Literacy Professional Development Project, teachers were presented with a summary of their teaching practice based on classroom observations and asked to identify the beliefs that underpinned it. The teachers were then introduced to new methods of practice, based on the needs they had identified through this process, and incorporated these into their practice. Student writing outcomes after four months were positive (ES = 1.03, as measured by asTTle). This study is presented as a case in Appendix 1.

The third study (Fung, 2006)[39], also from New Zealand, focused on critical thinking in a writing context and involved a collaboration between an expert on critical thinking and three year 6 teachers in a decile 5 school. Teacher professional development involved action research on redesigning and implementing curriculum units so that they better integrated critical thinking, language, and content knowledge. After implementation for two school terms, participating students demonstrated significantly better performance than non-participating students in creative writing (ES = 1.07), analytical reasoning skills (ES = 0.88), and evaluative reasoning skills (ES = 1.46).

8.1.3 Supplementary studies

Of the 13 supplementary studies identified (Table 8.2), two had a narrow domain focus, three reported low or no gains in student achievement, and the others did not report sufficient information to ascertain the methodological adequacy of the study. These supplementary studies were included to inform conclusions drawn from the core studies.

Table 8.2. Literacy: supplementary studies

Study		**Focus of PD**	**Student outcome assessed**		**School sector/year levels**
I. Studies with a narrow domain focus					
1.	Baker & Smith (1999)[40]	Phonics & Phonological Awareness	Phonics and phonological awareness	US	Kindergarten (equivalent to year 1 in NZ)
2.	Maheady & Harper (1991)[41]	Spelling	Spelling	US	Grades 4–5
II. Studies with low or no gains in student achievement					
3.	Angrist & Lavy (2001)[42]	Reading in Hebrew	Reading (also mathematics)	Israel	Elementary
4.	Davis (2006)[43]	Literacy	Reading comprehension	NZ	Years 5–9
5.	MacIver & Kemper (2002)[44]	Reading (includes writing)	Reading	US	Elementary
6.	Montes (2002)[45]	English language learning support	Reading, writing, and oral language	US	Grades 6–8
7.	Timperley, Parr, & Higginson (2001)[46]	Literacy leadership	Reading, writing, and oral language	NZ	Primary

III. Studies with insufficient information about student outcomes					
8.	Coburn (2001)[47]	Reading	N/A	US	Elementary
9.	Fisher (2001)[48]	Instructional strategies in reading and writing	Reading and writing	US	High school – all grades
10.	Norton (2001)[49]	Reading		US	Elementary
11.	Rau (2004)[50]	Reading assessment using observation survey developed for Māori students	Reading accuracy	NZ	Years 1–2, Māori
12.	Timperley (2005b)[51]	Literacy: effective leadership	Reading	NZ	Years 0–2, low socio-economic population
13.	Vaughn (2001)[52]	Reading comprehension and content area reading	'Performance on high-stakes tests of reading'	US	Grade 6

8.1.3.1 Supplementary literacy studies with a narrow focus

Two supplementary studies with a narrow focus were identified (Table 8.2). The first (Baker & Smith, 1999)[53] was focused on explicit teaching of phonemic awareness and alphabet in the United States. Kindergarten[54] teachers from two elementary schools serving low socio-economic populations participated. Students' phonemic awareness improved (ES = 0.29 over control; 0.81 over baseline).

The second (Maheady & Harper, 1991)[55] concerned spelling and involved eight elementary school teachers who were trained in the use of a behavioural intervention known as Class-Wide Peer Tutoring. The duration of the professional development varied as it depended on how long it took teachers to implement the programme with a high level of fidelity. Improvements in spelling were evident as measured by weekly spelling tests (ES = 0.31).

8.1.3.2 Supplementary studies with low or no gains in student outcomes

Five supplementary studies that reported low or no gains were included in this section. These studies provided rich information on the circumstances under which professional development in literacy led to limited or no change.

The first of these studies (Angrist & Lavy, 2001)[56] was from Israel and focused on an intervention designed to improve reading (in Hebrew) and mathematics across 30 schools. The professional development focused on pedagogy only and promoted a teaching cycle consisting of systematic diagnostics, individualised instruction, and evaluation (0.25). The same gains were not replicated in religious schools that started the programme a year later. The study made a case for teacher training programmes being a more cost-effective option for increasing student achievement outcomes than smaller class sizes or a longer school day.

The second study (Davis, 2006)[57] involved literacy leaders from six New Zealand schools teaching year 5–9 students in a low socio-economic school community with a long history of underachievement in reading. The goal of the professional development was to raise student outcomes in reading comprehension by emphasising the importance of sharing learning goals with students, student use of metacognitive strategies, and explicit instruction in comprehension strategies. Although student gains in the STAR[58] pre- and post-tests of reading achievement were evident with an effect size over the baseline of 0.31, the effect size was only 0.08 when compared with a control group. These gains were not sufficient to meet our criteria for inclusion as a core study. They were, however, greater than those in the other two supplementary studies in this category, which showed no gains.

The third study (MacIver & Kemper, 2002)[59] was conducted in the United States and involved teachers using the Direct Instruction model to teach literacy. Strongly positive results for this initiative had been reported elsewhere in the literature[60], but the only study that we were able to locate that had details of the professional development found no measurable impact on student outcomes. As this synthesis focuses on unpacking the black box of professional development rather than the effectiveness of particular teaching strategies, we have included this study in the supplementary category. Teachers were required to use a predetermined sequence of instruction, with scripted lessons to support implementation. The focus of the professional development was to support teachers to implement the programme as designed. Gains in one part of the study were comparable to those of students in schools not using the programme. Other material suggested greater gains, but the information provided was insufficient to determine its validity.

The fourth study (Montes, 2002)[61] involved teachers adapting their practice to incorporate language-learning strategies into all content areas using the CAPE (Content Area Program Enhancement) programme for English Language Learners. The professional development was directed at training teachers to support students from high-poverty and high-minority communities, with a particular focus on English language learners. Teachers were trained in the use of the Cognitive Academic Language Learning Approach, which focused on using learning strategies in cooperative settings to accelerate the acquisition of both language skills and academic content. Teachers planned interdisciplinary units and learned to use technology to support their lessons. The professional development involved monthly interactive training sessions, in-class demonstrations, and a week-long summer institute. After a year of implementation, students demonstrated some gains in reading (ES = 0.05 for all students, ES = 0.19 for English language learners). Similar effect sizes were evident in mathematics.

The fifth study (Timperley, Parr, & Higginson, 2001)[62] evaluated an intervention aimed at reducing systemic underachievement in education in New Zealand. The intention was to train literacy leaders from primary schools so they could take a lead role in their schools. While the providers understood the aims of this professional development, the literacy leaders they worked with did not share them. Although many schools developed a more consultative and collegial way of working, the initiative did not impact on teaching practice and there was no evident change in student outcomes.

8.1.3.3 Supplementary studies with insufficient information about methodology to judge adequacy

Six supplementary studies provided useful information on the New Zealand Māori and United States contexts. They were categorised as supplementary because limited information was supplied about the professional development undertaken or on changes in student outcomes resulting from changed teacher practice.

The first study (Coburn, 2001)[63] considered how teachers negotiated the meaning of a literacy reform agenda in California. No student outcomes were assessed but the study provided rich descriptions of how messages were interpreted by teachers and professional development translated into teachers' own practice contexts.

The second study (Fisher, 2001)[64] involved teachers from a high school where the achievement scores of students were among the lowest in the state. A leadership team consisting of senior teachers, administrators, and university personnel trained the teachers to use seven literacy strategies that had been identified as effective from the research literature. After a year of implementation (1999–2000), students' reading scores increased overall by 12% as measured by the Gates-MacGinities reading test, enabling the school to meet state accountability targets for the first time in 15 years. This study is included in the supplementary category because the reporting of student achievement scores did not meet our methodological criteria.

The third study (Norton, 2001)[65] related to a two-week summer institute with a reading and writing focus. The participating teachers learned strategies for teaching reading, writing, and grammar. The school disaggregated data and identified problems that had previously been 'hidden in averages'. We include this study because it informed the synthesis with respect to a particular use of assessment data and because it was one of the few school-initiated cases.

The fourth study (Rau, 2004)[66] was of an intervention that trained resource teachers to use a Māori translation of an assessment tool[67]. The tool allowed teachers to identify areas of strength and need in literacy and to inform next teaching steps. Teachers were given intensive training in the use of this tool and then trained others in its use. The results were positive but could not be attributed to the initial professional development with any certainty.

The fifth study (Timperley, 2005b)[68] involved the teachers of students in years 1–3 in one school learning how to use assessment information on a range of literacy skills to inform their teaching practice. The school served a lower socio-economic community in an area that had a high proportion of Māori and Pasifika students. An analysis of assessment information showed that the students had good letter–sound knowledge but were unable to use this knowledge to write words. The professional development took the form of an action research project. Teachers worked together to develop strategies to help students transfer their letter-level knowledge to their writing. After a year of implementation, students showed greater ability at writing words in isolation and in their narratives.

The sixth study (Vaughn, 2001)[69] was from the United States and focused on enhancing reading comprehension and content-area reading for students with high learning needs in general education classrooms. The professional development programme consisted of three research-based, multi-level instructional practices in a programme that had been developed and refined since 1996. In the final study, 10 middle-school teachers of grade 6 students participated in a six-month training programme involving workshops and follow-up support. Although it was reported that the proportion of students passing high-stakes tests was greater that year, there was insufficient information for the study to be included in the group of core studies.

8.2 What works for whom in literacy?

This section synthesises the evidence from the studies that focus on literacy teaching and learning. It includes studies with a broad literacy emphasis, those with a specific focus on reading or on writing, and those with a narrower domain, such as spelling or phonemic awareness. The section is structured according to the aspects of the framework in Figure 4.2: context, professional learning environment, content and activities provided as part of the professional learning opportunities, and teachers' reactions.

8.2.1 The context of the professional learning opportunities

In this section, we identify contextual aspects of the professional development that appeared to contribute or not contribute to changes in teachers' literacy practice that had positive outcomes for students. A summary of key features is provided in Overview 8.1.

Overview 8.1. Key features of the context for literacy

Initial circumstances

- Neither who initiated the professional development nor whether it was voluntary or compulsory was associated with particular outcomes for students.

Time

- Length of time appeared to be less important than frequency of contact, but most of the studies concerned interventions lasting six months or more.
- A shorter time was sufficient for professional learning involving a narrow domain, such as spelling.
- Where the professional development was intensive (for example, daily during a summer institute), a shorter period was required.

Expertise/leadership

- All the interventions in the core studies made use of external expertise and most included an element of leadership training or involvement.

  But involving experts did not always lead to improved student outcomes.

Goals/accountabilities

- In all the interventions in the core studies, goals were both explicit and shared. All activities were linked to the achievement of stated goals.

Prevailing discourses

- In some of the studies, discourses were initially linked to teachers' theories about the limited capacity of their students, but as teachers became more skilled in specific teaching approaches, their expectations of students increased and their discourses reflected a greater sense of efficacy.

Infrastructural supports

- Most interventions provided some form of infrastructural support, such as release from class.
- The input of experts (researchers and/or providers) was funded in all interventions, typically from an external source.

8.2.1.1 Voluntary or compulsory and initiated by whom?

There is little in this group of studies to suggest that volunteering—either by the individual teacher or the school—is necessary for professional development to result in improved outcomes for students. The majority of studies in which schools volunteered were from New Zealand, where the Ministry of Education rarely mandates professional development, so schools typically elect to opt in to initiatives that are offered. We were unable to ascertain whether teachers *within* each school volunteered or not. Participation in the professional development associated with the literacy strategies in the United Kingdom was clearly mandated. There was only one core study in which a school initiated professional development independently of a wider project[70]. In this case (situated in a school in the United States), the principal led the teachers' professional learning.

Teachers' motivation and engagement throughout the professional development appeared to be more important than volunteering: the initial enthusiasm of volunteers is not always sustained when they realise that major changes in practice are expected or they find their theories of practice challenged. Box 8.1 describes a case in which initial motivation waned as teachers became aware of the extent of the changes expected[71].

Box 8.1. Waxing and waning of teacher motivation

Teachers were initially very motivated to be involved in the professional development offered because they were presented with research showing accelerated progress of students like theirs, following the introduction of an alternative approach to teaching reading. As they became involved in the professional development, however, they realised that they were being asked to make fundamental changes to the way they taught reading and writing. The extent of the change was unexpected. At this point, their motivation decreased markedly.

As they tried the new approach and found it to be effective in moving their students through beginning level texts, teachers came to value it more and became motivated to acquire further skills and knowledge. For a long time, however, they combined their previous ways of teaching with the new approach, which resulted in extra time spent teaching reading at the expense of other curricula. As they became more confident that the new approach was sufficient on its own, they gradually discarded old strategies.

8.2.1.2 Time

The professional development associated with the core studies ranged in length from a few weeks[72] to more than two years. Time appears to be a necessary but not sufficient condition. The only case of professional development that had no impact on student outcomes lasted for a year[73]. When, however, a relatively narrow curriculum area is targeted, much less time appears to be necessary. In the case of the spelling study[74], for example, the professional development took the form of brief individual teacher consultations supported by a textbook. Teachers were able to implement the programme with a high degree of fidelity after a maximum of seven 20- to 30- minute sessions (the mean was 6.62 sessions). So the consultation time involved amounted to no more than three hours. This example suggests that individualised and specific interventions with a narrow focus can take a relatively short time.

To achieve substantive change in reading or writing, however, longer and more frequent involvement was needed. The professional development in most of the core studies involved formal sessions at least once a fortnight—seldom less than once a month. It appears that frequent contact is important for sustaining the change process, given that most of these studies involved fairly substantial changes in teacher practice, together with the beliefs, values, and understandings on which that practice was based. The modification of practice and beliefs was an iterative, rather than sequential, process. Frequent contact with experts maintained the focus on new learning.

The one exception to this iterative pattern of input and practice was found in a study focused on writing[75], where teachers volunteered to be involved in a three-week summer institute. The brief but intense professional development was sufficient for teachers to develop new understandings and apply them effectively in their own contexts, apparently without further intervention.

8.2.1.3 Expertise and leadership

All the interventions detailed in the core studies utilised external experts who were researchers and/or providers with high levels of domain-specific knowledge. The majority of these interventions[76] also provided specific training for school leaders. The purpose of such training was typically to ensure the sustainability of the learning, but its effectiveness in achieving this goal was rarely tested. In several of the studies[77], teacher leaders worked in collaboration, offering practical expertise while providers and/or university researchers provided theoretical input.

In several studies, the teachers and/or leaders involved were identified as having particular interest or expertise in literacy[78], but researchers found that their understandings, theories, and practical expertise varied enormously. When teachers are nominated or volunteer to be literacy leaders, expertise should not be assumed. In some cases, this variable expertise was a hindrance to professional learning. Phillips & Smith[79] reported that "Some teachers, particularly those who had very clear and fixed ideas about these children's needs and the activities they should be engaged in, found it very difficult to hear what was being discussed and come to terms with suggestions being made by the team." (p. 25)

One of the main functions taken on by school leaders was to analyse assessment data and oversee its use[80]. In one follow-up study spread over four consecutive years[81], the role played by leaders in leading evidence-based discussions of student data was strongly linked to the sustainability of new practice. Box 8.2 describes how two of these leaders used assessment data to inform teaching programmes in their schools and demonstrates how their different approaches impacted on student outcomes.

Box 8.2. Sustaining change through internal leadership

The leaders of seven schools observed in the early stages of the four-year project placed different emphases on the way student assessment data were used. The following statements from two of the leaders concerned illustrate these differences. In the first example, data were afforded little importance:

"What we're going to do today is, I just wanted to just very quickly go through the latest bit of data—I've given you a copy but I know it's a paper war and just have a look at it today, and if you don't want it just give it back to me. You don't have to file it or anything like that this stage … it's just hand-written." (The leader from a lower-performing school)

In contrast, the second example involved a leader who regarded the use of data as both important and urgent:

"This is a valuable time—collecting all that data in and just looking at it. Although it is a pain getting it ready, it is the only way we are going to make a difference. I will give it out to you in a minute and you can have a look to see in your class who is below and who is above [the national benchmark] and look especially at the ones just below and think, 'What am I going to do to make sure they are not below next time?'" (The leader from a school with significantly higher reading achievement)

In the third year of this follow-up study, all seven schools came to use assessment data in ways similar to that in the second example, and student achievement improved correspondingly. (Timperley, 2005a)

8.2.1.4 Professional learning goals

In all the interventions documented by the core studies, the professional learning goals were explicit and shared with participants. Whenever accountabilities or student achievement targets were set, they were consistent with the goals. While this sharing of explicit goals seems to be a prerequisite for successful professional learning, the example[82] in Box 8.3 shows that providers cannot assume that participants necessarily share an understanding of what is required or intended. In this study, outcomes did not improve.

Box 8.3. The importance of a shared understanding

The goal of a national literacy initiative in New Zealand was to raise the achievement of low-performing students. Achievement of this goal was addressed in two ways. The first was to develop more learning-centred leadership in the schools. School leaders did not share this understanding and therefore did not see the need to change their approach. Instead, they responded by establishing more collegial and collaborative processes, in line with their own theories of effective leadership. Asked why he was satisfied with the initiative, a principal gave the following (fairly typical) response—one that focused on collegiality rather than instructional improvement:

"Because it was a whole-school thing, there was buy-in and input from most of the staff so everyone had a role to play. Everyone could have a say in the whole thing."

The second problem was lack of a shared understanding about the goal to reduce achievement disparities through developing evidence-informed practice. While the professional development providers sought to close gaps by examining assessment results and identifying needs, teachers were content if their lowest-achieving students made progress, even if they still lagged way behind. One teacher expressed this view on the use of achievement data:

"I don't need data to see that it has been successful. I mean, you can see by the children's attitudes and all the extra things that we are putting in. I mean, I look at my three bottom children and even though they are not catching up, they haven't caught up but they have made gains. I mean, we do little extra things for those children."

As well as understanding the broad goals of the programme, participants need to have a shared understanding of the specific goals of each component at each stage. Without this understanding, confusion and/or negative reactions can be the result, as the example in Box 8.4 shows[83].

Box 8.4. The importance of linking professional learning goals to activities

In the Literacy Professional Development Project, teachers' classroom practice was observed by providers who then gave feedback. The purpose of the observations was for providers to work with teachers on their specific learning goals. But when teachers were interviewed by the researchers following the feedback sessions, they typically were unable to articulate any specific learning, only a generalised understanding of purpose, such as "[The observation was] a snapshot of where I am in my teaching."

In addition, some teachers were unclear about how the feedback they received was linked to messages from other parts of the professional development or to their individual learning goals. One teacher actually rejected the feedback she was given, commenting, "I've come from a completely opposing viewpoint to the complete and utter opposite and now I'm really confused about what I should be doing." This confusion was not explicitly addressed.

The more successful examples from this study had a set of criteria for effective practice linked to the teachers' learning goals, against which to reference improvements in practice. This reference point allowed both the teacher and the facilitator to negotiate how practice could be changed. One teacher made the following comment after repeated opportunities to learn, practise, and reflect, using the criteria:

"I feel things are now falling into place easier … to me, I struggled with what makes a level 2 argument and once I understood that, then it was easy enough to teach it and get the kids to learn the parts … once you know what you are doing then you can actually teach the kids. That's the big thing."

8.2.1.5 Prevailing discourses

Teachers' prevailing discourses prior to and during the professional development provided an indication of their current theories about students and their belief in their students' ability to learn. In one study, these theories were based on an assumption that some students were unable to learn due to factors beyond the teachers' control[84], such as home background or inherent ability. Professional development providers challenged this assumption by producing evidence that contradicted it, showing that students could learn faster if taught differently. As the teachers examined and discussed the evidence, their theories and discourses changed. As they became more confident with the new strategies and saw the resulting improvement in the achievement of their students, the teachers' discourses came to reflect their greater sense of efficacy and their new awareness of the positive impact they could have on student outcomes.

8.2.1.6 Infrastructural supports

A range of infrastructural supports, mostly in the form of funding and release time, was made available to the schools in these studies. In all cases where external experts were involved, the necessary funding was provided. When whole schools were engaged in professional development projects initiated by central administrative agencies, release time was provided so that teachers could participate.

Considerable funding was made available to develop schools' capacity to lead literacy developments themselves. The time provided reflected the depth of learning involved—ranging from 15 full days to two full days followed by a further 17 half-days. A supplementary study in which only two full days' release was provided for literacy leaders[85] did not have the anticipated impact on teacher practice, though the limited time was not the only reason for the lack of impact.

One issue with release time was highlighted in a United States supplementary study[86] where teachers were given substantial release time to attend workshops and plan collaboratively. Teachers were reluctant to be out of class so much and instead asked that the professional development take place during their non-contact time. This situation is discussed in Box 8.5.

Box 8.5. Issues with release time

Teachers were unwilling to use release time made available for their involvement in professional development for two reasons. Firstly, they felt that relief teachers did not have sufficient knowledge of their students to meet their learning needs adequately, resulting in lost teaching time. Secondly, they were concerned about the availability of quality relief teachers. Sometimes, not enough relief teachers were available due to the need for so many staff to be released simultaneously. At other times, a teacher's preferred substitute was already engaged, leaving only less skilled relievers available. When released from their classrooms, teachers wanted to feel that their programmes were not going to be disrupted and that their students were in good hands.

In many of the core studies, school leaders had a crucial role to play in providing infrastructural support. They provided an environment that supported the professional learning goals either directly or indirectly by, for example, organising release time, making a priority of the professional development in school and classroom programmes, timetabling, and making suitable venues available for professional learning.

8.2.2 The content of the professional learning opportunities

In this section, we identify the kinds of knowledge and skills presented during professional learning opportunities that appeared to be effective in changing teachers' literacy practice in ways that led to positive student outcomes. A summary of the key points is provided in Overview 8.2.

Overview 8.2. Key features of the content of the professional learning opportunities

Pedagogical content knowledge

- Pedagogical content knowledge was strongly linked to theories about literacy and about how students learn to read and write.
- The rationales given for introducing pedagogical content knowledge depended on the context. They included:

  to understand instructional practices that can better meet the needs of underachieving students;

  to promote students' higher-order thinking.
- Some core studies focused on effective teaching strategies only.
- Theories underpinning literacy practice and student learning were pivotal to the effective translation of content into practice.

Shared theories

- The meaning of new theories of practice was mediated by teachers' existing theories.
- In all the core studies, teachers' existing theories were engaged rather than bypassed.

Multiple uses of assessment:

- Assessment was used for these purposes:

  to inform the focus of professional development by identifying professional learning needs;

  as a catalyst for initial and ongoing engagement;

  to test the effectiveness of practice with particular students;

  to identify student needs in order to focus teaching.

Developing content knowledge at teachers' own level

- The development of content knowledge was a major focus of professional development in writing and critical thinking for primary teachers.

8.2.2.1 Pedagogical content knowledge

The term 'pedagogical content knowledge' encompasses knowledge of the subject, knowledge of how to teach, and knowledge of learners. In the case of reading and writing, knowledge of the subject consists primarily of knowing specific linguistic features of text and how they work. This knowledge underpins teachers' ability to make effective moment-by-moment pedagogical decisions in their classrooms.

In all the core studies in this category, considerable emphasis was placed on pedagogical knowledge and/or pedagogical content knowledge. This knowledge was strongly linked to theories of literacy and student learning. The rationales for introducing the knowledge, and for choosing the type of knowledge to promote, depended on the context in which the professional development was taking place.

In reading, for example, the goal of most of the interventions discussed in the core studies was for teachers to understand the instructional practices that would most effectively meet the learning needs of students or groups of students who were not making adequate progress in response to current teaching methods[87]. New pedagogical content knowledge was introduced to accelerate the progress of these students. However, one study with a focus on writing dealt with a more general problem: student outcomes across a whole school[88]. In this study, knowledge was introduced about effective teaching strategies, together with knowledge about how texts achieve their communicative and rhetorical purposes. Another initiative drew on pedagogical content knowledge to promote students' higher-order thinking in their writing[89].

Most of these interventions made use of research knowledge about effective instructional approaches to improve the literacy achievement of all students. An example of the use of research to inform the content of professional development is outlined in Box 8.6[90].

Box 8.6. Using research on effective teaching strategies

The staff at a Californian high school with achievement scores among the lowest in the state selected seven strategies identified in the research literature as successful in raising literacy achievement. Those selected could be adopted at every level and across every curriculum area taught. The strategies were: read-alouds, charts, graphic organisers, vocabulary instruction, writing to learn, structured note taking, and reciprocal teaching. This shared decision by all staff resulted in the articulation of a school-wide focus on instruction. Each strategy was incorporated into accountabilities as it was introduced through professional development. The following example describes how reciprocal teaching was incorporated into a physical education class:

The teacher introduced the rules of volleyball by providing students with a text that explained all the rules of the game. He could have explained the rules verbally, but he knew that reading, asking questions, and clarifying the rules in small groups would both foster literacy skills and increase his students' understanding of the game. "When we overheard a student remark, 'Hey, isn't this reciprocal teaching?' we knew that we had succeeded in making this strategy clear to our students." (p. 73)

McNaughton et al.[91], however, cautioned professional developers about promoting specific strategies without foregrounding their purpose for reading. Observations of teachers and students in their study of low-achieving students showed that teachers taught and students used a range of so-called 'effective' strategies. They discovered that what was missing was an understanding of the purpose for using those strategies, that is, comprehending text. It was only through a careful analysis of how teaching practices were reflected in student learning that these authors were able to target the professional development appropriately.

Greater emphasis was given to developing teachers' content knowledge in the core studies focusing on writing and critical thinking than in those with a reading focus. This may have been due to the stronger research base that underpins the teaching of reading; the teaching of writing and critical thinking has not received the same attention from researchers. Typically, new writing content knowledge was introduced to support teachers to respond to identified student learning needs, rather than for more general reasons. The exception to this context-driven approach was the National Writing Project[92], where teachers attended a three-week summer institute focused on generic methods for teaching writing.

Whether focused on reading or writing, all the interventions documented in the core literacy studies ensured that teachers had access to theories and principles underpinning literacy practice and student learning that could inform their practice in the many, varied, and continually changing contexts in which they taught. In contrast, an intervention that failed to impact on teacher practice or student achievement[93] focused on process rather than improving content knowledge. Literacy visions were established and action research projects initiated, but no specific effort was made to improve teachers' pedagogical content knowledge as it related to literacy instruction.

8.2.2.2 Shared theories

Understandings, beliefs, and goals shared by providers and teachers were a feature of all the core studies but absent in one of the supplementary studies that had no impact on student outcomes. In addition (in those studies that reported this issue), mutual understandings of theoretical principles were negotiated between researchers and/or providers and teachers in ways that allowed teachers to translate theory into practice. This negotiation of meaning was consistent with the idea that teachers need to develop theoretical knowledge on which to base their practice, rather than simply comply with a set of practices that have been predetermined by researchers or providers. McNaughton et al. (2004) describe the iterative process of forming, testing, and refining theories through critical discussion about teaching and learning needs. This was seen as a collaborative process in which understandings were mediated and shaped by the theories of both researcher and teacher.

Teachers are adult learners with considerable practical experience and professional knowledge and the evidence suggests that they rarely accept new or alternative theories without convincing evidence that they are relevant and worthwhile[94]. The meanings of new theories are mediated via existing theories. Bypassing teachers' existing theories about effective literacy teaching can lead to the rejection of new practice that is based on alternative theories. Box 8.7 illustrates how, in one school, teachers mediated meanings[95].

Box 8.7. How teachers' theories influence their understandings

Cynthia Coburn spent a year observing how teachers in one Californian elementary school collectively interpreted, negotiated, and adapted messages about effective reading instruction. Teachers with different theories constructed different understandings of the same messages. In one example, teachers in two groups came to different understandings about what it meant to use assessment to inform instruction. The first group understood reading instruction to be a particular sequence of skills. Using assessment to inform instruction, therefore, meant knowing where in the sequence a child was, and planning and teaching accordingly. They concluded: "Using assessment to inform instruction is the skill work … We plan learning centre work based on the skills they need to know and it goes in a particular sequence." (p. 16)

A second group working on the same question believed that skills should be taught in response to students' needs rather than in a set sequence. They constructed their understanding of this concept as developing lessons in response to the particular needs of a student, no matter what the sequence. One teacher summarised the group's response in the following way: "So we're saying it's ongoing observation of students … you are constantly looking at what they are doing and when you see something they are having trouble with, you plan a mini-lesson." (p. 16)

In these formal professional learning sessions, the sharing of diverse perspectives sometimes allowed teachers to challenge one another's theories. When there was a very broad range of different perspectives, however, the teachers tended to construct responses reflecting the views of the more dominant members. The composition of the groups was critical to how key messages were interpreted.

Informal settings worked differently. The tendency to seek out like-minded teachers in informal settings created situations of greater homogeneity. As a result, informal settings tended to be more supportive and also more conservative, reinforcing rather than challenging individual points of view.

The process that emerged was one in which teachers, in conversation with their colleagues in formal and informal settings, co-constructed understandings which were strongly influenced by existing theories, made decisions about which messages to pursue in their classroom, and negotiated technical and practical details of implementation (p. 3).

8.2.2.3 *Multiple uses of assessment*

Assessments provide teachers with information that can help them understand student learning needs. In the literacy studies, assessment information was used variously to determine the content of the professional development, to provide evidence of scope for alternative practices, to test the effectiveness of teaching practices for particular students, and as a catalyst for teachers to engage in professional development.

All the core New Zealand studies and one from the United States[96] made much of using assessment information to identify students' learning needs. Once these needs had been identified, the providers worked with teachers to discover the ways in which they needed to teach differently. These teaching needs then informed the content of the professional development[97]. In this way, teacher learning and student learning were closely interlinked.

In all these interventions, teachers were encouraged to move beyond using assessment data to group and label students, and to use it instead as the basis for identifying alternative practices, based on different theoretical principles, that could better meet the specific needs of their students. One study[98] found that this shift resulted in teachers feeling more successful, which led them to attend more closely to the impact of their teaching on their students and to take more responsibility for outcomes. The process of change was iterative, with actions and outcomes shaping and being shaped by each other.

In all but one of the core literacy studies[99] assessment was used to measure the impact of changes in practice on students, and inadequate progress was treated as a teaching problem. Teaching and learning were seen to be closely interrelated.

At times[100], dissonance was created by presenting assessment information that called teachers' current beliefs into question. Teachers discovered that students like theirs could learn faster than they had thought possible and this served as a motivator for them to modify their teaching practices. In this particular study, assessment data was the catalyst for change as well as a basis for deciding the direction that the change should take. (See the section on prevailing discourses in Chapter 9.)

In two supplementary studies, an analysis of student assessment information provided the initial catalyst for teachers to engage with the professional development. Dissatisfaction with current levels of achievement led these schools to adopt new teaching practices[101]. To ensure accurate data gathering, interventions in which teachers used assessment tools to identify student learning needs usually included some form of training. The importance of accuracy is illustrated by the example in Box 8.8[102].

Box 8.8. The importance of accuracy in the use of assessment tools

This study explored how teachers' knowledge of students' needs impacted on their decision making and how this affected student achievement. The study tracked nine students, seven of whom made accelerated progress. The importance of correct administration and use of assessment tools was highlighted when one teacher used running records for two of her students with accuracy rates well below the 90% required to establish an appropriate instructional reading level.

[The] two students, while showing growth in critical knowledge and skills, remained on the same level throughout the study. In reviewing the baseline data, the researcher discovered the teacher had not calculated the accuracy levels on the running records correctly and had these students reading from texts that were in the frustration level. Her understanding of the purpose of the running record and all its components was not clear, and therefore, her application was incomplete. Her misapplication resulted in less focused instruction and had a clear impact on student learning (p. 282).

Both students failed to make adequate progress in reading because the incorrect text level was identified from the initial assessment. These students were still reading the same level after 12 weeks of instruction, but seven peers who were placed at the correct instructional level made between six months' and two years' gain in reading level over the same period.

8.2.2.4 Developing content knowledge at teachers' own level

In the core studies, writing and critical thinking were the two areas in which curriculum content knowledge was presented at the teachers' own level. The focus on these areas, not reading, probably reflects greater concerns on the part of providers about the depth of teachers' knowledge. Besides developing their content knowledge, one of the purposes of the tasks in which teachers worked at their own level was to model appropriate pedagogical techniques. The same two purposes applied to similar studies of professional learning in mathematics in which teachers were situated as learners. The example in Box 8.9 shows how teachers learned to use critical thinking skills themselves in order to understand how to teach them to their students[103].

Box 8.9. Increasing teachers' own level of expertise in curriculum content

The aim of the intervention was to support classroom teachers to raise student achievement in terms of the Thinking Critically objective, as specified in the English curriculum for New Zealand schools (NZ Ministry of Education, 1994). Three year 6 teachers and their students participated in this school-based, collaborative action research project.

Professional development first improved the teachers' own understanding of the principles, theories, and skills of critical thinking that underpinned the conceptual model entitled Collaborative Reasoning: Critical Thinking Based Learning and Instruction. The teachers then learned how to use their conceptual understanding, in collaboration with the researcher, to redesign curriculum units that integrated the teaching and learning of critical thinking, language, and content knowledge. In particular, the teachers learned how to probe, assess, extend, and give feedback to students about their thinking during their reading and writing instruction. Further professional learning and development occurred in cycles of implementation, observation, reflection, and revision across three school terms.

8.2.3 Activities constructed to promote the professional learning

In this section, we synthesise the evidence concerning the types of activities used to promote professional learning in literacy. Some of these activities involved external providers directly; in others, teachers participated without such provider input. The activities used in the different studies varied, but all except one[104] of the interventions had a similar overall structure. They typically began with a rationale or catalyst for engagement. Participants were introduced to the conceptual basis for the alternative approaches advocated. Teachers were then given opportunities to translate their new understandings into practice. Further activities designed to help teachers refine the new practice in their own classrooms were also offered sequentially or iteratively. This process is similar to that observed for other curriculum areas and is illustrated in Figure 6.1.

The one intervention that did not have a structure of this kind consisted of a three-week summer institute in which teachers engaged in intensive professional development positioned as students working at their own level in writing. Once the teachers returned to their classrooms, no further support was available to assist them to refine their practice or to translate it into their own contexts. It may be that, in this less-supported form of teacher professional development, volunteering is an important condition.

In all other cases where substantial changes in practice and student outcomes were evident, the learning was iterative, with multiple supported opportunities for teachers to work with, revisit, and use new knowledge in their own contexts and with their own students. A summary of this section of the synthesis is provided in Overview 8.3.

Overview 8.3. Activities constructed to promote professional learning

Professional instruction

- The interventions in all the core studies began with a rationale to engage, followed by initial instruction in the underlying theoretical principles related to pedagogical practices and/or training in procedures (such as assessment) or specific programmes.
- The role of the provider was often to mediate the theoretical messages derived from research, making them available to teachers.

Activities used to link key ideas to teaching practice

- Different combinations of activities allowed teachers to negotiate meaning.
- Construction of meaning involved teachers developing understanding of links between their current and evolving theories and practices and the new professional learning.
- Engaging with selected professional readings, aided by provider mediation of the messages.
- Watching demonstrations of practice (most effective when students were similar to those in teachers' own contexts).

Activities to enact key ideas in the teachers' own classroom

- Activities were effective when there were clear and shared understandings of the theoretical framework underpinning the practice and where multiple opportunities to engage were provided.
- The most frequently used activity consisted of observations and feedback, where teacher practice and provider input were allowed to shape and refine understandings.
- Opportunities to plan collaboratively were successful where there was a clear framework outlining the preferred teaching practices and where data on student outcomes and learning needs were available.

Participation in professional learning communities

- A common element in all the core studies was the establishment of a professional learning community with shared contexts and similar needs.
- Some communities were school-based; others were off-site and involved teachers from different schools meeting for a common purpose.
- Professional learning communities did not always support new professional learning and in some cases served to maintain the status quo.

8.2.3.1 Professional instruction

The interventions detailed in the core studies all began with some kind of rationale to engage and this was followed by initial instruction, including instruction in the underlying theoretical principles. These principles developed pedagogical content knowledge and were delivered in face-to-face situations by an expert professional development provider or researcher. These initial sessions typically included information about how to translate the theoretical principles into practice. This translation function, taken on by the provider, was often pivotal in mediating the theoretical messages derived from research, combining them with expert curriculum knowledge, and making them recognisable to and usable by teachers.

8.2.3.2 *Activities to link key ideas to teaching practice*

The interventions described in the core studies made use of different combinations of activities to help teachers develop deeper understandings of the links between their current and evolving theories and practices and the new professional learning. Facilitators often discussed these theory–practice links with a more expert colleague or professional development provider as issues arose in the iterative process by which teachers translate theory into practice. In a number of New Zealand studies[105], new theories presented by the professional development providers were explicitly compared with teachers' existing theories. This process assisted teachers to understand how new practice was connected with underpinning pedagogical principles. These negotiated processes may have been more obvious in the New Zealand studies because central administrators have limited authority to mandate particular teaching practices. Teachers must, therefore, be persuaded of the benefits of new practices rather than compelled to enact them. This environment provides a greater incentive for providers of professional development to help teachers construct meaning than does an environment in which the educational jurisdiction allows for imposition.

Engagement with professional readings was not often reported in the core studies. When used, readings were often theory-based and not directly related to teacher practice, so time was set aside for teachers to discuss the implications for their own contexts. Professional development providers introduced them at points in the programme where the material was thought likely to be salient and useful[106] and often mediated the messages to ensure that they were clearly understood[107].

Watching someone modelling the particular teaching approach being advocated in the professional development—either in person or on video—was another way in which providers linked theory and practice. This activity was described in seven of the core studies[108]. In all cases, this modelling of practice followed an introduction to underlying theoretical principles. Modelling is not always effective, however. One study[109] found that teachers were unlikely to benefit from modelling if they did not fully understand the principles underpinning the modelled practice, the particular aspect of practice that was being modelled, and the reason why that aspect was being modelled.

Observations of other teachers' practice proved to be valuable in a study where the provider's attempts to give constructive feedback to a teacher were unsuccessful[110]. Box 8.10 describes how the provider used this activity to respond to the teacher's specific professional learning needs and to reinforce the links between theoretical principles and practice.

Box 8.10. Demonstrating practice to clarify links between theory and practice

The professional development provider had observed a teacher's guided reading lesson with her five-year-old students and had offered feedback on several occasions. She became aware that this approach had not been successful in engaging the teacher or changing her teaching. She had observed, however, that when she modelled the practice she was talking about, the gap between theory and practice was bridged more effectively.

"I realised when I talk to her, it doesn't sink in … so I'm trying not to talk too much to her now. I'm just trying to show her … She was much better when I modelled things for her and I gave her an observation sheet and told her to take note of everything that she'd seen and to try and analyse things a bit … I'm taking her to see another new entrant teacher who's brand new and who is also struggling and I'm also taking her to see an experienced teacher and I've got them each to talk about two different things with her." (p. 27)

The teacher described the experience of observing others in the following way:

"... visiting the other schools and just observing how the other teachers teach writing. I think I was having low expectations of my children and I've got high expectations now ... I just thought, 'OK, they are five they can only write one sentence type.' ... After observing at the other school and they were doing narratives and I thought, 'My gosh, my goodness me,' and I thought, 'My kids could do that.' Yes, well, here I was thinking I was doing the right thing." (pp. 27–28)

8.2.3.3 Activities to support teachers to enact key ideas in their own practice settings

The activities described in this section provided opportunities for teachers to translate new knowledge into their own practice contexts. The activities were effective when there were clear links to the theoretical frameworks that underpinned practice, and shared understandings of these links, but were less effective when these were lacking.

In all the core studies, except for the National Writing Project study[111], time was allowed for teachers to revisit ideas and incorporate change gradually into their practice so that change would become embedded. As was noted in the section on Time (8.2.1.2), the frequency of the professional development opportunities in most interventions allowed for new practice to be developed gradually and for teachers to be supported through the process of change.

Being observed and receiving feedback was the most commonly used activity both in the core studies and in the supplementary studies that had positive student outcomes. It was usually associated with a discussion of practice with a more expert colleague or the provider. Teachers were encouraged to analyse their current practice in the light of new theory and to construct new practice that was more closely aligned with the theoretical principles of the professional development.

In a number of studies, cycles of observation and feedback were used to help translate theory into practice. Box 8.11 describes how teachers in Māori-medium settings learned to use an assessment tool and analyse the data gained for the purpose of informing their teaching practice[112].

Box 8.11. Ensuring consistency in the use of assessment tools

This intervention introduced teachers to a newly developed assessment tool—the Observation Survey in Māori. Trainers who were conversant with both the administration and the analysis of the tasks elaborated on these before teachers practised using the tool themselves. As they did, they were observed and received feedback. Iterative cycles of practice and feedback occurred until the trainers were satisfied that the teachers were able to use the tool to the standard required. This process of refinement ensured that data gathered was of consistently high quality and that teachers were able to analyse it to determine students' strengths and needs.

Collaborative planning to implement new learning was another activity used to help teachers translate theory into practice[113]. It ties in closely with the development of professional learning communities (discussed in the following section). Collaborative planning was a successful activity when teachers were given a clear framework outlining the preferred teaching practices and when student achievement information was available for the purpose of monitoring and adjusting new practice. In this situation, the role of the provider was to challenge teachers' assumptions about the causes of student outcomes and to ensure that teachers used student outcomes as the basis for their planning and reflecting on the effectiveness of their practice.

Although several studies reported that teachers were provided with prepared student activities and material, this was less common than in the other categories, such as science, and appeared to play a minor role in literacy professional development.

8.2.3.4 Creating professional learning communities

In all the core studies, teachers participated as members of a professional learning community. These communities came in a variety of shapes and sizes: whole schools[114], groups of teachers within a school[115], and individual teachers and leaders[116] learning off-site. By participating in a learning community, teachers were able to work together to compare their theories, plan collaboratively, or reconstruct practice. Box 8.12 discusses the role played by learning communities in the case of one intervention[117].

Box 8.12. The value of professional learning communities

Opportunities for colleagues to observe and discuss one another's practice were an integral component of Reading Recovery training. Teachers watched lessons from behind a one-way mirror and discussed their observations and analyses of what was happening. In these conversations, they articulated their questions and dilemmas and described teaching practice in detail. This process built professional knowledge of a theory in action and continually required teachers to move beyond what they saw and explore their understandings and interpretations of what was happening. The links between the teaching practice and the students' learning were explored in context. This professional learning community was able to share goals, discuss similar teaching challenges, and discuss students with common needs—even though the teachers came from different schools.

While participation in a professional community appeared to be a necessary condition for professional development that impacted positively on student outcomes, it was not sufficient. In the literacy studies, professional learning communities did not always promote professional learning. Box 8.13 discusses such a case and shows how teachers can reject new practices and support one another to maintain the status quo[118].

Box 8.13. Gatekeeping to reinforce the status quo

Coburn studied how teachers worked together to construct understandings from the messages given in professional development and how they selected which ideas they would engage with and which they would dismiss. Their reasons for rejecting ideas and approaches all came back to prior assumptions about the nature of their students or of literacy teaching and learning and thus served to reinforce and entrench the status quo. Teachers gave the following reasons for rejecting the alternative teaching approach:

- It did not apply to their grade level.
- It was too difficult for their students.
- They were philosophically opposed to aspects of the approach (for example, the assessment of comprehension was deemed "too traditional" as it used story excerpts and multiple choice questions).
- It was outside the bounds of comprehensibility (for example, when it was suggested that individualised instruction be adopted, one teacher said, "How can you possibly teach reading without putting kids in groups? That's crazy!")
- The ideas "didn't fit" with how they currently taught students reading or were "unmanageable" due to time constraints, record-keeping requirements, or behaviour management issues.

8.2.4 Learning processes

Most of the core studies provided sufficient information on learning processes to be included in this section (only one of the studies, from the United States[119], did not). Most of the interventions concerned promoted more than one learning process. The synthesis of evidence from these studies is summarised in Overview 8.4.

Overview 8.4. The learning processes

Consolidation of prior knowledge

- Consolidation of prior knowledge was not a major aim or emphasis in any of the studies, though in some, new pedagogical knowledge was systematically built around existing curriculum knowledge.

Introduction of new information

- This was the most frequently reported learning process. The new information was deeply situated and usually presented in the form of pedagogical content knowledge together with the theoretical understandings and principles underpinning it. At times, new information generated dissonance.

Dissonance and repositioning

- In those studies that reported dissonance:

  It was usually triggered by demonstrating the greater effectiveness of alternative teaching approaches.

  Teachers became convinced of the value of new approaches when they saw them having a positive impact on the achievement of their own students.

  Teachers gained a greater sense of agency in promoting their students' learning and a reduced sense that outside influences predetermined student underachievement.

Consolidation of prior knowledge was not reported as the primary aim or emphasis in any of the core studies, but in some, new pedagogical knowledge was built on existing curriculum knowledge[120]. In studies where the stated aim of the professional development was to enhance existing practice[121] (rather than introduce an entirely new approach), prior knowledge was used as a starting point for the change process.

Introduction and assimilation of new knowledge and skills was the most frequently reported learning process. The new information was generally in the form of pedagogical content knowledge and the theoretical understandings and principles that underpinned it.

8.2.4.1 The creation of dissonance, and repositioning

Dissonance was created by demonstrating the effectiveness of alternative teaching approaches. The studies that reported this learning process all related to the professional development of teachers working with students from low-income communities where reading levels typically fell well below the national average. Most were from New Zealand[122], with some from the United States[123]. These studies found that once teachers had used the new teaching approaches with their own students and seen the positive impact on achievement, most became convinced of the value of the new learning and also of their own agency in their students' learning outcomes. In most cases, this process resolved the dissonance and resulted in reconstructed practice. In some cases, however (see the following section), the end result was rejection[124].

8.2.5 Teachers' responses

All the core studies that reported teachers' responses found that a majority of teachers engaged with the professional learning and changed their practice in some ways.

Teachers' responses often reflected the type of learning process in which they had engaged. This association was particularly evident in interventions that created dissonance[125]. As teachers encountered new information that challenged their existing beliefs or offered new possibilities for their students' learning, they often chose to actively engage with the new approaches and theories and to change their practice substantially. In four of these studies[126], however, groups of teachers rejected the new theory and practice and elected to continue with their existing practice. In three of those cases[127], teachers selected only parts of the new theory and practice and incorporated these into their existing ways of teaching. These teachers were a minority of those involved. Where they formed the majority, student outcomes did not change[128].

In all the studies, both core and supplementary, the evidence suggested that teachers who made changes to their practice were motivated by the desire to improve learning outcomes for students rather than by compliance requirements. Even in those cases where teachers rejected or only partially implemented new approaches, it appeared (based on the commentary provided) that teachers chose this course of action in the belief that existing practice would better serve the needs of their students.

Teachers in a number of New Zealand studies[129] moved beyond simply adopting new theories and approaches and developed self-regulatory learning skills. They evaluated and adapted their practice in light of their students' progress, refining and reviewing their knowledge of how best to enhance their students' achievement and extending and enriching their own theories as a result.

8.3 Bringing it all together

In this final section, we draw together our findings from this group of studies to answer the question 'What works for whom, and why, and under what circumstances?' The biggest group of studies that met our selection criteria comprised those that had a literacy focus and (in all but four[130]) the target was those whose learning needs were not being met by current practice and who were, as a result, achieving at levels below those of their peers.

The demands of literacy teaching and learning are complex and challenging. All primary teachers invest a significant part of their classroom time teaching students to read and write. Secondary teachers are highly trained in their subject areas, but do not necessarily consider themselves to be teachers of literacy. Thus, whenever approaches to literacy teaching were the subject of professional development, substantial change was required of teachers.

'Craft knowledge', developed through practical classroom experience, routinely guides teachers' day-to-day actions[131]. This knowledge, together with their experience as professionals and the discourses in which they engage both formally and informally, shapes teachers' theories about literacy and how it should be taught. Existing theories can compete strongly with new approaches when the principles underlying them are in conflict. These theories are often implicit rather than explicit[132] and need to be engaged if change is to take place. The challenge for professional development providers, therefore, particularly when calling for substantial changes in practice, was to not simply supply teachers with new and more effective ways of teaching, but to convince them that these would improve the learning outcomes for students whom they typically believed incapable of making the gains advocated.

Success in implementing new approaches was affected by a number of factors. These included: the degree to which teachers understood and shared the goals and understandings presented in the professional development; teachers' understandings of underlying theories and principles, and the opportunities they were given to translate these into their own contexts; the availability of mutually accepted evidence for the effectiveness of the new approaches; the time and frequency of opportunities afforded teachers to translate new learning into practice and to refine it; and the opportunity to work in professional learning communities with others who shared the same goals and faced the same challenges.

For teachers to access the content of professional development, they needed to share beliefs, understandings, values, and goals with the provider. This condition could not be taken for granted. In the interventions detailed in the core studies, the process of getting to this point was both gradual and iterative, with multiple opportunities for teachers to revisit and refine their understanding of the messages they were hearing. When teachers involved in the Literacy Leadership Project[133] did not share goals and understandings with the providers, they relied on their existing theories to inform what they believed was new practice but which, in reality, resembled prior practice.

The unique context that constituted the working environment of each teacher influenced how new methods would be translated into practice. For successful translation, teachers required an understanding of the theoretical principles underpinning the pedagogical content knowledge that related to the new practice. With this understanding, they were able to respond as professionals to their students rather than applying new strategies in ways that were divorced from the realities of their classrooms. In the study where the focus was on teacher implementation of a set of separate strategies, supported by scripted lessons[134], teachers did not have the opportunity to engage with the new theory and adapt it to their own contexts; their success was judged by the degree to which their practice followed the programme outline, not the outcomes for their students—and these showed no greater gains than those whose teachers had used alternative teaching methods.

An important factor in all the core studies was the availability of assessment tools to establish the need for change, judge the effectiveness of changes designed to raise student achievement, and help teachers decide what they and their students needed to learn. Where teachers did not have a strong focus on improving student outcomes through the use of assessment data[135], the outcomes rarely changed.

The importance of repeated opportunities for teachers to encounter, understand, translate, and refine new theories and related practices was apparent in most of the core studies. In most, extended time was structured so that teachers were given multiple occasions and a variety of activities to link theory and practice, revisit theoretical understandings, and refine practice. Where such opportunities were not given, neither extended time nor frequency of contact were sufficient to change teacher practice or improve student outcomes.

Finally, the establishment of professional learning communities was a feature of all the core studies and some of the supplementary studies. To be effective, these communities needed to have input from an expert leader, establish common goals, and be concerned with the learning of students who had similar needs.

References

[1] Ministry of Education. (2002). *Literacy leadership in New Zealand schools*. Wellington, NZ: Learning Media.

Campbell, J. R., Kelly, D. L., Mullis, I. V. S., Martin, M. O., & Sainsbury, M. (2001). *Framework and specifications for PIRLS assessment 2001*. Chestnut Hill, MA: Boston College.

[2] Literacy Experts Group. (1999). *Literacy Experts Group report to the Secretary for Education.* Wellington, NZ: Ministry of Education. Available online at:

http://www.minedu.govt.nz/web/document/document_page.cfm?id = 3810.

[3] Anderson, V. (1992). A teacher development project in transactional strategy instruction for teachers of severely reading-disabled adolescents. *Teaching and Teacher Education, 8* (4), 391-403.

[4] Anderson, V. & Roit, N. (1993). Planning and implementing collaborative strategy instruction for delayed readers in Grades 6-10, *Elementary School Journal, 91* (2), 121-137.

[5] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies.* London, UK: DfES.

[6] Basit, T. (2003). Changing practice through policy: Trainee teachers and the National Numeracy Strategy. *Research Papers in Education, 18* (1), 61-74.

[7] Beard, R. (1999). *National Numeracy Strategy: Review of research and other related evidence.* Leeds, UK: University of Leeds.

[8] Brown, M., Millett, A., Bibby, T., & Johnson, D. (2000). Turning our attention from the what to the how: the National Numeracy Strategy. *British Educational Research Journal, 26* (4), 457-471.

[9] Department for Education and Skills (2003). *Best practice: Teaching literacy and mathematics to children with emotional and behavioural difficulties*. London, UK: DfES.

[10] Department for Education and Skills (2002). *Targeting support: Managing NNS/NLS intervention programmes. A guide for headteachers and senior managers.* London, UK: DfES.

[11] English, C. & Bareta, L. (2006). *Literacy Professional Development milestone report*. Wellington, NZ: Learning Media.

[12] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning. Milestone 5 (Final report)*. Wellington, NZ: Learning Media.

[13] Jinkins, D. (2001). Impact of the implementation of the teaching-learning cycle on teacher decision-making and emergent readers. *Reading Psychology, 22* (4), 267-288.

[14] McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005). *Reading Recovery in New Zealand: Uptake, implementation, and outcomes, especially in relation to Màori and Pasifika students (Report).* Wellington, NZ: New Zealand Council for Educational Research.

[15] Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005). *Changing futures: The influence of Reading Recovery in the United States*. Worthington, OH: Reading Recovery Council of North America.

[16] **McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.**

[17] Phillips, G. & Smith, P. (1997). *A third chance to learn: The development and evaluation of specialised interventions for young children experiencing the greatest difficulty in learning to read.* Wellington, NZ: New Zealand Council for Educational Research.

[18] Phillips, G. E., McNaughton, S., & MacDonald, S. (2001). *Picking up the pace: Effective literacy interventions for accelerated progress over the transition into decile one schools* (Final report). Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/web/document/document_page.cfm?id = 6444.

[19] **Timperley, H. S. (2005a). Distributed leadership: Developing theory from practice. *Journal of Curriculum Studies 37* (6), 395-420.**

[20] Timperley, H. & Robinson, V. M. J. (2001). Achieving school improvement through challenging and changing teachers' schema. *Journal of Educational Change, 2* (4), 281-300.

[21] Timperley, H. & Wiseman, J. (2003). *The sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement*. Wellington, New Zealand: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

[22] Timperley, H. & Phillips, G. (2003). Changing and sustaining teachers' expectations through professional development in literacy. *Teaching and Teacher Education, 19*, 627-641.

[23] Pritchard, R. J. (1987). Effects on student writing of teacher training in the National Writing Project model. *Written Communication, 4* (1), 51-67.

[24] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit., chapter 8, (ref. 12).

[25] Fung, I. Y. Y. (2006). *Collaborative reasoning: Critical thinking based learning and instruction.* Unpublished doctoral thesis, University of Auckland, Auckland, New Zealand.

[26] Anderson, V. (1992), loc. cit. (ref. 3).

[27] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 5).

[28] English, C. & Bareta, L. (2006), op. cit. (ref. 11).

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).

[29] Jinkins, D. (2001), loc. cit. (ref. 13).

[30] McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005), op. cit. (ref. 14).

[31] Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).

[32] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).

[33] Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).

[34] Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

Timperley, H., & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

Timperley, H. S. (2005a), loc. cit. (ref. 19).

[35] Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).

[36] **Timperley, H. S. (2005a), loc. cit. (ref. 19).**

Timperley, H., & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

[37] Pritchard, R. J. (1987), loc. cit. (ref. 23).

[38] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit., chapter 8, (ref. 12).

[39] Fung, I. Y. Y. (2006), op. cit. (ref. 25).

[40] Baker, S. & Smith, S. (1999). Starting off on the right foot: The influence of four principles of professional development in improving literacy instruction in two kindergarten programs. *Learning Disabilities Research & Practice, 14* (4), 239-253.

[41] Maheady, L. & Harper, G. (1991). Training and implementation requirements associated with the use of a classwide peer tutoring system. *Education and Treatment of Children, 14* (3), 177-199.

[42] Angrist, J. D. & Lavy, V. (2001). Does teacher training affect pupil learning? Evidence from matched comparisons in Jerusalem public schools. *Journal of Labor Economics, 19* (2), 343-369.

[43] Davis, A. (2006). *Characteristics of teacher expertise associated with raising the reading comprehension abilities of years 5-9 students*. Unpublished doctoral thesis, University of Auckland, Auckland, New Zealand.

[44] MacIver, M. A. & Kemper, E. (2002). The impact of direct instruction on elementary students' reading achievement in an urban school district. *Journal of Education for Students Placed At Risk, 7*, 197-220.

[45] Montes, F. (2002). Enhancing content areas through a cognitive academic language learning based collaborative in South Texas. *Bilingual Research Journal, 26* (3), 697-716.

[46] Timperley, H., Parr, J. M., & Higginson, R. M. (2001). *Evaluation of the Literacy Leadership Initiative: The Enhancement Programme 2001*. Final Report to the Ministry of Education. Wellington, NZ: Ministry of Education.

[47] **Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23* (2), 145-170.**

[48] Fisher, D. (2001). Trust the process: Increasing student achievement via professional development and process accountability. *NASSP Bulletin, 85* (629), 67-71.

[49] Norton (2001). A story breakthrough. *Journal of Staff Development, 22*(4), 22-25.

[50] Rau, C. (2004). *He Matai Matatupu: Assessment for Māori medium literacy learning.* Unpublished Masters thesis, The University of Waikato, Hamilton, New Zealand.

[51] Timperley, H. (2005b). Instructional leadership challenges: The case of using student achievement information for instructional improvement. *Leadership and Policy in Schools, 4* (1), 3-22.

[52] Vaughn, S. (2001). Collaborative strategic reading as a means to enhance peer-mediated instruction for reading comprehension and content-area learning. *Remedial & Special Education, 22* (2), 66-74.

[53] Baker, S. & Smith, S. (1999), loc. cit. (ref. 40).

[54] Kindergarten in the United States is equivalent to year 1 in New Zealand

[55] Maheady, L., & Harper, G. (1991), loc. cit. (ref. 41).

[56] Angrist, J. D. & Lavy, V. (2001), loc. cit. (ref. 42).

[57] Davis, A. (2006), op. cit. (ref. 43).

[58] Elley, W. B. (2001). *Supplementary tests of achievement in reading*. Wellington, NZ: New Zealand Council of Educational Research.

[59] MacIver, M. A. & Kemper, E. (2002), loc. cit. (ref. 44).

[60] Borman, G., Hewes, G.M., Overman, L.T., & Brown, S. (2003). Comprehensive school reform and acheivement: A meta-analysis. *Review of Educational Research, 73* (2), 125-230.

[61] Montes, F. (2002), loc. cit. (ref. 45).

[62] Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).

63 **Coburn, C. E. (2001), loc. cit. (ref. 47).**

64 Fisher, D. (2001), loc. cit. (ref. 48).

65 Norton (2001), loc. cit. (ref. 49).

66 Rau, C. (2004), op. cit. (ref. 50).

67 Clay, M. M. (1993). *An observation survey of early literacy achievement.* Auckland, New Zealand: Heinemann Education.

68 Timperley, H. (2005b), loc. cit. (ref. 51).

69 Vaughn, S. (2001), loc. cit. (ref. 52).

70 **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

71 Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

72 Pritchard, R. J. (1987), loc. cit. (ref. 23).

73 Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).

74 Maheady, L. & Harper, G. (1991), loc. cit. (ref. 41).

75 Pritchard, R. J. (1987), loc. cit. (ref. 23).

76 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 5).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).

Pritchard, R. J. (1987), loc. cit. (ref. 23).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

Timperley, H. S. (2005a), loc. cit. (ref. 19).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

77 **Timperley, H. S. (2005a), loc. cit. (ref. 19).**

Fung, I. Y. Y. (2006), op. cit. (ref. 25).

78 Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).

Rau, C. (2004), op. cit. (ref. 50).

Timperley, H., Bertanees, C., & Parr, J. (2004). Case study: A South Island school. In H. Timperley & J. Parr & S. Werner (Eds.), *Literacy Professional Development Project: Milestone report* (pp. 15-43). Wellington, NZ: Ministry of Education.

79 Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).

80 McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).

Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).

Pritchard, R. J. (1987), loc. cit. (ref. 23).

Timperley, H. (2005b), loc. cit. (ref. 51).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

Timperley, H. S. (2005a), loc. cit. (ref. 19).

81 **Timperley, H. S. (2005a), loc. cit. (ref. 19).**

82 Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).

83 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).

84 Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

85 Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).

86 Montes, F. (2002), loc. cit. (ref. 45).

87 Jinkins, D. (2001), loc. cit. (ref. 13).

McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005), op. cit. (ref. 14).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).

Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).

Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).

Pritchard, R. J. (1987), loc. cit. (ref. 23).

Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

Timperley, H., Smith, L., Parr, J., Portway, J., Mirams, S., Clark, S., Allen, M., & Page, J. (2004). *Analysis and use of student achievement data. Final report to the Ministry of Education.* Wellington, New Zealand: Ministry of Education.

88 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit., chapter 8, (ref. 12).

[89] Fung, I. Y. Y. (2006), op. cit. (ref. 25).
[90] Jinkins, D. (2001), loc. cit. (ref. 13).
[91] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
[92] Pritchard, R. J. (1987), loc. cit. (ref. 23).
[93] Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).
[94] **Coburn, C. E. (2001), loc. cit. (ref. 47).**
[95] **ibid.**
[96] Jinkins, D. (2001), loc. cit. (ref. 13).
[97] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).
Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. S. (2005a), loc. cit. (ref. 19).
[98] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Phillips, J. (2003), loc. cit. (ref. 70).
[99] Pritchard, R. J. (1987), loc. cit. (ref. 23).
[100] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
[101] MacIver, M. A. & Kemper, E. (2002), loc. cit. (ref. 44).
Phillips, J. (2003), loc. cit. (ref. 70).
[102] Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
[103] Fung, I. Y. Y. (2006), op. cit. (ref. 25).
[104] Pritchard, R. J. (1987), loc. cit. (ref. 23).
[105] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
[106] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit., chapter 8, (ref. 12).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
[107] Fung, I. Y. Y. (2006), op. cit. (ref. 25).
[108] Anderson, V. (1992), loc. cit. (ref. 3).
McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005), op. cit. (ref. 14).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).
Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
[109] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
[110] Ibid.
[111] Pritchard, R. J. (1987), loc. cit. (ref. 23).
[112] Rau, C. (2004), op. cit. (ref. 50).
[113] Davis, A. (2006), op. cit. (ref. 43).
Fisher, D. (2001), loc. cit. (ref. 48).
Fung, I. Y. Y. (2006), op. cit. (ref. 25).
Phillips, G. & Smith, P. (1997), op. cit. (ref. 17).
Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
Timperley, H., Bertanees, C., & Parr, J. (2004), loc. cit. (ref. 78).
Timperley, H. S. (2005a), loc. cit. (ref. 19).
[114] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Phillips, J. (2003), loc. cit. (ref. 70).
[115] Anderson, V. (1992), loc. cit. (ref. 3).
Fung, I. Y. Y. (2006), op. cit. (ref. 25).

Jinkins, D. (2001), loc. cit. (ref. 13).
McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
Timperley, H. S. (2005a), loc. cit. (ref. 19).

116 Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).

117 Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).

118 **Coburn, C. E. (2001), loc. cit. (ref. 47).**

119 Pritchard, R. J. (1987), loc. cit. (ref. 23).

120 McDowall, S., Boyd, S., Hodgen, E., & van Vliet, T. (2005), op. cit. (ref. 14).
McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Timperley, H. S. (2005a), loc. cit. (ref. 19).

121 Davis, A. (2006), op. cit. (ref. 43).
McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Montes, F. (2002), loc. cit. (ref. 45).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
Davis, A. (2006), op. cit. (ref. 43).
McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).
Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005), op. cit. (ref. 15).
Timperley, H. (2005b), loc. cit. (ref. 51).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
Timperley, H. S. (2005a), loc. cit. (ref. 19).

123 Anderson, V. (1992), loc. cit. (ref. 3).
Baker, S. & Smith, S. (1999), loc. cit. (ref. 40).
Jinkins, D. (2001), loc. cit. (ref. 13).
Pritchard, R. J. (1987), loc. cit. (ref. 23).

124 Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

125 See the studies cited in Section 8.2.4.1.

126 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).

127 Pritchard, R. J. (1987), loc. cit. (ref. 23).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

128 Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).

129 McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 16).
Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 12).
Phillips, G. E., McNaughton, S., & MacDonald, S. (2001), op. cit. (ref. 18).
Timperley, H. (2005b), loc. cit. (ref. 51).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 22).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 20).
Timperley, H. S. (2005a), loc. cit. (ref. 19).

130 Fung, I. Y. Y. (2006), op. cit. (ref. 25).
Pritchard, R. J. (1987), loc. cit. (ref. 23).
Timperley, H., Bertanees, C., & Parr, J. (2004), loc. cit. (ref. 78).

131 Brown, S. & McIntyre, D. (1993). *Making sense of teaching.* Buckingham: Open University Press.

132 Robinson, V. M. J. & Lai, M. K. (2006). *Practitioner research for educators: A guide to improving classrooms and schools.* Thousand Oaks, California: Corwin Press.

133 Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 46).

134 MacIver, M. A. & Kemper, E. (2002), loc. cit. (ref. 44).

9. Reframing Teachers' Social Constructions of Students

We selected this focus as one of the broad categories for this synthesis because it became apparent from our examination of the literature that, at least in some circumstances, improved outcomes for students were associated with teachers thinking differently about the students they taught. The interventions considered in this chapter typically sought to redress some kind of inequality.

9.1 Studies considered

Eight core studies, one of which was actually a group of studies, were included in this category (Table 9.1); all were from the United States and New Zealand. As elsewhere, the core studies are those that met our methodological criteria and had evidence of moderate to high academic and/or social outcomes for students. In one instance, additional material that did not meet our methodological criteria was consulted (the source is bracketed in the table). Five supplementary studies were also included, to shed light on what did not work so well.

9.1.1 Core studies

Two subgroups were identified within the group of core studies. One of these comprised those studies that made explicit the goal of changing how teachers thought about students in terms of their social positioning or their abilities[1]. The second comprised those that focused primarily on the acquisition of some kind of content or pedagogical knowledge, addressing more indirectly the issue of how teachers thought about their students[2].

The second group was not easy to establish because, for interventions such as cooperative learning, such reframing is an underlying principle of the pedagogical approach. In the core studies, heterogeneous grouping was promoted as a way of encouraging teachers to abandon conventional notions of intelligence, to think about it in a more encompassing sense, and to celebrate linguistic, cultural, and ability diversity—or as a way of providing previously marginalised groups with equal access to higher levels of instruction. One cooperative learning study promoted this wider agenda and was included in this chapter; others had a more functional focus—typically to examine the effectiveness of different ways of grouping students using new pedagogical strategies, without reference to the wider social agenda. These studies were not included in our analysis. A brief description of each of the core studies is provided below.

Table 9.1. Reframing teachers' social constructions of students: core studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
1. Alton-Lee et al. (1997)[3]	Gender positioning	Self-esteem	NZ	Regular intermediate
2. Alton-Lee et al. (2000)[4]	Social positioning of disability	Disability as a resource	NZ	Regular primary
3. Bishop et al. (2005)[5]	Te Kotahitanga Social positioning of and pedagogical relationships with Māori students	Essential skills and numeracy	NZ	Regular secondary years 9–10

4. Cohen & Lotan (1997a)[6] (Bianchini, 1997)[7] (Bianchini, Holthuis, & Nielsen, 1995)[8] (Cohen & Lotan, 1997b)[9] (Good, Burross, & McCaslin, 2005)[10] (Cohen, Lotan, Abram, Scarloss, & Schultz, 2002)[11]	Complex instruction – creating equitable classrooms	Academic access and social acceptance for low-status students	US	Regular grades 2–6
5. Moxon (2003)[12]	Restorative justice	Reduction in suspensions	NZ	Regular secondary school (whole school)
6. Phillips (2003)[13]	Success needs to include all students; Innovative curriculum.	Reading, writing, mathematics, science, social studies	US	Middle school
7. Stevens & Slavin (1995)[14]	Reframing expectations of achievement for some students	Reading, language, math, social relationships	US	Years 2–6
8a. Timperley & Phillips (2003)[15] 8b. Timperley & Robinson (2001)[16]	Expectations of achievement from students in low-decile schools; reading	Reading	NZ	Years 0–1, low decile

In the first study (Alton-Lee, McBride, Greenslade, & Nuthall, 1997)[17], referred to as 'the Antarctic study', the principal and teachers from an intermediate school rethought how they depicted gender stereotypes in their teaching materials, looking particularly at a unit about Antarctica. When they reviewed their resources, the teachers were shocked to find that they featured exclusively men: women were invisible. With the assistance of a university professor, the teachers revised their resources and invited women scientists to come and speak to the students. The result was that girls participated in class more confidently. The self-esteem of both boys and girls (as measured by the Coopersmith Self-Esteem Inventory) improved (ES = 0.64 for girls), and the difference between the genders was reduced.

The second study (Alton-Lee et al., 2000)[18] involved a single teacher who had completed post-graduate action research. A theme introduced into the course was the social positioning of students with disabilities. The 'personal tragedy' position treats disability as a problem or deficit located within the individual and which requires 'fixing'; the 'social constructivist' position views disability as a product of social factors that create barriers and limit opportunities for participation. The teacher concerned carried out a further action research cycle to address the marginalisation of a student with spina bifida. The strategy was to replace the personal tragedy framework with a social constructivist framework. As a result, the student with spina bifida came to be viewed by other students as a valuable resource. This study was qualitative, so no effect size was available.

The third study (Bishop, Berryman, Powell, & Teddy, 2005)[19] in this group related to an intervention known as Te Kotahitanga and involved a large number of teachers from 12 secondary schools. The focus was on challenging the pedagogical relationships and social positioning of Māori students in English-medium classrooms in New Zealand. Students collaboratively developed stories about their experiences of school and these stories were used to challenge teachers' ways of thinking about Māori students. The professional development went on to help teachers develop more interactive ways of teaching year 9 and 10 Māori students, with positive outcomes reported, particularly for lower-achieving students, in terms of their learning of essential skills (ES = 0.42 in 2004, and 0.31 in 2005, as measured by the Essential Skills Assessment) and numeracy (ES = 0.76, as measured by asTTle).

The group of Cohen's studies[20] related to the introduction of Complex Instruction as a means to address issues of student equity and diversity and foster higher-level conceptual learning and creative problem solving. Complex Instruction units are built around 'big ideas', use open-ended tasks, and depend on the teacher to make connections and stimulate higher-order thinking. Teachers received two weeks' training with follow-up support. These studies consistently reported substantive outcomes for students, with a particular focus on science (ES = 1.06, as measured by a researcher-developed test).

The fifth study in this group (Moxon, 2003)[21] involved a medium-sized secondary school that was challenged to reduce its high rate of student suspensions and chose to do so by setting out to improve the social and emotional climate of the school through the introduction of a school-wide restorative justice programme. Suspensions decreased from 32.9 per 1000 students in 2000 to 10.4 per 1000 in 2004.

The sixth study (Phillips, 2003)[22] involved student achievement at a Charter school. When teachers examined the achievement profiles of subgroups of their middle school students, they were challenged to address the learning needs of *all* students. Although student achievement was high overall, a large group was not succeeding. The teachers reviewed their practices and introduced a more innovative curriculum designed to better meet the needs of all students. Students showed significant gains in their learning of academic skills when their performance was assessed using the previous year as the baseline (ES = 0.93, as measured by the Texas Assessment of Academic Skills).

The seventh study (Stevens & Slavin, 1995)[23] was a two-year study of the impact on two elementary schools of their adoption of a cooperative school model for school and classroom organisational and instructional processes. Teachers were provided with an understanding of the inclusionary philosophy behind cooperative learning and given training, materials, and follow-up assistance. Compared with the matched controls, the two cooperative learning schools had higher student outcomes in reading (ES = 0.25) and maths (ES = 0.20) for regular students. This was also true for gifted students (ES = 0.39 maths, 0.67 reading), as well as those with special needs (ES = 0.47 maths, 0.81 reading). Social relationships also improved, particularly between students with learning disabilities and their non-handicapped peers (ES = 0.86).

The final study (Timperley & Phillips, 2003)[24] in this category consisted of two related studies. The first[25] explicitly examined how teachers' expectations of students from low-income communities changed as they engaged in professional development related to early literacy acquisition. Much to the surprise of the 26 participating teachers from six schools, new pedagogical approaches led to greater achievement in reading for year 1 students (ES = 0.53). This led, in turn, to teachers having a greater sense of efficacy and heightened expectations of students in their first year of schooling.

The second of these two studies (Timperley & Robinson, 2001)[26] examined three case studies of schools whose teachers had engaged in professional development similar to that in the first study (Timperley and Phillips, 2003). Two of these case studies provided an analysis of how changed expectations could be observed in teachers' practice and their interactions with one another. The other identified why teachers in the third school failed to change their practice after participating in the same professional development as the teachers in the other two schools. This study is included as a contrasting, 'negative' study. As it was a qualitative study, no effect sizes were reported.

9.1.2 Supplementary studies

Four supplementary studies (Table 9.2) that did not meet the criteria for inclusion as core studies were used to inform the conclusions drawn from the core studies. The first[27], comprising three separate studies, was excluded from the core group because insufficient detail was provided on the methodology. It was included as a supplementary study because the school-based changes implemented had a large impact on typically disadvantaged students and because it provided rich descriptive data on what appeared to work for them.

Two other studies were categorised as supplementary because the teachers concerned failed to change their social construction of students, or their interactions, even though it appeared that such change was vital if outcomes for students were to be lifted[28]. The fourth study[29] related to the Teacher Expectations and Student Achievement (TESA)[30] programme—frequently used in the United States for staff development—which was designed to reduce disparities by addressing teacher expectations of low-achieving students. It was included in the supplementary category because the outcomes for student achievement, academic self-concept, and attachment to school were very mixed, with the more robust measures actually indicating a negative effect. Teachers' attitudes to students were not measured directly. These three no-change studies, together with the study referred to in Timperley & Robinson above[31], contribute to our understanding of professional development that does not improve outcomes for students.

Table 9.2. Reframing teachers' social constructions of students: supplementary studies

Study	Focus of PD	Student outcome assessed	Country	School sector/year levels
1. (Ancess, 2000)[32]	Case 1: Providing access to high-stakes math curriculum Case 2: Putting ambitious goals into action. Case 3: Rethinking expectations in terms of learning	Case 1: Course taking and passing rates in math Case 2: Attendance and graduation rates Case 3: Writing, math, college admission rates	US	High schools for at-risk students
2. (Lipman, 1997)[33]	Increased teacher collaboration	Not assessed, no change in teaching	US	Junior high with changing student demographics
3. (Cazden, 1990)[34]	Reducing differential treatment of Māori students	Not assessed, no change in teaching	NZ	Primary
4. (Gottfredson et al., 1995)[35] (Kerman, Kimball, & Martin, 1980)[36]	Teacher expectations	Reading, math, academic self-concept, and attachment to school	US	Grades 1–5

9.2 *What works for whom in reframing teachers' social construction of students*

This section synthesises the evidence from the studies that addressed how teachers thought about their students in terms of social positioning, their inclusion in the full range of classroom activities, and their own expectations of student achievement. The section is structured according to each of the aspects of the framework in Figure 4.2: context, professional learning environment, content and activities, and teachers' reactions.

9.2.1 The context of the professional learning opportunities

In this section, we identify aspects of the contexts of the professional learning opportunities that appeared to contribute to changing teachers' social constructions of students in ways that led to positive outcomes for students (Overview 9.1).

Overview 9.1. The context of the professional learning opportunities

Infrastructural supports

- There was no evidence of a clear relationship between infrastructural supports (such as funding and release from class) and successful outcomes for students.

  What was important was how any additional time and funding were used.

Voluntary or compulsory

- Volunteering was associated both with interventions that had substantive impact and with others that had low or no impact.
- In many core studies, schools volunteered but teachers did not.

  What was more important than volunteering was that teachers engaged in the learning process at some point; a prior commitment to engage was not necessary.

Expertise

- The interventions in all the core studies made use of expertise external to the group of participants.
- This expertise was provided either by someone from outside the school or by a high-status person from within the school who was prepared to challenge the status quo.

Leadership

- In the school-based core studies, leaders were involved in the professional learning even when they did not have relevant expertise.

Prevailing discourses

- Where prevailing discourses were problematic, they were typically based on the assumption that some groups of students could not or would not learn as well as others.
- In successful interventions, these discourses shifted, with teachers taking more responsibility for promoting student learning.

Time

- Professional development that had substantive impact on student outcomes took place over a relatively long period: from six months to five years.

  But participation for an extended period was not a guarantee of success.

  It was important that professional development challenged existing assumptions and provided alternative pedagogies that were better able to meet the needs of students.

Professional learning goals

- Successful interventions had explicit professional learning goals. In some, teachers' existing social constructions of students were challenged directly; in others, indirectly, with the professional development focusing on raising achievement through alternative pedagogical approaches.

9.2.1.1 Infrastructural supports

The first aspect of the context to be considered was provision of infrastructural supports such as funding and release time. As far as we were able to ascertain, in most of those studies that involved a year level or a whole school[37], a reasonable amount of release time was provided for participating teachers. In those interventions that involved one or two teachers, no release time was made available[38]. However, the most generous provision of all (two hours per day) was found in the intervention[39] that led to no evident change in teacher practice or attitudes during its year-long implementation period: generous provision of time does not necessarily lead to positive outcomes for students. As for our analysis of curriculum-based professional development (Chapters 6–8), what mattered was what happened during the time made available, and how any additional funding was used.

9.2.1.2 Voluntary or compulsory

In most of the studies where part or all of a school was involved, the school opted in voluntarily, but there was usually some form of pressure on teachers within the school to participate. The high rate of school-level volunteering may be an artefact of the high proportion of New Zealand studies in this category, as New Zealand schools are rarely compelled to participate in professional development activities. In the study involving the individual teacher[40], the professional learning arose out of an action research project that was part of postgraduate studies, and a financial incentive to upgrade qualifications had been offered. But two of the unsuccessful studies[41] also involved volunteer teachers, so volunteering cannot be considered a condition for success. A more important condition than initial volunteering was whether, over the time of engagement in professional learning, teachers were able to see that changed practices were having a positive impact on their students.

Initial volunteering is no guarantee that enthusiasm won't wane when serious challenges are made to teachers' existing assumptions about students and how to teach them effectively. In Timperley and Phillips[42], for example, teachers were initially hopeful about learning new skills for teaching early literacy but became sceptical and resentful of facilitator challenges to their beliefs about students and the expectation that they needed to change their practice substantively. As they learned more about the alternative approach to teaching literacy and students' achievement began to improve as a result, most of the participating teachers engaged with the key ideas and became more willing to change their practice.

All the secondary school interventions involved cross-disciplinary cooperation. Yet getting secondary schools to buy in to an inter-disciplinary approach can be a major challenge because of what has been described as the 'Balkanisation' (compartmentalisation by subject area) of the curriculum at this level[43]. A supplementary study describes how one principal[44], when introducing ambitious achievement goals for students who would traditionally be considered 'at-risk', managed to get cross-disciplinary cooperation going by starting with a small group of volunteers and working outwards from there (Box 9.1).

Box 9.1. Getting buy-in across a secondary school

The initiative described in this high school study used the volunteer principle in a slightly different way. It was started by the principal and a small group of teachers who realised that they needed to change the curriculum and the teaching approach if they were to be successful in improving outcomes for their at-risk student population. These teachers were organised into a self-contained unit. At the end of the first year, the improvement in student outcomes became evident. The results were given wide publicity and the target students were able to present their work and their experiences in the programme to other faculty members. These teachers were impressed with the authenticity of the students' responses to their questions. After some years, the majority of the faculty voted to restructure the school into autonomous, interdisciplinary teaching teams. Some teachers did continue to oppose the reform, so the principal clustered them together and worked with them intensively to support their development while ensuring that they did not burden or distract their more engaged colleagues.

9.2.1.3 Engagement of expertise

All the successful core studies involved someone with expertise from outside the school who was prepared to challenge the ways in which teachers thought about their students. As noted above, in one of the supplementary studies, this expertise came from the principal[45]. Cohen's work on Complex Instruction[46] has demonstrated the value of having the support of experienced educators with a research background in social science or psychology. But the best of expertise—whether internal or external—can be negated when school leaders conspire with their teachers to maintain the status quo[47] or when teachers support one another to resist change[48] (see Box 9.2).

Box 9.2. Maintaining the status quo

In response to pressure from the school district to integrate African-American students into a predominantly white school, a group of teachers were given two hours release per day over a year-long period to plan collaboratively so they could better meet the needs of these students. Over the year, they focused less on how their practice might be contributing to poor outcomes for students and more on perceived student shortcomings. The only African-American teacher in the group, who could see how this discourse and consequent teaching practices were impacting negatively on the students, was increasingly marginalised and eventually shifted to work in a non-academic stream. Her expertise was discounted and nothing changed for the students in the other teachers' classrooms.

9.2.1.4 Leadership

School leaders were involved in the professional learning in all the school-based core studies. In one supplementary study (noted above[49] and see Box 9.3), the principal led the professional learning. In others, school leaders participated as learners[50]. Sometimes leadership was shared with other staff but, in such situations, the leaders themselves did not abdicate responsibility. In the studies related to Complex Instruction, Cohen[51] noted that producing equitable classrooms requires schools to change the way they are organised, so naturally, leaders must be involved. The successful introduction of equitable classrooms requires changes in the curriculum and changes in the school. One school discovered that the high average achievement of its students as a whole disguised the low achievement of a large group[52]. Box 9.3 describes how the principal got his teachers to accept responsibility for developing more demanding curricula for their under-served students.

Box 9.3. Showing leadership

In a school that catered well for its higher-achieving students but poorly for its lower-achieving students, the principal wanted to create a leadership team that used its classroom knowledge as a starting point. He said to the teachers:

"Now guys, don't think I don't know what you're going through. I was there, and I'm as guilty as the rest of you. But we've got to make it a priority. Now let's talk about how we're going to do that. Let's get a plan of action to shift this focus more to the classroom" (p. 252).

This principal also provided teachers with a non-contact period for professional learning. He did not dictate what should occur during this time, but did require the teachers to keep diaries of what they had learned (not what they had done). He also kept a diary himself. In this way, he was able to have an ongoing professional learning dialogue with the teachers during the change process.

9.2.1.5 Prevailing discourses

Prevailing discourses were identified from the New Zealand studies (insufficient information was reported in those from the United States). These New Zealand studies found that teachers were typically unaware of the impact of their prevailing discourses on the way they thought about and taught students. It was only when these discourses were challenged during professional learning that they developed this awareness. The prevailing discourse of the teacher in Alton-Lee's study on the positioning of disability[53], for example, came from the 'personal tragedy' position, where disability is thought to be a problem or deficit located within the individual and in need of 'fixing'. Operating within this discourse, students with disability are treated in a compensatory—rather than educational—way. The teacher's shift in discourse was the result of being exposed to a social constructivist model, which interpreted disability as the product of social factors that created barriers and limited opportunities for equal participation. How this alternative way of thinking changed the way in which the teacher worked with her student is described in a case study found in Appendix 1.

In the Antarctica study[54], teachers were shocked to realise that their referents and resources were all male-oriented: women were invisible; it appeared that only men broke the exploratory and scientific frontiers of Antarctica. Once they became aware of this bias, the teachers reconstructed their resources. They also invited a woman scientist and expedition leader and a young conservationist who had worked in Antarctica to speak to the students.

In other studies[55], the problematic prevailing discourses were typically focused on assumptions about what students could not or would not learn or do. Instructional practices and classroom discourses were based on these assumptions in ways that were at times detrimental to teacher–student relationships. Successful interventions either challenged such discourses directly or showed teachers that their students could learn if taught differently. The result was that prevailing discourses shifted from blaming students and their parents, and teachers became more focused on how to teach their previously-failing students. Box 9.4 shows how expectations changed for teachers in the early literacy intervention.

Box 9.4. Changed expectations

When teachers were asked, prior to the professional development, about the relative influence of community, whānau/family, and teachers on student achievement in schools situated in low-income communities, most focused on problems with the children or their families. Their ideas included:

"The children come to school with limited experiences."

"A lack of oral language."

"Lack of interest from parents/caregivers."

After the course, they indicated a greater willingness to examine the influence of their own practice. At this point, their responses included:

"We don't know how to teach them to read effectively."

"Sometimes the strategies/methods of how to deal with English as a second language children are not there."

"Teacher/school expectations."

9.2.1.6 Time

In all the core studies, exposure to new ideas and practices took place over a considerable period, from a minimum of six months through to several years. Intensive initial input was typically followed by further, spaced opportunities to learn. Even extended time frames did not, however, necessarily lead to the required changes in beliefs or practices if the expertise engaged did not challenge the status quo[56] or if leaders helped to reinforce it[57].

9.2.1.7 Professional learning goals

All the interventions documented in the successful studies had explicit professional learning goals that related directly to student outcomes. These typically included mastery of alternative pedagogical relationships to change the nature of interactions both between students and between students and their teachers. Some goals focused very directly on achievement[58], while others focused on pedagogical relationships designed to improve student participation, achievement, and other social outcomes[59].

In the study on the introduction of restorative justice[60], for example, the goal was for teachers to interact differently with students in order to reduce the number of suspensions and stand-downs in the school. A shift in thinking located the cause of behaviour problems in relationships rather than individuals and led to teachers addressing them in ways consistent with this orientation. Relationships were the key to improvement rather than the implementation of a 'tough love' policy.

9.2.2 The content of the professional learning opportunities

In this section, we synthesise the evidence concerning the content of the professional learning opportunities provided to teachers. 'Content' covers both what was new and that which served to deepen knowledge and refine skills. The key points are summarised in Overview 9.2.

Overview 9.2. The content of the professional learning opportunities

Integration of theory and practice

- In all the core studies, the interventions involved the acquisition of new understandings and skills related to alternative pedagogies and ways of interacting with students. These were presented in terms of the theoretical principles that underpinned them, together with a clear rationale for why the alternatives being put forward were more effective for particular groups of students.

Identifying problems in the teaching–learning relationship as a motivator to engage

- Each core study identified a specific problem in the teacher–learner relationship that needed to be addressed if outcomes for students were to improve.

A new vision for teaching and learning

- A rationale for change, often accompanied by practical examples and evidence of better outcomes, formed the basis for a vision of what might be possible for particular groups of students.

Social constructions of students and relationships

- Some of the interventions in the core studies explicitly addressed how teachers' social constructions of students influenced teacher–student relationships and how alternative pedagogies and ways of interacting communicated different social positions.

Negotiating meaning

- Alternative pedagogies all focused on providing improved opportunities for students to construct meanings of concepts taught and professional development was consistent with this approach. Pedagogical approaches were usually embedded in understandings of how students learn.

9.2.2.1 Integration of theory and practice

It was noteworthy that, in all the interventions documented in the core studies, the understandings and skills presented were strongly grounded in specific theoretical principles. These principles came with a clear rationale for why the alternative pedagogical relationships were more effective for particular groups of students. Teaching strategies were then presented in terms of these principles. There was no theory/practice divide. In Boxes 9.5 and 9.6 respectively, we outline how this was done when introducing cooperative learning into two schools[61], and restorative justice into a high school[62].

Box 9.5. A clear rationale for introducing cooperative learning

Before teachers were asked to introduce cooperative learning into their schools and classrooms, the benefits of doing so were explained: cooperative learning provides all students with more active learning experiences, equal access to learning, and a more supportive social environment—which also benefits teachers. Then, using cooperative learning strategies, the teachers were shown how to translate the principles into pedagogical practices.

Box 9.6. A clear rationale for introducing restorative justice in the school

In the case of the school that set out to reduce suspensions through the introduction of restorative justice, it was the locating of problems in relationships rather than individuals that helped teachers to understand the implications for their own practice. Demonstrations of the kinds of interactions that would promote reconnection with students and build or enhance teacher–student relationships made sense within this theoretical framework.

9.2.2.2 Identification of problems with the teaching–learning relationship as a motivator to engage

In all the core studies, it was identification of outcomes issues or problems in teacher–learner relationships that provided the basis and motivation for change. Sometimes, problems in learning outcomes were revealed when student achievement data was disaggregated[63]. In these studies, it was the examination of the data that helped teachers identify individuals or groups of students who were not achieving well, and/or teaching practices that were not having the desired impact. And it was the identification of these patterns that gave teachers the motivation to learn how to do things differently. The process, however, led nowhere if teachers or their leaders explained away the problems revealed in the analysis by attributing them to the students, their homes, or their communities. Such external attribution was evident in studies of two interventions that resulted in no change in outcomes for students[64]. To act as a motivator for change, the focus needs to be on the relevance and implications for teaching of all information about students and their learning. Box 9.7 shows how achievement data can be disaggregated by student group[65]. In Box 9.8, the data on students' early literacy skills were disaggregated, revealing a programming emphasis on basic rather than advanced skills[66].

Box 9.7. Disaggregating data by student group

Teachers in an urban middle school in the United States believed that they were catering well for their students. Two-thirds of the students were enrolled in the 'magnet' programme, which had produced many distinguished graduates. The principal said, "The big picture looked beautiful; it was wonderful." But disaggregation of data by student group revealed considerable disparities between the achievement of the 'magnet' students and the 'regular' students, producing what the principal described as a "notion of discomfort".

Box 9.8. Disaggregating data by basic and advanced literacy skills

The professional development began with the facilitator working with the teachers to disaggregate reading assessment data for students at the end of their first year at school. Assessments had been done of letter identification, letter–sound relationships, word identification, concepts about print, writing vocabulary, and text reading. Compared with other students nationally, students from these low-decile schools did well on the lower-level skills but were well below national norms for the higher-level skills of writing vocabulary and text reading. Teachers were asked to think about the emphasis they gave to these different skills in their programmes. They discovered that what they had emphasised, their students had learned; what they had paid less attention to, their students had failed to learn so well. Unfortunately for the students, it was the higher-level skills that had been neglected.

The systematic collection of data in relation to the implementation of Complex Instruction[67] went beyond simply looking for evidence of achievement and learning. Cohen encouraged participating school leaders to go into classrooms and see how Complex Instruction was working, to find out what the teachers were having difficulty with, and which features of the approach were connected to learning outcomes.

It is not only student achievement data that can be used to identify problems in ways that serve as a motivator for change. In the Te Kotahitanga[68] study, designed to improve the pedagogical relationships between teachers and students in New Zealand secondary schools, the data comprised stories from engaged and disengaged students and from parents/whānau, principals, and teachers. Box 9.9 describes how the project used these stories to challenge teachers' social construction of students. More details are provided in the case study Establishing a Culturally Responsive Pedagogy, found in Appendix 1.

Box 9.9. Collaborative stories as data

In order to constructively engage teachers in rethinking their deficit theories, Te Kotahitanga employed a kaupapa Māori strategy of 'collaborative storying', which sought to authorise the various participant voices in a particular situation. Early in the professional development experience, teachers were presented with stories that had been compiled during an earlier phase of the project. These stories came from students (both engaged and non-engaged), their parents/whānau, principals, and teachers and concerned the influences on students' educational engagement and achievement. There were marked differences between the descriptions of daily realities provided by the students themselves, those parenting them, principals, and teachers. The extremes were represented by the teachers and the students.

Teachers attributed the difficulties experienced by Māori students to personal deficiencies. They pathologised the daily experience of Māori students—many believing that Māori learners were simply less capable of educational achievement because of limited language skills and poor home backgrounds. But the students' powerful stories focused primarily on their classroom experiences and their relationships and interactions with teachers. They recounted the negative attitudes and beliefs they experienced, and their sense of being excluded when teachers mispronounced their names and Māori words. They were also able to identify positive relationships—with teachers who knew and trusted them and made an effort to know them as Māori. In addition, they described how their achievement could be enhanced through a range of alternative pedagogical approaches that essentially were more discursive and inclusive than the expert—novice transmission model that was their experience in many classrooms.

Generalised problems, not located specifically within a teacher's practice context, did not appear to be enough to provide motivation for changes that impacted on students. For example, in the TESA intervention, which had little effect on achievement[69], no specific problem was identified within the participating school other than that it was desirable to have high expectations of students so that they should not be disadvantaged.

9.2.2.3 New vision for teaching, learning, and relationships

Problems identified from student data are more likely to be accepted as important and relevant to the teaching–learning relationship if teachers can envision an alternative and have the confidence that they will be appropriately supported to make the necessary changes. If these conditions are not met, teachers are likely to feel blamed. Under these circumstances, it is natural to look to external causes for explanations of learning and social problems. In the core studies, alternative visions were provided in a number of ways. In the Antarctic study[70], teachers could see how they could be more inclusive of women in their unit on Antarctica. In the study about the positioning of disability[71], the teacher could see how a child with spina bifida could be a resource for her year 1 students. In Te Kotahitanga[72], a more discursive teaching model, identified by Māori students as effective in promoting their learning, was presented to and studied by teachers during a marae-based hui[73]. Teachers in the schools adopting cooperative learning strategies[74] were shown how to use such strategies to promote the social and academic inclusion of students with learning disabilities. Box 9.10 illustrates how a new vision of reading acquisition was presented[75].

Box 9.10. Presenting a new vision

The facilitator used a series of video clips to show a group of teachers how to accelerate the acquisition of basic reading skills. These clips showed a child whose initial skills were similar to those of the students from these teachers' low-income communities. Using the approach about to be presented in the professional development, the clips went on to show how the student's reading progress was accelerated over the course of a few teaching sessions. The teachers were surprised and became interested in learning more about this approach to teaching literacy.

9.2.2.4 An emphasis on pedagogical relationships

One of the distinguishing features of this category is that all the core studies showed explicitly or implicitly how teachers' perceptions of students—in terms of who they were and what they should be learning—were reflected in their relationships with the students, and the content of what they were offering. A change in pedagogy also meant a change in relationships, and, at times, curriculum content. Cooperative learning[76], for example, was promoted as a way to include students with learning disabilities in regular classroom activities and, in doing so, to expose them to more cognitively demanding material.

If changed pedagogical relationships are to result in changed achievement, teachers may need to understand the curriculum in greater depth so that they can teach it differently. In the professional development associated with Complex Instruction[77], teachers examined the curriculum in depth because it was a central premise of the approach that more demanding curriculum content should be made available to students who had typically been exposed to low-level, less demanding curricula. Improved relationships in the context of an impoverished curriculum are unlikely to have much impact on student outcomes.

Although nearly all the core studies focused on the teaching–learning relationship, the study that described the introduction of restorative justice[78] into a school showed that a change in relationships could also impact on student behaviour, both inside and outside the classroom.

9.2.2.5 Constructing meaning

Most of the core studies documented pedagogical shifts that required teachers and students to jointly construct meanings for curriculum content. This process was promoted through group work[79] and/or interactions with teachers[80]. This emphasis on negotiating meaning and implications for practice contrasts with the professional development programme that aimed to increase student achievement through raised teacher expectations[81], yet had outcomes that were more negative than positive. This programme focused on three strands of prescribed teacher behaviours: equitable distribution of response opportunities across high- and low-achieving students, positive personal feedback, and personal regard focusing on proximity, courtesy, and personal interest. The lack of emphasis on improving the quality of curriculum content may partly explain the lack of impact of the professional development. If student outcomes are to be improved, prescription of particular affective-type teaching behaviours cannot be divorced from teaching and learning content.

9.2.3 Activities constructed to promote the professional learning

Professional learning opportunities were often described as workshops, coaching, etc. The documentation typically provided nothing more than a superficial analysis of the activities that were effective or ineffective. In this section, we synthesise the evidence (such as is available from these studies) concerning the types of activities likely to promote professional learning in ways that were intended by the provider. (See the summary in Overview 9.3.)

Overview 9.3. Activities constructed to promote the professional learning

Professional instruction followed by multiple opportunities to learn

- The interventions described in the core studies all involved instruction from someone with appropriate expertise. This person provided theoretical overviews on particular teaching approaches or the social positioning of students and challenged existing assumptions.
- Instruction was accompanied by multiple opportunities for teachers to construct meaning, to develop a deeper understanding of theory—practice links, and to compare new and existing theories.

Activities that integrated theory and practice

- Teachers were provided with opportunities to practise what they had learned, discuss problems that arose in terms of theory—practice linkage, and deal with challenges to their existing assumptions. These were then followed by further opportunities to learn and practise.

Examining student outcomes and understandings

- The interventions described in the core studies helped teachers to examine how their practice impacted on their relationships with students and/or their students' understanding of the curriculum.

Participation in professional communities

- In all the core studies that involved two or more teachers, the teachers formed or were part of a professional community in which they planned collaboratively and examined the impact of their practice on students.

  Collaborative planning may be necessary for improving student outcomes but it is not sufficient, particularly if teaching–learning links are not a primary focus.

9.2.3.1 Professional instruction followed by multiple opportunities to learn

In each of the interventions described in the core studies, the professional development provider presented the underpinning theoretical principles. These principles related to pedagogical practices, the social positioning of particular groups of students, or teacher–student relationships. Following this presentation, teachers were given multiple opportunities to learn, via activities such as discussing changes in teaching practice with more expert colleagues or the facilitator[82], watching a video demonstration or modelling of practice, or being observed and receiving feedback[83].

During the introduction of the restorative justice programme, for example, an external facilitator led teacher workshops that covered the principles and practice of restorative justice. These workshops were followed by a series of in-school staff meetings at which key concepts were discussed and ways of connecting/reconnecting with students through restorative conversations demonstrated and practised. Teachers who found themselves in challenging situations where students exhibited serious behaviour problems received coaching and ongoing support from specialist staff as they learned to engage with students on the premise that relationships were the issue.

The importance of such continuing support was evident in an early phase of Te Kotahitanga[84]. Some teachers attended the initial marae-based part of the programme but did not get ongoing support in their schools. These teachers failed to implement the key features of the effective teaching profile, even though they had expressed the intention to do so at the completion of the initial phase. It appears to be too difficult to change practice in such fundamental ways without ongoing support.

9.2.3.2 Activities that integrated theory and practice

As noted in the section on the content of the professional learning opportunities, theory and practice were closely integrated. The professional learning activities documented in the core studies focused on this integration, rather than on a set of teaching strategies divorced from theory. Box 9.11 provides an example from the study relating to early literacy acquisition[85].

Box 9.11. Integrating theory and practice

Early in the series of ten half-day sessions, the teachers of emergent readers were presented with a key theoretical concept that underpinned the approach to teaching reading. This idea was that to be successful emergent readers, children needed to understand the author's message, and that teaching approaches needed to provide young readers with the skills and understandings to do this. This idea contrasted with many of the teachers' own ideas; they typically defined success for emergent readers in terms of the acquisition of a set of itemised skills such as recognising letters, making letter—sound connections, and learning a set of basic words.

The new teaching methods were deliberately framed as an 'approach' to teaching reading—rather than a 'programme' for teaching reading—to underline the importance of understanding the rationale for why particular strategies should be used at particular times. Teachers learned how to observe students closely from this theoretical perspective so that they could judge when the students had acquired key skills and were ready to move on to further skills that they would need in order to understand the authors. Demonstrations were provided to illustrate how to put theory into practice. At workshops, teachers were invited to discuss issues they were struggling with and were encouraged to continue these discussions between workshops, in their school-based professional communities.

9.2.3.3 Examining student outcomes and understandings

Having seen the value of data for identifying student learning or relationship problems, the teachers in most of the core studies continued to monitor the impact of their teaching and interactions on students in some way. In those studies that involved two or more teachers, the skills to monitor this impact were typically part of the professional development. This ongoing monitoring allowed the teachers to continually refine their practice.

In the study that concerned the construction of disability[86], the teacher herself developed a monitoring technique that allowed her to understand how the inclusion in the group of a boy with spina bifida was impacting on five-year-olds' perceptions of disabilities. This teacher creatively adapted a 'thinking books'[87] approach, which she had encountered during her postgraduate course, asking her students to draw their experiences and reflections. As the case A Needs Analysis Approach (Appendix 1) illustrates, in early drawings the boy with spina bifida was depicted as marginalised and insignificant. As the unit of work progressed, he was depicted as a more central character.

A contrasting study was the study of teacher expectations[88], in which change was initiated through the prescription of a set of preferred teaching behaviours. This time the provider was less successful in impacting on teacher expectations or student achievement. Examining the impact on students was not part of the process, so teachers were not focused on monitoring whether their changed behaviour was having the desired effect. Peers were encouraged to observe each other and monitor particular behaviours but this monitoring did not extend to observing how these behaviours were affecting students.

9.2.3.4 Participation in professional communities

Participation in professional communities that provided opportunities for teachers to plan and negotiate the meaning of new knowledge and skills was reported by all the core studies that involved two or more teachers. It was also reported by two of the studies[89] that found no change to student outcomes, indicating that while such participation may be a necessary condition for professional learning it is not enough to ensure improved outcomes for students.

A feature of the professional communities documented in the core studies was that some kind of data was accepted by teachers as an indicator of progress towards desired goals. Such data variously comprised desired teaching practices[90], indicators of relationships with students[91], and achievement outcomes[92]. A second feature was the presence of a leader who was prepared to challenge the meanings that teachers attributed to the data, along with their assumptions about teaching practices, relationships, and/or achievement. A third feature of these professional communities was an unrelenting preoccupation with teaching–learning or teacher–learner connections. Desired changes in teaching practice or ways of interacting were always referenced to their impact on students.

By way of contrast, the teachers involved in the professional development that set out to improve outcomes for African-American students were allocated generous amounts of time for planning and discussing practice with colleagues but made few changes to their practice[93]. In this situation, the effectiveness of teacher deliberations was never referenced against outcomes for students—either in terms of relationships or achievement—and teachers continued to attribute particular student behaviours to deficits located within the students. This allowed the effectiveness of teaching practice to remain unexamined. Similarly, in the school where no change in teaching practice or student outcomes was apparent despite extensive professional development in early literacy[94], participation in the professional community only served to reinforce existing thought and practice. The teachers and their leader refused to accept that student learning might be accelerated if they taught higher-level skills, despite the progress of similar students in the other participating schools. Without any reference to comparative student outcomes, teachers continued to assert the belief that their programme was more effective than the alternative approach.

9.2.4 Learning processes

Only the New Zealand studies have been included in this section because those from the United States reported insufficient detail on the learning processes for any conclusions to be drawn. The synthesis of the evidence from these New Zealand studies is summarised in Overview 9.4.

Overview 9.4. Learning processes

Creating dissonance with current position (values and beliefs)

- The interventions documented in the New Zealand core studies all challenged existing assumptions about relationships, pedagogy, and/or students and their achievement.
- Those teachers whose student outcomes improved resolved the dissonance, reconstructed practice, and repositioned their relationships with their students and/or students' relationships with each other.

New information

- In all the core New Zealand studies, provision of new information and of theoretical understandings consistent with the new position was part of the professional learning opportunities.

Consolidating prior knowledge

- Cueing, retrieving, and consolidating prior knowledge only was a feature of those studies in which there appeared to be no change in student outcomes.

9.2.4.1 Creating dissonance with current position

The interventions documented in this group of studies presented teachers with considerable challenges. It is not surprising that these created dissonance—a function of the gap between teachers' current views of teaching, students, and/or learning and those being advocated in the professional development. In situations where there were entrenched learning and achievement problems—as was the case in many of these studies—something quite fundamental needed to change if the targeted students were to learn more effectively. Creating dissonance that could lead to fundamental change was the purpose of many of the professional learning opportunities provided.

In some interventions, the awareness of a powerful theory played a major role. Sometimes the theory challenged existing beliefs, as was the case for the teacher who enrolled in the action research course and found herself confronted with the impact of her own well-meaning construction of disability as personal tragedy[95]. At other times, the theory opened up new possibilities for addressing an acknowledged problem, as was the case in the introduction of the restorative justice programme in a New Zealand secondary school[96].

In yet other interventions, dissonance was created by unexpected outcomes for alternative teaching practices. This was the case[97] where teachers were shown how alternative teaching approaches could lead to accelerated reading progress for young students from low-income communities. When they employed the alternative approach in their own classrooms, they could see the rapid progress of their students and became convinced of its efficacy. In each of these interventions, a key to their impact was a shift in teacher perception—from one that saw student underachievement as the result of external forces to one that recognised the considerable influence teachers had over outcomes for students.

Other interventions created dissonance through the use of data, particularly where data documented the unintended consequences for their students of teachers' current practice and positioning. In one study[98], the stories of engaged and disengaged Māori students assisted teachers to think about how they interacted with their own Māori students and how those interactions impacted on their relationships. In another, a survey of teaching resources for a unit on Antarctica highlighted the unintentional invisibility of women in the curriculum and the impact this had on both boys' and girls' valuing of women and on patterns of participation[99].

In all these cases, the teachers were given multiple opportunities to learn and to change. As part of the professional learning, new information was provided for the purpose of deepening understandings and refining skills consistent with the new position. Blame did not appear to be a feature of any study.

The interventions in the core studies stand in contrast to the interventions in the three studies that failed to impact on teaching practice[100] or student outcomes[101]. It appears that in none of these latter studies was any kind of dissonance created for the participating teachers. In one of them[102], the teachers continued to believe that the causes of student learning problems resided solely with the students and their families. The contribution their teaching was making to the problem remained unexamined. In another study[103], teachers were presented with a set of desirable behaviours that they were expected to implement in order to give more equitable opportunities to students, but there was no evidence that their assumptions about students or teaching were challenged as part of the process.

9.2.4.2 Teachers' responses

Most of the core studies provided some evidence that teachers actively engaged with the new ideas presented and changed their practice to a greater or lesser extent. None of the interventions documented appeared to take place in a situation where there was high-stakes accountability or an environment focused on compliance, so it is reasonable to assume that engagement and change were outcomes of the professional learning rather than compliance demands.

Creating dissonance and keeping those experiencing it engaged is not without its risks—it could be likened to walking a tightrope. Rejection of new ideas is a likely outcome if teachers are taken too far out of their comfort zone. This is illustrated by the study in which teachers refused to adopt the new ideas promoted in professional development workshops on early literacy teaching[104]. In fact, the teachers at the school concerned actively rejected the approach advocated. In research interviews they individually and collectively asserted the superiority of their current programme over the recommended alternative.

A second feature of the responses of the teachers in this group of core studies is the frequency with which the structured professional learning included the development of self-regulatory skills: targets were set for students, and teachers learned how to self-monitor and receive feedback. These monitoring and self-regulatory processes were as varied as the studies themselves and included using thinking books as a means for five-year-olds to record their reflections on their learning[105], monitoring beginning students' reading levels[106], and monitoring the number of students suspended from school[107]. The frequency with which self-regulatory learning was reported in these studies may reflect the fact that the original motivation for the professional development arose out of student difficulties: there was an immediate and urgent problem to solve. Under these circumstances, it is likely that the participants would want to see if changed practice was in fact contributing to a solution.

9.3 Bringing it all together

The remaining challenge of this section is to conclude by summing up what works, for whom and why, and under what circumstances. We begin by noting that the students who benefited from the professional learning and development in the interventions documented in these studies were typically those who were socially and academically marginalised. There was no evidence, however, that their more advantaged peers were disadvantaged in any way as a result of the resulting changes in practice—most often, they were similarly advantaged.

In many respects, the changes required of teachers in this group of studies were a bigger 'ask' than those in any other group, so it is not surprising that the professional development took place over an extended period of time, with multiple opportunities to practise, receive support, and continue to be challenged. Teachers needed this extended time to migrate from their earlier positions and prevailing discourses, understand the new position in sufficient depth to learn new pedagogies and approaches consistent with it, and develop the self-regulatory skills needed to ensure that identified problems were on the way to being solved. This required teachers to construct new meanings for the teaching–learning and teacher–learner relationships. Not surprisingly, one-off professional learning events, even if they lasted several days, were not enough to develop new understandings in sufficient depth to change practice in ways that impacted positively on students. As Cohen warns, "Beware of people who claim that they have a simple solution that will achieve this goal [of an equitable classroom] without extensive staff development, change in curriculum, and change in the school" (p. 3)[108].

Engaged leaders were also a feature of these studies. It is not surprising that teachers making major changes to their practice needed to know that their leaders understood what was required and to be encouraged by them to make changes. When leaders acted to reinforce the status quo rather than challenge it, teachers were quick to do the same.

In all the core studies, it was a problem in search of a solution that motivated teachers to engage in professional learning. Problems were typically framed in terms of the impact of teaching interactions and practice on students and provided the rationale for change. The problems were not always apparent up front—sometimes they became so through engagement. Professional development providers typically structured their learning opportunities in ways that would bring such problems to the surface.

Teacher engagement and understanding was expected at both a theoretical and practical level. No intervention offered teachers 'handy hints' to implement as they wished. Instead, a deep theoretical understanding was demanded and teachers were given opportunities to translate this theory into classroom practice.

By contrast, the study by Gottfredson et al.[109] of the Teacher Expectations and Student Achievement (TESA) programme in the United States—a programme that provided teachers with a set of techniques designed to raise their expectations and reduce disparities—is illustrative of what does not work particularly well, and why[110]. Yet TESA is "one of the most-used offerings in staff development programs across the country"[111] (p. 42). Despite the popularity of the programme, student outcomes as reported in this study were very mixed. Most of the students on the receiving end of the programme actually scored less on a range of measures than those in a neighbouring school whose teachers did not receive the professional development.

Our analysis revealed important differences—both in content and process—between the TESA programme and interventions documented in the core studies that had substantive impact on students. Firstly, teachers in the TESA programme were not presented with a problem in need of a solution from their own practice context, other than the generalised finding that low teacher expectations could disadvantage low-achieving students. Whether the participating teachers did, or did not, disadvantage their students in the ways assumed was never established. There was, therefore, no urgency to solve an immediate problem of practice grounded in an analysis of the impact of the participating teachers on their students. Nor were teachers presented with a challenge to examine their existing assumptions and practices. They were all volunteers so it was likely that they wanted to maximise learning opportunities for their low-achieving students. What was missing was an analysis of the extent to which their current practice advantaged or disadvantaged the students they taught. Given that the providers were committed to training the teachers in new teaching techniques, it can be assumed that they believed current practice to be problematic in some way.

Secondly, the content of the professional learning opportunities comprised a set of discrete teaching techniques. Although a rationale for these techniques was provided as part of the professional development programme, they consisted essentially of a set of behaviours which teachers were expected to implement. Despite the name of the programme, teachers' expectations of students were not addressed directly or indirectly, nor did the professional development programme include the acquisition of inquiry skills that teachers could use to assess how the new teaching behaviours and/or the old behaviours were impacting on their students' learning. Other approaches that prescribed what teachers should do without equipping them with the skills to inquire into their impact were similarly ineffective in changing teachers' practice in ways that impacted positively on students[112]. As the authors[113] of the TESA study note, "'mere training' is insufficient to produce meaningful change in schools." We would add, mere training is insufficient particularly when an issue as complex as teachers' social constructions of students is to be addressed.

References

1 Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997). *Gendered discourses in social studies: Intermediate students' learning and participation during studies of Antarctic work and survival focused on women.* Report to the Ministry of Education. Understanding Learning and Teaching Project 3. Wellington: New Zealand Ministry of Education.

Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education, 4* (3), 179-210.

Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream education. Phase 2: Towards a whole school approach* (Progress report and planning document). Wellington, New Zealand: Ministry of Education.

Cohen, E. G. & Lotan, R. A. (1997a). Creating equal status interaction in heterogeneous classrooms: Evidence from complex instruction. In R. Ben-Ari & Y. Rich (Eds.), *Enhancing education in heterogeneous schools* (pp. 249-280). Israel: Bar-Ilan University Press.

Stevens, R. J. & Slavin, R. E. (1995). The cooperative elementary school: Effects on students' achievement, attitudes, and social relations. *American Educational Research Journal, 32* (2), 321-351.

2 **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

Timperley, H. & Phillips, G. (2003). Changing and sustaining teachers' expectations through professional development in literacy. *Teaching and Teacher Education, 19*, 627-641.

Timperley, H. & Robinson, V. M. J. (2001). Achieving school improvement through challenging and changing teachers' schema. *Journal of Educational Change, 2* (4), 281-300.

3 Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

4 ibid.

5 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

6 Cohen, E. G. & Lotan, R. A. (1997a), loc. cit. (ref. 1).

7 Bianchini, J. (1997). Where knowledge construction, equity and context intersect: Students learning of science in small groups. *Journal of Research in Science Teaching, 34* (10), 1039-1065.

8 Bianchini, J., Holthuis, N., & Nielsen, K. (1995). Cooperative learning in the untracked middle school science classroom: A study of student achievement. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA (ED389515).

9 Cohen, E. G. & Lotan, R. A. (1997a), loc. cit. (ref. 1).

10 Good, T., Burross, H., & McCaslin, M. (2005). Comprehensive school reform: A longitudinal study of school improvement in one state. *Teachers College Record, 107* (10), 2205-2226.

11 Cohen, E., Lotan, R., Abram, P., Scarloss, B., & Schultz, S. (2002). Can groups learn? *Teachers College Record, 104* (6), 1045-1068.

12 **Moxon, J. (2003). A study of the impact of the Restorative Thinking Programme within the context of a large multi-cultural New Zealand secondary school. Unpublished Masters thesis, The University of Auckland, Auckland, New Zealand.**

13 **Phillips, J. (2003), loc. cit. (ref. 2).**

14 **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).**

15 Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

16 Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

17 Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

18 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

19 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

20 Bianchini, J. (1997), loc. cit. (ref. 7).

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational*

Research, 64 (1), 1-35.

Cohen, E. G. (1997). Complex Instruction. Keynote speech for Cooperation and Diversity: Cooperative Learning in Intercultural Education Conference (August, 1997), organized by the International Association for Intercultural Education. Co-sponsored by IASCE. Sodertalje, Sweden.

[21] **Moxon, J. (2003), op. cit. (ref. 12).**

[22] **Phillips, J. (2003), loc. cit. (ref. 2).**

[23] **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).**

[24] Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[25] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[26] Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[27] **Ancess, J. (2000). The reciprocal influence of teacher learning, teaching practice, school restructuring and student learning outcomes. *Teachers College Record, 102* (3), 590-619.**

[28] **Lipman, P. (1997). Restructuring in context: A case study of teacher participation and the dynamics of ideology, race and power. *American Educational Research Journal, 34* (1), 3-37.**

Cazden, C. B. (1990). Differential treatment in New Zealand: Reflections on research in minority education. *Teaching and Teacher Education, 6* (4), 291-303.

[29] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

[30] Kerman, S., Kimball, T., & Martin, M. (1980). Teacher expectations and student achievement: Coordinator manual. Bloomington, IN: Phi Delta Kappan.

[31] Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[32] **Ancess, J. (2000), loc. cit. (ref. 27).**

[33] Lipman, P. (1997), loc. cit. (ref. 28).

[34] Cazden, C. B. (1990), loc. cit. (ref. 28).

[35] Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).

[36] Kerman, S., Kimball, T., & Martin, M. (1980), loc. cit. (ref. 30).

[37] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

Moxon, J. (2003), op. cit. (ref. 12).

Phillips, J. (2003), loc. cit. (ref. 2).

Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[38] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).

[39] Lipman, P. (1997), loc. cit. (ref. 28).

[40] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

[41] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

Cazden, C. B. (1990), loc. cit. (ref. 28).

[42] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[43] Siskin, L. S. & Little, J. W. (Eds.) (1995). The subjects in question: The department organization of the high school. New York: Teachers College Press.

[44] **Ancess, J. (2000), loc. cit. (ref. 27).**

[45] **ibid.**

[46] Cohen, E. G. (1997), op. cit. (ref. 20).

[47] Timperley, H., & Robinson, V. M. J. (2001), op. cit., case 3, (ref. 2).

Timperley, H., Bertanees, C., & Parr, J. (2005). Case study: A South Island school. In H. Timperley & J. Parr & S. Werner (Eds.), *Literacy professional development project: Milestone report* (pp. 15-43). Wellington, NZ: Ministry of Education.

[48] Lipman, P. (1997), loc. cit. (ref. 28).

[49] **Ancess, J. (2000), loc. cit. (ref. 27).**

[50] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

Moxon, J. (2003), op. cit. (ref. 12).

Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[51] Cohen, E. G. (1997), op. cit. (ref. 20).

[52] **Phillips, J. (2003), loc. cit. (ref. 2).**

[53] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

[54] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

[55] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[56] Lipman, P. (1997), loc. cit. (ref. 28).

[57] Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3 (ref. 2).

[58] **Phillips, J. (2003), loc. cit. (ref. 2).**
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[59] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).
Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).
Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Moxon, J. (2003), op. cit. (ref. 12).
Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).

[60] **Moxon, J. (2003), op. cit. (ref. 12).**

[61] **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).**

[62] **Moxon, J. (2003), op. cit. (ref. 12).**

[63] **Phillips, J. (2003), loc. cit. (ref. 2).**
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[64] Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3, (ref. 2).
Lipman, P. (1997), loc. cit. (ref. 28).

[65] **Phillips, J. (2003), loc. cit. (ref. 2).**

[66] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[67] Cohen, E. G. (1997), op. cit. (ref. 20).

[68] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

[69] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[70] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

[71] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

[72] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

[73] This context is uniquely Māori in that the marae is a communal meeting place. Hui refers to a meeting that conforms with Māori protocols.

[74] **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).**

[75] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[76] **Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).**

[77] Filby, N. N. (1997). A viewpoint on dissemination. In E. G. Cohen & R. A. Lotan (Eds.), *Working for equity in heterogeneous classrooms: Sociological theory in practice* (pp. 277-285). New York: Teachers College Press.

[78] **Moxon, J. (2003), op. cit. (ref. 12).**

[79] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Phillips, J. (2003), loc. cit. (ref. 2).
Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).

[80] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[81] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[82] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).
Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Cohen, E. G. (1997), op. cit. (ref. 20).
Moxon, J. (2003), op. cit. (ref. 12).
Phillips, J. (2003), loc. cit. (ref. 2).
Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), op. cit., cases 1 & 2 (ref. 2).

[83] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**
Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).
Moxon, J. (2003), op. cit. (ref. 12).
Cohen, E. G. (1997), op. cit. (ref. 20).

[84] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

[85] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).

[86] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

[87] Swan, S. & White, R. (1994). *The thinking books* (Vol. Falmer Press). London; Washington DC: Falmer Press.

[88] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[89] Lipman, P. (1997), loc. cit. (ref. 28).
Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3 (ref. 2).

[90] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

[91] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).
Moxon, J. (2003), op. cit. (ref. 12).

[92] **Phillips, J. (2003), loc. cit. (ref. 2).**
Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).
Stevens, R. J. & Slavin, R. E. (1995), loc. cit. (ref. 1).

[93] Lipman, P. (1997), loc. cit. (ref. 28).

[94] Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[95] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

[96] **Moxon, J. (2003), op. cit. (ref. 12).**

[97] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[98] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 1).

[99] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997), op. cit. (ref. 1).

[100] Lipman, P. (1997), loc. cit. (ref. 28).
Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3 (ref. 2).

[101] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[102] Lipman, P. (1997), loc. cit. (ref. 28).

[103] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[104] Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3 (ref. 2).

[105] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 1).**

[106] Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 2).
Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 2).

[107] **Moxon, J. (2003), op. cit. (ref. 12).**

[108] Cohen, E. G. (1997), op. cit. (ref. 20).

[109] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

[110] Kerman, S. (1979). Teacher expectations and student achievement. *Phi Delta Kappan, 60* (10), 716-718.
Kerman, S., Kimball, T., & Martin, M. (1980), loc. cit. (ref. 30).

[111] Joyce, B. & Showers, B. (1988). *Student achievement through staff development.* White Plains, NY: Longman.

[112] Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.
Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

[113] **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995), loc. cit. (ref. 29).**

10. What the Evidence Tells Us about Some Topical Issues

In this chapter we examine the evidence relating to five contextual and content issues often thought to impact on the effectiveness of professional development. These are: the multiple roles of assessment in promoting teacher learning, leadership, and professional development, the role of teachers' theories, the qualities of professional learning communities, and effective professional development in secondary schools. The question guiding this chapter is, 'What evidence is there that these issues impact on professional learning in ways that lead to improved outcomes for students?'

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

Some kind of assessment was reported in every study in this synthesis (it was a requirement for inclusion), but it was often carried out after the event by an external person and was unrelated to teacher learning about assessment and its uses. It was this latter function of assessment that interested us, and approximately half the core[1] studies that reported substantive impact on student outcomes made specific reference to teachers developing their understanding of, and use of, assessment. The types of assessment varied widely: from students' drawings and interviews to close observation of student work, to standardised tests. Assessment was always used for more than one purpose. In this section, we synthesise the evidence related to how assessment was used in the studies and conclude with reflections on how it can be used to promote professional learning. See Overview 10.1 for a summary of findings.

Overview 10.1. Multiple roles of assessment in the core studies

Assessment of students for the purpose of improving teaching was a feature of half the studies that had substantive outcomes for students

- In all these studies, assessments were used to provide an analysis of the teaching–learning relationship in order to improve teaching.
- Student learning was seen to be a function of teaching, and assessment data a means of refining teachers' understanding of the teaching–learning relationship.

Ways in which the assessment information was used:

To identify the next steps for teaching—at an individual, class, or programme level;

To review the effectiveness of teaching;

To provide motivation for teachers to engage in professional learning.

No core study intervention addressed assessment only; each also addressed one or more of:

Pedagogical content knowledge;

Interpretation of assessment information;

Use of assessment information to guide teaching and learning.

10.1.1 Studies used in the synthesis of assessment use

Twenty-seven core studies were used in this part of the synthesis. We also included five supplementary studies that incorporated assessment in the professional learning opportunities but which did not demonstrate related substantive impact on student outcomes. These studies helped us identify circumstances in which assessment as part of professional development did not appear to work.

10.1.1.1 Core studies included in the analysis of assessment use

The core studies considered for this section of the synthesis are listed in Table 10.1, together with the curriculum area for which student outcomes were assessed and the use made of the assessment information. The information in the table should be viewed as a guide only, because our reliance on published reports—particularly for the international studies—means that some information is incomplete. This caution is, of course, applicable to all sections of the synthesis. The table lists those uses of assessment that the authors considered worth reporting. For reasons of space, only the lead study is given for groups of studies but it should be noted that the information about how assessment was used was sometimes found in one of the other studies in the group. (Details of the lead and linked studies can be found in Chapters 6 to 9.)

Table 10.1. Assessment use: core studies

Study	Curriculum	How assessment was used
1. Absolum (2006)[2]	Literacy	To inform next teaching steps, involve students in own learning, and review teaching effectiveness.
2. Adey (1999, 2004)[3]	Science	To 'read' students' responses in order to assess understanding and level of challenge.
3. Alton-Lee et al. (2000)[4]	Cross-curricular	To gain knowledge of students' thinking in order to inform next teaching steps.
4. Bianchini (1997)[5] Cohen & Lotan (1997)[6]	Complex instruction	To understand students' thinking and inform next teaching steps.
5. Bishop, R. et al. (2005)[7]	Cross-curricular	Improving the educational achievement of Māori students in mainstream education.
6. Cardelle-Elawar (1995)[8]	Math	To use students' thinking and metacognitive processes to inform next teaching steps.
7. Carpenter et al. (1989)[9]	Math	To build instruction on knowledge of students' thinking.
8. Confrey et al. (2000)[10]	Algebra	The emphasis was on understanding student thinking and achievement data, but the exact purpose for this was not made clear.
9. D'Oria (2004)[11]	Phys ed	Observations to identify student motivation and participation to inform next lesson.
10. Earl et al. (2003)[12]	Literacy and numeracy	Assessment based on state standards determined what was taught and was used to review effectiveness at programme level.
11. Kennedy (1998)[13]	Math	Teachers with largest student gains used assessment of student reasoning to assist teachers to be responsive to students.
12. Mason & Good (1993)[14]	Math	To establish flexible student groupings.

13. McClain & Cobb (2001)[15]	Math	Daily assessment to inform next teaching steps.
14. McNaughton et al. (2004)[16]	Reading	To inform next teaching emphases.
15. Moxon (2003)[17]	Relationships with students	To reflect on effectiveness of communication with students showing behavioural difficulties.
16. Parke & Coble (1997)[18]	Science	To give teachers continuous feedback about student understanding and reflect on the effectiveness of teaching.
17. Parr et al. (2006)[19]	Reading and writing	To identify patterns of student needs, inform next teaching steps, and evaluate progress.
18. Phillips & Smith (1997)[20]	Reading	To inform next steps in teaching on a daily basis.
19. Phillips (2003)[21]	School-wide	As a catalyst to engage in change process. Then used by teachers to stay student focused.
20. Ross et al. (1994, 1999)[22]	Generic pedagogy	Teachers generated their own questions and data and applied these to their own contexts.
21. Saxe et al. (2001): Condition 1[23]	Math	Teachers with largest student gains used ongoing assessment to understand student thinking and to inform next teaching steps.
22. Schober (1984)[24]	Economics	To reflect on students' attitudes to the subject.
23. Schorr (2000)[25]	Math	To build instruction on knowledge of students' thinking and reflect on effectiveness of practice.
24. Taylor et al. (2005)[26]	Literacy	To reflect on effectiveness of teaching and shape future programme.
25.Timperley & Wiseman (2003)[27]	Reading	To review progress and inform next teaching steps.
26. Vandevoort et al. (2004)[28]	Cross-curricular	Examining student outcomes promoted but specific purpose unclear.
27. Higgins et al. (2005)[29]	Numeracy	To inform next teaching steps and determine progress at end of year.

10.1.1.2 Supplementary studies included in the analysis of assessment use

The only supplementary studies considered for this analysis were those in which assessment was a major component. One study[30], by Hohepa and colleagues in Māori-medium settings, appeared to have a positive impact on student outcomes, but the data did not permit calculation of effect sizes. The other studies met our methodological criteria but reported weak outcomes for students. They were included in this group to help identify the circumstances under which assessment may not be effective in promoting professional learning. These studies are too numerous to list but are referenced in the text.

10.1.2 Uses of assessment: What worked for whom and why

What the studies listed in Table 10.1 had in common was that assessment information was used to provide an analysis of the teaching–learning relationship for the purpose of improving it. Student learning was seen to be a function of teaching. Assessment was not divorced from its implications for teaching.

Most often, teachers used assessment information to guide their decisions about what steps to take to advance student learning at the individual, class, or programme level. Less frequently—but central to the impact on students of several studies—assessment information was used by teachers to review the effectiveness of their teaching. In some studies, it was used as a motivator for teachers to engage, either at the beginning or during the course of the professional learning opportunities. We now consider each of these three purposes in turn.

10.1.2.1 Informing next teaching steps

The most frequently-reported use of assessment was to inform next teaching steps at the individual, class, or programme level. Ongoing assessment of students' thinking and learning enabled teachers to be responsive to their particular needs and to appropriately tailor instruction. Box 10.1 describes how a teacher assessed her students by means of interviews and observations and then used the information to adapt her mathematics instruction[31].

Box 10.1. Using assessment to guide instruction

Ms J's year 3 mathematics programme was based on the principles of cognitively guided instruction. A researcher reports:

"... assessment was multifaceted: it was formal as well as informal, written and oral, and done in group or individual sessions. The main purpose of the assessments appeared to be to gain knowledge that could be used in making decisions about how to structure the learning environment for individual children."

Ms J. did formal interviews with her students three times during year 3 and used the information obtained to buttress her informational observations of the children. During Ms J.'s formal assessment, she asked the child to solve a problem and questioned him or her as to how the problem was solved. Depending on the child's responses, he or she would be asked to solve either harder or easier problems. The problem types that could be solved, the size of the number the child understood, and his or her solution strategies were carefully recorded. Depending on the level of maturity of the child's responses to the problem types, Ms J. made decisions about what to ask the child about the other mathematical content areas.

Informal assessment took place during regular mathematics classes when Ms J. questioned children, either in groups or individually, about their thinking and problem-solving procedures. Observation of the children's use of counters or other manipulatives also provided information about their thinking. Assessment usually had a specific purpose, and knowledge gained from the assessment was often used immediately.

It should be noted that several of the conditions identified in these core studies facilitated such use of assessment information. A key factor was teachers' deeper pedagogical content knowledge, which put them in a position where they could interpret the information they acquired. Many studies focused on students' thinking and learning processes in a particular curriculum. This element was missing from two[32] of the three supplementary studies that reported little change in student outcomes, which indicates that assessment can't be used to inform teaching independently of content knowledge and teacher understanding of how students learn that content.

Through professional development, the teacher discussed in Box 10.2 had acquired not only the necessary pedagogical content knowledge but also the skill to interpret the meaning of assessment information for teaching and learning. Such information is of little use without that skill. In their report on the United Kingdom literacy and numeracy strategies, Earl et al.[33] expressed concern that when assessment information in the form of numbers suddenly became the currency of conversations about improving literacy and numeracy, the numbers were often interpreted with little understanding of their derivation or how they might be used to inform teaching.

The skills of interpretation for teaching purposes are complex. In New Zealand, McNaughton and colleagues[34] spent a year scoping student learning needs by analysing reading assessment data from the upper primary school years. Following each assessment, teachers and researchers delved into the data to see what it could tell them about the understanding of the students. Student outcomes improved as teachers learned to access and use this information. See Box 10.2 for a snapshot of the process.

Box 10.2. Using assessment information to understand student learning needs in reading

In these primary schools (located in a suburb of low socio-economic status), it was assumed by most teachers that students' factual comprehension of text was adequate, but not their inferential comprehension. Because this assumption was so deeply held, they had never checked it out in any systematic way. The researchers' analysis of students' responses on a multiple choice test did not, however, support the assumption, so the teachers decided, with the assistance of a research team, to investigate exactly what students could and could not do.

The students then completed a second reading assessment that revealed that their vocabulary levels and sentence comprehension were closer to national norms than their paragraph comprehension. Paragraph comprehension was assessed using a cloze test, where the students were asked to insert missing words at various points so that the paragraph would make sense. They found that students were not using the context of the paragraph when making their choices.

The next step was to link this finding to teaching practices. Classroom observations by the research team revealed that the teachers were giving affirmative and generalised feedback to students in relation to their efforts to work out the meaning of text, even when they were wrong, so students were not getting the corrective feedback they needed.

Armed with this information, the teachers were able to work with the researchers to help the students to incorporate more checking procedures into their reading, with a consequent improvement in their ability to comprehend text at the paragraph level.

It does not necessarily follow, however, that teachers who have the skills to interpret data will be inclined to use information from assessments to focus their teaching. Only one of the core studies referred to this issue[35], but in one of the supplementary studies[36], it was the primary reason why an early literacy professional development programme failed to impact on student outcomes. In this study of students from a community of low socio-economic status, the teachers and their leaders used assessment information to label students and to confirm their view that they were achieving at the level that should be expected. Reading difficulties were attributed to the students' home backgrounds and a general inability to learn.

10.1.2.2 Review of teaching effectiveness

The use of assessment information to review teaching effectiveness was implicit in most studies, but explicit in only ten. In these, the review always involved identifying next teaching steps. Box 10.3 describes how teachers used assessment information in an early literacy project[37].

Box 10.3. Using assessment information to review teaching effectiveness

In two New Zealand primary schools where students made greater progress in their first year than those in similar schools located in neighbouring suburbs of low socio-economic status, the teachers regularly reviewed the progress of their young readers. All the teachers had access to graphs of the students' progress that were benchmarked against expected levels of achievement. They worked together to identify those who had made adequate progress since the last review and those who were falling behind. Changes to the programmes of those in the latter group were discussed as the teachers tried to work out what to do next to accelerate their progress.

10.1.2.3 A motivator to engage

Less frequent, but central to the success of several studies[38], was the use of assessment information to motivate teachers to engage either at the beginning of or during the professional learning programme. In one whole-school intervention in the United States[39], assessment information provided the motivation for initial engagement. The principal and the teachers at this school had taken pride in the high average achievement of their students on the Texas state tests (TAAS). When the data was disaggregated as required by the state authorities, it painted a different picture and provided the motivation for teachers to learn how to teach differently (see Box 10.4).

Box 10.4. Assessment information providing the motivation to engage

The principal explained that, prior to the requirement to disaggregate student achievement data obtained from the Texas Assessment of Academic Skills (TAAS), "the big picture looked beautiful; it was wonderful; all of our Vanguard (magnet) students were doing great" (p. 251).

As a Texas public school they were required to disaggregate student achievement data by four socio-economic groups: African-American, Hispanic, white, and economically disadvantaged. Once this had been done, the gap between the different student groups became apparent. The polarisation of the groups created what the principal referred to as "a notion of discomfort".

As a result of the process, the teachers changed their practice. The principal explained, "We have focussed on data specific to every child in this school for the last three years now. We pick it apart so that we know exactly how students are doing when they come to us, instead of not having a clue and not really being concerned because our 900 students (the magnet students) make everything look great … We took the item analysis, and we went through the objectives. We looked at the items kids were getting wrong. We had department meetings and asked ourselves, 'What does this mean?' And some teachers realised they hadn't taught the concept before the TAAS test was given in April" (p. 255).

In another New Zealand study[40], in which teachers learned new approaches to teaching early literacy, a close analysis of the improved reading levels that resulted from the new teaching approach provided the motivation for teachers to continue to change and refine their practice. Box 10.5 describes how this occurred.

Box 10.5. Iterative cycles of teaching and progress heighten teachers' sense of efficacy

Students in these schools (located in two communities of low socio-economic status) were traditionally slow to acquire literacy skills. Looking for ways to speed up this progress, the teachers of the year 1 students agreed to take part in a six-month course. At the beginning of the course, they were shown a video of a student similar to those they taught making rapid progress over a series of lessons. This video helped them to see what might be possible. Following the early introduction of a few new strategies, they began to see greater progress. As the course progressed, many of their treasured ideas about teaching literacy were challenged and their motivation began to waver. What kept them engaged, however, was the accelerated progress their students were making, as demonstrated by their regular assessments of students' reading levels. As they became more confident with the new strategies, the teachers' sense of efficacy was strengthened in tandem with their students' improved reading levels.

10.1.3 Forms of assessment

Assessment is typically thought of in terms of standardised tests and (in the United States in particular) state tests. The reported use of state tests in these studies was very limited and in only one[41] was there any mention of state tests being used to promote professional learning instead of as a measure of the outcomes of a professional development course or programme. This was the study described in Box 10.4, where teachers discovered that, in spite of the high average achievement of the students in the school concerned, as evidenced by state tests, a large group was failing to benefit from the instruction offered. These results became the catalyst to engage in the professional development.

Other kinds of standardised test were used to great effect, providing both rich diagnostic information from which to teach, and information about students' achievement relative to that of others of a similar age[42]. It appears that it is not—as is sometimes claimed—standardisation that is the problem, rather it is the depth of curriculum content assessed and whether teachers can use the data gained to inform their work. Tests of superficial content, divorced from the curriculum, are unlikely to help teachers determine what to teach in ways that will promote substantive student learning.

Where assessment was used on a daily basis to inform next teaching steps it was inevitably relatively informal. For example, in a study involving year 1 students in New Zealand[43], a teacher used an adaptation of a 'thinking books'[44] approach, each day asking her students to draw their experiences and reflections. (See the case study Translating Theory into Practice, found in Appendix 1.) In a study of professional development with a focus on writing, teachers used a combination of standardised assessment and informal student interviews (Box 10.6)[45].

Box 10.6. Using a combination of assessment strategies

The teachers in this New Zealand primary school were about to begin professional development in writing, with a provider and researcher working alongside. They had chosen writing because their assessment of students, using exemplars of writing at different levels, had shown the writing levels to be low.

During the first observation of teaching practice, students' understandings about writing were assessed by interviewing them in small groups. Their answers revealed that most of them believed that learning to write involved writing long stories, punctuating and spelling them correctly, and presenting them neatly. The teachers' intended learning goals focused on the deeper features of the writing, such as content, structure, and vocabulary. The teachers were surprised at the students' answers and, with the assistance of the professional development provider, began to be more explicit about the intended learning. After a few lessons, they assessed the students' understanding of the learning goals by interviewing the students themselves.

A few weeks later, they assessed the students more formally using a curriculum-based assessment tool (asTTle) to make a closer diagnosis of their knowledge of writing and to identify what they needed to learn next. Through engagement with this assessment tool, they improved their pedagogical content knowledge and their understanding of students' learning progressions in writing and were able to focus their writing instruction more effectively.

10.1.4 Why assessment should be so powerful

When used in formative ways, it is not surprising that assessment should be such a powerful component of professional development in terms of impacting on student outcomes. Formative assessment has been shown to have one of the strongest influences on student learning[46] and, in a meta-analysis of influences on student achievement, Hattie[47] has identified that much of its power arises from the part it plays in providing feedback to enhance learning. Scrutiny of the studies included in Hattie's meta-analysis reveals that assessment information in feedback is effective when it can answer three questions for the learner: 'Where am I going?', 'How am I going?', and 'Where to next?'[48]. Being able to answer these questions promotes self-regulated learning because the learner has an awareness of the learning goals, uses the assessment information to identify the gaps between their skills and knowledge and the learning goals, and has the confidence to set about closing these gaps. These self-regulatory skills were a key feature of studies where teacher and student outcomes were sustained after the regular involvement of external providers had been withdrawn (see Chapter 11). For teachers as learners, these three questions needed to be answered in two ways. The first related to their students, the second to themselves.

10.1.4.1 Where am I going?

It is not always easy to determine from the descriptions of the core studies how well the assessment information provided answers to all three questions for the student and teacher learners. The first question required teachers to have a vision of where they and their students were heading. Assessment information unrelated to learning goals loses much of its value. It is reasonable to assume that the participating teachers had some knowledge of what it was that the students in their classes needed to learn, whatever the year level, and so were able to answer the question. But the situation is not as simple as it may seem. In the section of this synthesis on reframing teachers' social construction of students (Chapter 9), it was identified that some teachers needed to change their expectations of particular groups of students if those students were to be given the same learning opportunities as others. Low expectations lead to low-level goals. Knowing what constitutes adequate progress and being committed to helping students make such progress is of crucial importance if teachers are to use assessment information to accelerate the learning of those not currently benefiting fully from the education system[49].

Some of the core studies found that teachers had explicit goals for themselves as learners to better help their students to make progress. Such a shared understanding was not evident in any of the supplementary studies that led to no change in student outcomes.

10.1.4.2 How am I going?

It can reasonably be assumed that in the interventions reported in the core studies, teachers were shown how to answer this second question in terms of the progress of their students. The widespread use of standardised and researcher-developed measures indicates that student information was readily available to participants. Some studies[50] showed how this information, when related to explicit goals, motivated teachers to engage in the professional learning opportunities.

Availability of information does not, however, guarantee sound interpretation. Earl et al.[51] noted in their evaluation of the literacy and numeracy reforms in England that many teachers were unable to interpret assessment information. They needed what these authors described as greater 'assessment literacy'. In particular, these authors showed that it was important that those who interpreted assessment information should understand that an assessment was not a label or an absolute, but part of a picture of the learning and achievement of a particular student or group of students.

It was less obvious whether the interventions documented in the core studies equipped teachers to answer the 'How am I going?' question in terms of their own progress as teachers. Box 10.7 outlines how this and the other two questions were answered for both teachers and students in a formative assessment professional development opportunity in New Zealand[52].

Box 10.7. Answering the feedback questions using assessment information

At the beginning of the professional development, teachers videotaped their teaching practice and worked with the professional development provider to assess their practice against a set of practice profiles. These profiles described progressive stages of teacher competence in the use of formative assessment. The process allowed the teachers to identify where they were going, how they were going, and what they needed to do next. Their progress against the profiles was reviewed throughout the year of the professional development contract.

At the same time, the teachers assessed their students on a standardised reading assessment that provided them with rich diagnostic information so they could answer the same questions in relation to their students. The professional development provider assisted them to interpret this information for teaching purposes and to share it with their students, so they too could answer the questions, 'Where am I going?', 'How am I going?', and 'Where to next?'

10.1.4.3 Where to next?

The reading assessment information for the students in the above study (Box 10.7) provided the basis for teachers to answer the 'Where to next?' question for their students. Much of the assessment-related professional development in this study and in the other core studies was directed at helping teachers understand what students needed to learn next. What was also evident in these core studies was the relative absence of the use of state tests for this purpose. Typically, the assessments used were informal observations, researcher-developed assessments, or standardised assessments that provided rich diagnostic information on students' learning. Choosing the right kind of assessment is essential if it is to be used for formative purposes.

It was surprising how infrequently mention was made in any of the studies showing student gains about deepening teachers' understanding of developmental progressions through the curriculum[53]—particularly given how important this knowledge is when trying to answer the 'Where to next?' question. Apart from a few notable exceptions[54], this knowledge appeared to be assumed rather than explicitly addressed. But we would argue that, if teachers are to answer the question in detail and at depth, they need explicit knowledge of curriculum progressions in the content area concerned.

Absolum's study (see Box 10.7) documented how formative assessment teaching profiles made it possible for teachers to measure implementation of formative assessment practices in their classrooms against a series of progressions. It should be noted that it was not advocated that these profiles be used without a close eye also being kept on whether implementation was impacting on students' learning; the evidence we have synthesised shows that a focus on teaching practices independent of student learning is not particularly effective in impacting on that learning.

10.1.5 Implications for professional learning and development

Learning to understand and use assessment information was part of the professional learning experience in about half the core studies associated with substantive impact on student outcomes. Uses of assessment information included determining the next steps for teaching and learning, reviewing the effectiveness of teaching, and motivating teachers to engage with professional learning. For assessment information to be used in this way, teachers needed to understand that assessment was about informing the teaching–learning relationship, not about labelling students.

Teachers who could answer three questions about themselves and their students were the most likely to use assessment for these purposes. These questions were 'Where am I going?' (which required teachers to have a vision of themselves as effective and their students as successful); 'How am I going?' (which is about giving and receiving feedback concerning the gap between vision and reality—feedback that motivates the learner to engage); and 'Where to next?' (the learner can be secure in the knowledge that they can, with assistance if necessary, close the gap between vision and reality). When teachers were able to answer these questions for themselves they could identify their own learning needs and develop the self-regulatory skills needed to progress towards goals. These self-regulatory skills are associated with sustainability (see Chapter 11). When teachers were able to answer these questions for their students, they could identify next teaching/learning steps and develop focused teaching programmes. To do so, they required in-depth pedagogical content knowledge and an understanding of student progressions in relation to the curriculum.

10.2 Issue 2: The role of school leaders in promoting professional development

Much of the responsibility for promoting the professional development of teachers rests with school leaders. With the devolution in 1989 of many administrative responsibilities to the local school[55], professional development in New Zealand became the responsibility of boards of trustees, who typically exercised it through the principal. There is also increasing international recognition of the importance of the role of leaders in organising and promoting the learning of those they lead[56].

How leaders can best fulfil this role depends on how leadership itself is understood. We have identified four models of leadership and suggest that all contribute to an understanding of what leaders need to know and do in order to promote the learning of their people. The first model is the visionary leader, who provides overall direction and the motivation to pursue the vision. While the heroic version of this leadership style has been largely discredited as a desirable and sustainable option[57], elements of it continue to be important. In the context of professional learning, it is important that the leader articulates a vision of how things might be different for the school's diverse student population, ensures that the collective effort is coherent with the vision, and motivates teachers to work towards achieving it.

One of the criticisms of this first model is that leaders also need to manage the more mundane aspects of school life[58]. Visions are not pursued in an organisational vacuum. We do not intend to enter the leadership versus management debate, but we recognise that leadership for professional development involves a strong organisational component, the ability to make things happen.

Greater emphasis has been placed recently on leadership that actively promotes a climate of teacher learning within the school. Stein and Nelson[59] argue that "Professional development for teachers is not sufficient to change instructional practice, especially across an entire system. Teachers must believe that serious engagement in their own learning is part and parcel of what it means to be a professional and they must expect to be held accountable for continuously improving instructional practice. Similarly, principals must not only be capable of providing professional development for their teachers, but also have the knowledge, skills, and strength of character to hold teachers accountable for integrating what they have learned in professional development into their ongoing practice" (p. 425).

This demanding notion of leadership, associated with the realisation that what is being asked may be well-nigh impossible to deliver, has led to the view that effective leadership is and should be distributed. According to this view[60], leadership is "a set of functions or qualities shared across a much broader segment of the school community that encompasses administrators, teachers and other professionals and community members, both internal and external to the school. Such an approach imposes the need for school communities to create and sustain broadly distributed leadership systems, processes and capacities" (p. 376).

From this perspective, part of the leader's job is to build capacity within a school by developing the intellectual and professional capital of its staff; this includes leadership potential.

In our analysis, we have synthesised for each of the above models of leadership the evidence that is associated with effective (and less effective) outcomes for teachers and the diversity of students (see Overview 10.2 for a summary). Inevitably there are overlaps, so the distinctions we make are, to some extent, artificial.

Overview 10.2. Leadership roles found in studies with substantive positive outcomes for students

Developing a vision

- The vision encompassed an alternative reality for student outcomes and possibilities for curriculum content and pedagogy.
- The vision was coherent with wider environmental and school policies.

Managing and organising

Establish priorities and reduce competing demands.

Engage reluctant participants by putting forward compelling reasons to do so, providing effective content, and engaging teacher theories.

Ensure focused and productive opportunities to learn.

Engage appropriate expertise.

Promote participation in professional communities focused on promoting the teaching–learning relationship in evidence-informed ways.

Leading the professional learning

Promote a challenging learning culture.

Know what content and learning activities are likely to be of benefit.

Promote evidence-informed, self-regulated learning for sustainability.

Developing the leadership of others

Distribute leadership by developing teacher leaders with specific areas of focus.

10.2.1 Developing the vision

Visions, usually expressed as goals, targets, or opportunities, were a key feature of most core studies. Visions encompassed a number of dimensions.

First was the vision of an alternative reality for student outcomes. In order for teachers to engage in meaningful professional learning in situations where student achievement had been depressed for some time, for example, teachers needed to believe that alternative outcomes were possible. In some of the core studies[61], these new possibilities were a powerful catalyst for teachers to engage in the professional development and became the basis of teacher goals for student outcomes.

A vision of alternative possibilities also applied to curriculum content and pedagogy, particularly in studies of mathematics and science. A focus on deeper meanings and processes, instead of facts and formulas, provided an alternative vision of ways to think about curriculum content and how to teach it[62].

Visions, goals, and targets can also promote coherence within the school and with the wider policy environment. It was particularly clear in the mathematics and science core studies that the pedagogical approaches being promoted were consistent with those sanctioned by national bodies and the policies of the relevant educational authorities. Conversely, in a New Zealand literacy study in which no change in student outcomes was apparent, teachers were unaware of the concerns about the country's achievement profiles that the initiative was designed to address[63]. Teachers judged their success on criteria relating to the middle- and high-achieving students, rather than the low-achieving students who were the intended targets of the initiative.

A coherent, unifying vision was also important for schools because the complex nature of the demands on teachers' time can quickly overwhelm, to their detriment and that of their students[64]. Following an extensive analysis of student outcomes, Bryk et al.[65] identified the importance of coherence in the Chicago reforms in the 1990s. The schools that ensured that their various efforts were coherent were more successful than those that allowed them to become fragmented.

10.2.2 Managing and organising

Schools do not thrive on visions alone. Professional learning opportunities need to be organised and managed. In the studies analysed, there was more evidence related to this aspect of leadership than any other. Coherence depends as much on the practical organising and managing functions of leadership as on the vison-setting function. Priorities need to be established and competing demands rationalised if the in-depth professional learning that will lead to positive outcomes for students is to happen.

Another feature of leadership, one that links vision and management, relates to the engaging of teachers who are reluctant to take part. Allowing some teachers to opt out of learning how to teach in more effective ways can have consequences for generations of students. Yet healthy scepticism is sometimes warranted, because there were studies that showed no improvement in student outcomes even when the interventions had resulted in changes to teacher practice.

There was little direct evidence in the core studies about how to engage disengaged teachers but some indirect evidence indicated possibilities. Volunteering was not associated with successful outcomes any more frequently than compulsion. What was important was that teachers engaged in the learning process at some point. Engagement depended more on the purpose behind the initiative and the content and form of the professional development than whether teachers volunteered or not.

It appears that professional development that engaged teachers' theories was more successful in engaging teachers in the professional learning itself. It was important that teachers' theories were regarded not as problematic but as worthy of debate and testing in terms of the outcomes for diverse students. In the study that best describes such engagement[66], it was made clear that no particular approach was entitled to automatic privilege. Through an iterative process of advocacy and testing, the providers and teachers came to a consensus about what was needed if student outcomes were to change. A fuller description of this process is provided in topical issue 3, Section 10.3.

Many core studies reported that substantial funding went into releasing teachers from classroom duties so that they could engage in professional learning opportunities. The relationship between time and professional learning is, however, complex. The study that reported the most generous provision of release time[67] also reported little impact on students. Conversely, several interventions that offered minimal release time had a major impact on student outcomes. The difference was a measure of the extent to which the activities in which teachers engaged during that time deepened their understanding and extended their skills. The content presented and the activities in which teachers engaged were more important than the amount of time provided. A recurring theme was that teachers needed multiple opportunities to learn, with sufficient frequency and over a sufficiently long period of time for deep learning of new content and skills to take place.

Funding was also used for the purpose of engaging appropriate external expertise. Nearly all the core studies involved external experts. This finding nevertheless needs to be treated with caution for two reasons. The first is that the involvement of external experts was sometimes associated with poor student outcomes[68]; even though, in these studies, the teachers implemented recommended practices with fidelity, student outcomes remained static. It is therefore crucial that the right external expertise is selected. The second caution relates to publication bias. Researchers are more likely than others to write up results in academically acceptable ways, so their reports more frequently met our methodological criteria and were included in the synthesis. Some supplementary studies that appeared to report positive outcomes for students were championed by school leaders but failed to meet our methodological criteria. It may well be possible to rely on internal expertise, but the evidence base for this is currently very limited.

Organising opportunities for teachers to process new information within a professional community was also identified as an important leadership function. All the core studies reported opportunities for teachers to work together, typically for planning purposes and to analyse the impact of their teaching on student learning. The relationship between participation in professional communities and student outcomes was, however, complex. While such participation was a consistent feature across the core studies, supplementary studies with neutral or negative outcomes also reported teacher participation in professional learning communities. Where such participation was the sole professional development activity, teacher learning was limited. Even when combined with other learning activities, it was important that professional communities focused squarely on promoting understanding of the teaching–learning relationship in evidence-informed ways.

10.2.3 Leading the professional learning

Leading the learning is central to the focus of this synthesis. This meant more than just organising opportunities for teachers to learn. It meant that leaders became involved in the learning itself and promoted learning cultures within their schools. In this section, we examine three aspects of this leadership role. The first relates to managing teachers' and leaders' own engagement in the learning process. By management and engagement we mean: ensuring that new information is understood; engaging dissonance constructively when challenging existing assumptions about teacher–student relationships, pedagogy, or student achievement; and ensuring that opportunities to learn are productive. We do not mean to imply that leaders were solely responsible for the professional learning process—particularly where external expertise was utilised—rather, that it was for them to ensure that learning for the purpose of enhancing student outcomes was taking place.

Managing process, however, is only one aspect of the leadership challenge. The second is about knowing what content and learning activities are likely to be of benefit. In-depth knowledge of theory that could be used as the basis for teaching and learning decisions, together with an understanding of how to translate theory into practice, appeared to be particularly important. These understandings needed to be applied to iterative cycles of assessment, teaching, and learning. The effectiveness of teaching was never divorced from its impact on student motivation, engagement, and learning. Assessment was used both to identify student learning needs and as a tool to inquire into the effectiveness of practice.

The third challenge is for leaders to understand what is required if improvements in student outcomes are to be sustained once major external support is withdrawn and the drive and initiative must come from the teachers themselves. In those few studies that reported sustained improvement in student outcomes, the professional development had provided teachers with a strong theoretical base that served as a framework for principled changes to practice, the skills to inquire into the impact of their teaching on student learning, and, above all, the skills to understand their students' problematic thinking. These elements were absent from the only study that reported a decline in student outcomes once external support was withdrawn[69].

This evidence is consistent with what is known about the conditions that promote self-regulated learning. Teachers who had inquiry skills and content knowledge, and who received support from their leaders, were in a position to regulate their own learning. As discussed earlier, self-regulated learners are able to answer three questions: 'Where am I going?', 'How am I going?', and 'Where to next?'[70] In the core studies, being able to answer these questions was consistently associated with impact on student learning. 'Where am I going?' is about vision and rationale—essential if teachers are to engage in professional learning opportunities. 'How am I going?' is about the effectiveness of teaching and progress towards the vision. 'Where to next?' speaks of the need for a detailed and theoretically sophisticated knowledge of curriculum content and student progressions on which to base instructional decisions. When teachers are able to answer these questions they are also likely to drive their own learning.

The context in which teachers taught also impacted on sustainability. If teachers are to engage in evidence-informed inquiry and theoretical development, then leaders need to promote these activities as core business. Perhaps their most important function is to create infrastructure and conditions that are conducive to teachers monitoring the impact of their work on student outcomes and examining the implications of such monitoring for future teaching.

10.2.4 Developing the leadership of others

Several studies documented interventions that systematically developed teacher leadership in a particular area of curriculum or pedagogy. Typically, the training was based on a 'cascade' model in which external experts trained teacher leaders, who then trained teachers. This process was followed because it was believed that it would lead to sustainability but there was no evidence in any of the studies that sustainability was in fact achieved. A caution needs to be sounded concerning this model, in that two studies found that teachers sometimes felt uncomfortable about taking on the role of 'expert'. Their discomfort made them diffident about identifying areas that needed attention and when giving feedback[71]. Another study found that those who volunteered to be curriculum leaders were not always those with relevant expertise[72]. Distributed leadership may be a highly desirable goal but it is not without its own set of difficulties.

10.2.5 Implications for professional learning and development

In many of the school-based studies, leadership played a very important role. We have identified four different roles that leaders may adopt: developing a vision of how teaching might impact on student outcomes, managing the professional learning environment, promoting a culture of learning within the school, and developing the leadership of others in relation to curriculum or pedagogy. In no core study did leaders take on all four roles. All, however, were adopted by leaders in various ways that led to positive outcomes for students. Effective leaders did not leave the learning to their teachers—they became involved themselves.

10.3 Issue 3: Teachers' existing theories

During the synthesis process it became evident that many of the core studies that reported substantive outcomes for students also reported some kind of engagement with teachers' existing theories of practice during the course of the professional learning opportunities. At final count, 20 studies made specific reference to such engagement[73]. Other core studies did not make it clear if theories were engaged, but it appears that in a high proportion of the supplementary studies with no or low impact this was not the case. In some of these studies[74], teachers were provided with opportunities to learn but the content and activities were left largely to their own discretion. In others[75], teachers were taught (and expected to implement) a set of behaviours considered by the providers to constitute effective teaching practice. When the professional development related to curriculum goals with a relatively narrow focus (such as spelling or phonemic awareness)[76], ensuring that teachers implemented a particular set of behaviours appeared to be sufficient to impact on student outcomes. In this section, we examine why engaging their theories of practice appeared to be important when asking teachers to address complex curricula, and what the implications of this might be for those providing professional learning and development.

By 'teacher theories of practice', we mean personal theories that consist of particular beliefs and values; related knowledge, skills and practices; and desired outcomes[77]. Teacher values and beliefs may relate to society and include, for example, the kind of community they wish to promote through education and/or the knowledge and skills considered to be of worth. Values may also be much more local or specific, relating, for example, to the teaching strategies believed to be effective for a particular group of students. By 'engaging' with theories, we mean examining current practice in the light of its outcomes for students and then constructing new theories, which, based on the available evidence, should lead to better outcomes.

As far as we were able to determine, construction of new theories usually occurred during the opportunities to learn that followed the initial 'front loading' of new ideas (see Figure 6.1). In the main synthesis, we identified a typical sequence of activities that consisted of a rationale or catalyst to engage, the presentation of the content of the new learning, and provision of a range of activities designed to help teachers translate the new knowledge into practice. This latter element appears to be very important: teachers need to understand the implications of new practice for existing practice.

Other studies report an equally effective approach that involved problematising teaching practice in relation to student outcomes[78] and engaging teachers' theories about effectiveness throughout the professional learning opportunities. One example of this approach was a New Zealand study[79] that aimed to develop better pedagogical relationships between Māori adolescents and their teachers. Teachers' theories came under scrutiny as the assumptions that underpinned their reading of classroom dynamics were challenged by students' stories of what it was actually like for them. Starting from this challenge to their existing theories, teachers worked together with the professional development providers to construct new understandings of the kinds of relationships needed in their classrooms. Ongoing support helped them to develop such relationships.

10.3.1 The need for theory engagement

In our search for an explanation for the importance of theory engagement, we went beyond the literature on professional development and consulted the literatures on cognition, the social psychology of change, and policy. Given the broad base of this literature, generic terms were normally used for those being asked to change their practice. Spillane et al.[80], for example, use the term 'implementing agents'. For the purposes of this synthesis, we are assuming that the implementing agents are teachers and that the change messages are those being promoted in the professional learning opportunities; we adopt these referents for the sake of clarity.

Several reasons appear collectively to account for the greater impact of professional development that engaged (rather than bypassed) teachers' theories of practice. The first relates to the nature of teaching itself. Teachers do not need to be reminded that teaching is a complex activity. At minimum, any effective teaching act requires teachers to integrate their understanding of the content to be taught with decisions concerning how to best present that content to that particular group of students. There is no simple recipe; every context is different. Policy environments differ, what constitutes valued knowledge differs, communities, teachers and students differ. It is into this complex environment that teacher educators attempt to inject messages about change and improvement.

Given this complexity, the challenge for providers is to present professional development messages in ways that make sense to the teachers they expect to influence. As Spillane et al. (2002) claim, "Sense-making is both necessary and unavoidable" (p. 162). Sense-making is not simply a matter of professional development providers making their messages clear to teachers (as appears to be the case when they expect teachers to enact a specific set of behaviours). Nor is it about leaving teachers to make their own professional judgments without first having had the adequacy of their existing theories challenged. Sense-making is a complex process involving interaction between an individual's existing cognitive structures (knowledge, beliefs, and attitudes), the situation in which they practise, and the providers' messages[81]. Decontextualised messages about change do not take this interplay of influences into account.

In a detailed study of teachers' reactions to feedback following classroom observations, Parr et al.[82] demonstrated how teachers' beliefs influenced their interpretation of providers' messages. In another study, by Spillane et al.[83], feedback offered an ideal opportunity for theory engagement and sense-making. The two sessions that engaged teachers' theories led to immediate and substantive changes in practice. Following sessions that bypassed their theories, the teachers did not act on the feedback they were given, either because they disagreed with the observers' judgments about their practice or the worth of the alternative practices advocated, or they had no idea how to integrate the alternative practices into their existing practice.

In a Californian study, Coburn[84] described how situations, particularly the social interactions taking place within them, led to the same messages about reading instruction being interpreted in different ways by different teachers, even within the same school. Informal alliances exerted an equal or greater influence than formally constructed networks. The implication is that situation, far from being a mere backdrop to providers' messages, is a constituting element of the sense-making process. As noted in the introduction to this synthesis, Putman and Borko[85] assert that:

> The physical and social contexts in which an activity takes place are an integral part of the activity, and the activity is an integral part of the learning that takes place within it. How a person learns a particular set of knowledge and skills and the situation in which a person learns become a fundamental part of what is learned. (p. 4)

Another issue in the sense-making process is what is referred to by Kennedy (1999)[86] as 'the problem of enactment': teachers need to translate what is learned into their particular teaching context. This United States study involving the video analysis of teaching practice and beliefs demonstrated how decisions about lesson content and process were subject to many influences other than the messages of those who wished teaching practice to change. In their moment-by-moment decision making, teachers made trade-offs that had the effect of filtering, diluting, and changing the implementation-as-intended of standards-based teaching practices. It was not that the teachers disagreed with the principles of the reform ideas, it was that they had difficulty enacting them in their classroom situations. Part of the difficulty was that the messages were interpreted by teachers in terms of their own theories about effectiveness. The principle of making knowledge accessible to all students, for example, was interpreted as encouraging student participation. Often this participation was achieved at the expense of another principle, increasing the depth of intellectual engagement. Teachers needed to engage much more deeply with theory and its implications for practice in order to know how to make knowledge accessible in the form of intellectually demanding tasks.

10.3.2 Mediating competing theories

Robinson and Lai[87] explained how important it is to engage teachers' prior understandings in any change situation. According to them, teaching practice can be thought of as a problem-solving process: how to manage and engage students, how to teach particular content, and how to do it all within the available time and resources. These problems are resolved—usually on the run—in accordance with an integrated theory of action based on a coherent set of beliefs, values, and practical considerations. This problem solving is mostly tacit and routine, not conscious and deliberate. Professional learning that seeks to change practice needs to help teachers understand their own underpinning theories of action and examine what is tacit and routine so that these theories and practices can be evaluated and decisions made about what should be changed. Without such engagement, it is unlikely that new learning will be adequately integrated with existing theories. The consequences of this range from non-implementation to adaptation-beyond-recognition.

Some adaptations of new practice simply end up layered on top of existing practice. Such adaptations result when teachers believe that they are implementing new practice but, due to limited understanding of what this means, they implement only superficial features or procedures, leaving the core of existing practice intact. This process is referred to by Bransford et al.[88] as *over-assimilation* and is identified in many studies that were not included in the body of this synthesis because teaching practice did not change. Firestone[89], for example, found that mathematics teachers reported substantive changes to their teaching practice in line with standards-based reforms when, in reality, they changed some structural conditions (for example, did more group teaching), but continued to use their existing teaching strategies. From a theory engagement point of view such adaptations are to be expected if teachers' theories have not been engaged in ways that equip them to make principled comparisons between existing and new practice. Adaptations will inevitably be made as teachers respond to their particular contexts. The issue is not that teachers should 'do it right' but whether they have sufficient understanding of the principles to recognise the differences between the old and the new.

Conventional analyses of implementation problems have typically concluded either that the messages were unclear or unrealistic[90] or that teachers were unwilling or unable to change[91]. More nuanced understandings of the issues, based on, for example, sense-making theories, have recently emerged. Putting the evidence from our core and supplementary studies together with the theories outlined above, we suggest that the challenge is to mediate competing theories at the interface between the change messages (coming from the professional development providers) and the myriad agendas that teachers must cope with in their practice situations. It can almost be taken for granted that providers' theories and teachers' theories will be different and in competition with one another. Every teacher's practice is grounded in a theory about how to be effective, based on their experience and their knowledge of the practice context. The more experienced the teacher, the more likely it is that their theory will be coherent. Indeed, 'novice-to-expert'[92] progressions typify the expert as one who has a holistic grasp of relationships within a particular context and is able to fluidly and efficiently solve problems as the need arises.

If providers did not have different theories of how to be effective, they would not be asking teachers to change. Given this, competing theories should be expected and accepted. It follows, then, that during the process of professional learning both providers and teachers need to engage with the others' theories concerning what constitutes desirable practice and the beliefs on which that practice is based.

10.3.3 Definitions of success

A theory competition approach does not assume the superiority of either the providers' or the teachers' theories[93]; instead, it assumes that the worth of particular teaching theories and practices needs to be negotiated. It is, however, quite possible to reach agreements that have no greater value than the original theories[94]. One way to increase the probability that negotiation will result in better outcomes for students is to make these the criteria against which success will be judged. Does the negotiated theory make a difference to students in terms of these outcomes? Cooperative learning, for example, is based on principles of social justice and inclusion. Yet Ross[95] reported that the students of teachers who felt highly efficacious in implementing cooperative learning strategies following professional development were less willing to offer and seek help than their counterparts in other classes. The definition of success, therefore, needs to go beyond implementation of particular practices or measures of teacher confidence. Theories and associated practices need to be rigorously evaluated in terms of their impact on students.

Professional learning opportunities, therefore, need to equip participants with the skills to test and verify theories, for without such skills teachers are unable to judge the worth of prior or new practice. How do they know that their students are benefiting or not benefiting? Implemention of desired practices, regardless of who is advocating them, is no guarantee of better outcomes for students.

10.3.4 Resistance

Teacher resistance to change is often portrayed negatively. It is true that if student outcomes are poor, teacher refusal to engage in improving practice is problematic. But as noted above, not all change achieves the desired outcomes. When this is the case, resistance may well be in the best interests of students.

Resistance can be framed in terms of competing theories about how to be effective. In a study by McNaughton et al.[96], teachers' theories about reading comprehension were based on ensuring that students used particular strategies, and praising and encouraging them when they did. In their interactions with students, teachers did not comment on the appropriateness or accuracy of their responses. One strategy involved predicting what was likely to happen next in the text. Teachers encouraged and reinforced use of this strategy by responding with praise, such as "Good prediction" and "That was clever", regardless of whether the prediction made sense. Students' comprehension of text remained low despite the teachers' conscientious efforts.

In this situation, the researchers introduced a competing theory. They suggested that students' predictions should be linked explicitly to the text and their accuracy checked. They advocated that teachers should focus on these behaviours in their responses and not commend predictions regardless of accuracy or context. After discussion of the competing theories, many teachers changed their practice, making sure that students checked the text before arriving at a prediction. Because the teachers made changes to their practice based on an understanding of the principles of the competing theory, there was no resistance. The rate of focused teacher responses went up from an average of once in 120 minutes to an average of once in 7–8 minutes. Students' comprehension of text improved accordingly.

A problem these researchers encountered early in the process was that some teachers took theory testing as a personal or professional attack[97]. Spillane et al.[98] explain this response partly as a strategy for preserving self-esteem. Professionals want to believe that they have performed well in the past and are hesitant to concede that their efforts may have been misdirected. This is most likely to happen when particular practices are central to their professional self-concept. Typically there is a power imbalance between providers and teachers and this can inhibit the open expression of teacher theories. There is no easy solution to this problem, only ongoing theory engagement and checking of student outcomes.

10.3.5 Sequence of change

Sense-making is not a linear process[99]. Although most core studies reported some kind of theoretical introduction or challenge to teachers' existing theories, the in-depth engagement needed for changed practice did not necessarily occur at this time. Such engagement appeared to require iterative cycles involving presentation and understanding of new theories, changes in practice, and changes in student outcomes. In the studies that provided sufficient detail, the process was more akin to a journey than an orderly sequence of events.

The initial catalyst for sense-making through theory engagement differed from study to study (not all identified such catalysts). In one[100], it was the introduction and negotiation of the meaning of a powerful theory that was in competition with teachers' existing theories. In others[101], it was an analysis of current practice and the introduction of competing theories that asserted greater effectiveness for alternative practices. In yet others, an analysis of what students did or did not know challenged teachers' existing theories[102]. Sometimes teachers changed their theories only after introducing practices advocated by providers and seeing the impact on student outcomes[103]. In other situations[104], it was the realisation that current practice was having negative outcomes for particular groups of students that provided the catalyst.

There is clearly no one 'best' sequence. Given the extended engagement reported in most of the core studies, it is clear that sense-making is an ongoing journey. The greater the discrepancy between current practice and new practice, the longer the journey is likely to be.

10.3.6 Implications for professional learning and development

Should existing teacher theories be considered a problem or an asset? We suggest that this is the wrong question. Teachers' theories exist—they are a necessary and integral part of practice. A better question is 'How can teachers' existing theories be engaged, debated, and challenged during professional learning opportunities in ways that ensure ongoing theory improvement?'

A much greater problem than teachers' existing theories of practice is the assumption made by some professional development providers that their preferred practices should be implemented without engaging these theories. Effective teaching is much more than a set of prescribed behaviours; it is an activity that integrates a teacher's existing cognitive structures (knowledge, beliefs, and attitudes) and every aspect of the situation in which they practise.[105] Elsewhere in this synthesis we have noted that the most effective theories are integrated around the notion of responsiveness to students. We suggest, therefore, that what matters is that teachers consider their teaching practices and the theories that underpin them, in order to maximise their students' opportunities to learn—and that they test the effectiveness of their efforts in terms of student outcomes.

10.4 Issue 4: Professional learning communities

All the core studies reported teacher participation in some form of structured professional group; this is one of the most consistent findings across the full range of studies. These groups were mostly school-based, but, at times, involved participants from different schools and/or researchers. The opportunity to process the meaning and implications of new learning with one's colleagues appears to be fundamental to the change process, where that change impacts positively on student outcomes.

Participation in structured professional groups was, however, associated with neutral or negative outcomes for students in several studies[106]. These studies show that it is possible for teachers to be given generous amounts of time to collaborate and talk together, only to have the status quo reinforced, with change messages misunderstood, misrepresented, or resisted. Lipman[107], for example, described how teachers who were given two hours of non-contact time per day to find an answer to African-American underachievement interacted in ways that reinforced existing deficit thinking and structural inequalities. Those who held alternative theories and could have served as a resource for the group's deliberations were marginalised.

So in this section we focus on identifying the characteristics of those professional communities that were associated with enhanced student outcomes and those that were not. Unfortunately, the quality of the evidence base is uneven. Although the core studies frequently mention professional communities, few describe their features in detail. They typically do little more than say that there were opportunities for discussion and interaction, and report that improved collaboration occurred. Indeed, the purpose of the communities in many of the studies did not seem to extend much beyond this limited function. In four studies[108], professional communities were the main vehicle for change and were described in greater detail, but three of these showed no improvement in student outcomes. Given this picture, we have selected different features from a range of both core and supplementary studies to provide the evidence base for this section.

In our analysis, we are taking for granted the usual organisational arrangements—such as a time and place to meet and talk—without which a professional community cannot operate. We exclude any analysis of communities that existed outside the school, not because they were unimportant, but because few provided specific detail. The potential importance of such communities is clear from a study of teacher involvement in a community of scientists, where opportunities for participation included regular seminars at which implications for teaching were discussed. The teachers' confidence, problem-solving skills, professional abilities, and identity were enhanced as a result of this participation, strengthening their ability to stimulate student interest and achievement in science[109]. This study was, however, the only one of its kind.

10.4.1 The nature of professional learning communities within schools

Part of the explanation for the variable accounts of professional communities and associated outcomes is a lack of shared understanding among those who write about them. The concept of community has its origins in anthropology[110], with common themes of interdependence, participation, shared interests, and meaningful relationships[111]. Work in the early 1990s focused on how professional communities were formed and functioned, from the perspective of participating teachers. It became apparent that while teachers found professional communities a source of support, they typically had little impact on the learning of their students[112], so the focus moved to identifying the qualities of communities that promoted professional learning.

As a consequence, a new rationale for such communities—one that went deeper than simple mutual support—was found in theories of distributed cognition and the need for shared expertise to navigate the complexities of teaching. This perspective is articulated by Newmann[113]:

> It [teaching] usually requires information, expertise and support far beyond the resources available to the individual teacher working alone in an isolated classroom. Teachers who collaborate with their colleagues are more likely to be effective with students, because they will benefit from expanded resources. (p. 1)

Others have focused on benefits that relate to the social nature of learning. From this perspective, learning is not merely subject to the influence of social factors, it *is* a social phenomenon[114]. In this synthesis, we have sought to understand how these expanded resources and opportunities to participate determined what was learned and how the learning was supported.

10.4.2 The qualities of professional communities that promote teacher and student learning

Two key qualities and several related conditions are identified in Overview 10.3. These include participants being supported to process new understandings and their implications for teaching, and a focus on analysing the impact of teaching on student learning.

Overview 10.3. Qualities of professional communities that promoted teacher and student learning

Participants were supported to process new understandings and their implications for teaching.

- *Dialogue challenged problematic beliefs and tested the efficacy of competing ideas.*
- *Expertise external to the group brought new perspectives and assisted in developing these dialogical norms.*

The focus was on analysing the impact of teaching on student learning.

- *Artefacts representing student learning helped ground discussions.*
- *Teachers had high but realistic expectations of students and believed they could make a difference.*
- *Norms of collective responsibility for students replaced teacher-focused norms of individualism and autonomy.*

10.4.3 Support to process new understandings

The first quality represents a hybrid of the older emphasis on community and mutual support and the more recent cognitive orientation towards professional learning. At their most basic, the professional communities reported in the core studies supported participants to process new information and to understand the implications for teaching. In order to make a difference to student outcomes, teachers found themselves having to engage in learning that typically seemed a major challenge. As one teacher commented when struggling to understand the implications of professional development in science, "What is really useful is getting together with everybody else and being able to talk about the problems … That support, it really lifts the weight from your shoulders"[115]. Mutual trust and respect are obviously very important if a professional learning community is to offer support to its participants.

Support can, however, be a double-edged sword because collegial interactions can equally well support maintenance of the status quo. Trust, respect, and support may be characteristics of the community but be marshalled to excuse discriminatory teaching practices[116], to remove the focus from teaching quality[117], and/or to justify continuing with practice that is less effective than that being promoted by the professional development[118].

A condition that differentiated the change-supporting communities from those that reinforced the status quo was the set of norms that governed dialogue. When the dialogue failed to challenge problematic beliefs or to test the efficacy of competing ideas, the status quo was likely to be further entrenched. When the reverse was true, the status quo was likely to be challenged[119]. Earl and Katz[120] refer to the disposition that underpins the latter orientation of teacher dialogue as "an inquiry habit of mind". Without such a disposition, dialogue within a professional community is likely to be more a ritual than a learning opportunity.

Involving someone with expertise external to the immediate community was a condition associated with effectiveness and with more challenging dialogue. All studies of professional communities that did not lead to improved outcomes for students lacked external input[121]. In these studies, challenges to assumptions held by community members typically did not happen, either because there was no one in the group with the necessary expertise or because challenges were perceived to be counter-cultural (threats to existing group norms). In effective communities, alternative perspectives introduced by external experts served to deepen teachers' understandings. Not only were external experts able to introduce new perspectives, they were not constrained by existing dialogical norms.

McNaughton and colleagues[122] described how they engaged and challenged teachers' existing beliefs and the theories of practice, using an independent but sophisticated analysis of the teaching–learning relationship. Within their school-based professional communities teachers had discussed strategies to raise their students' reading comprehension levels but had struggled to have an impact. An initial analysis of classroom observations showed that they were using strategies typically associated with effective teaching: the practices they had developed within their own communities were consistent with doing things 'right'. However, when the researchers made a more in-depth analysis of the teaching–learning relationship, they found subtleties that the teachers had not been able to recognise. The teachers were then able to refine some key elements of their practice, with associated improvements in student comprehension. The teachers' disposition towards inquiry underpinned the process. This ensured that, although the researcher–teacher dialogue was challenging, it was also respectful.

10.4.4 The impact of teaching on learning

The second quality of effective professional communities was a focus on analysing the impact of teaching on student learning. The connection between effective teaching and effective learning was taken as a given, and a priority was made of enhancing the ability of teachers to respond to students' learning needs. Activities that supported this focus included collaborative planning, peer observations, and reviews of student responses. An emphasis on the teaching–learning relationship was earlier identified (in the main synthesis) as a key to effective professional development. The importance of this emphasis is mirrored in professional communities.

A condition that supported a focus on the analysis of student learning was the presence of artefacts that served to ground teachers' deliberations in the realities of practice. These included student work, understandings and reactions[123], test results[124], and videos of teaching practice[125]. In some studies, a student perspective was gained in a different way, by teachers taking part in activities positioned as students—either at their own level or the students' level of understanding—followed by discussion of the implications for their own practice[126].

In a contrasting study, Little made a detailed analysis of three professional communities in United States secondary schools[127], describing how group dynamics worked against such grounding. These communities appeared to exemplify effective practice by reserving time to identify and examine problems of practice, opening up new possibilities, disclosing uncertainties, and asking for advice, but in reality, they provided limited opportunities for the participants to learn. One limitation was teachers' superficial, decontextualised descriptions of practice, expressed in generalised language that lacked shared meanings. In these circumstances, it was difficult for teachers to assist one another to be more effective.

Another condition associated with a focus on the analysis of teaching–learning interactions relates to the beliefs that teachers hold about students and their own efficacy in terms of student outcomes[128]. Newmann puts it this way in his analysis of effective professional communities:

> Teachers are focused on student learning. They assume that all students can learn at reasonably high levels, and that teachers can help them, despite many obstacles that students may face outside of the school. Within a strong professional community, this focus is not enforced by rules, but by mutually felt obligation among teachers.
>
> (Newmann 1994, p. 3)

In contrast, a focus on external explanations for poor student learning was a feature of at least two studies in which professional communities failed to have an impact on either teaching practice or student outcomes[129]. In one of these (a New Zealand study)[130], participation reinforced the teachers' and leader's belief that their students came from such impoverished backgrounds that the approach to literacy being promoted in the professional development would simply push them beyond their abilities, only to fail later. These beliefs were never tested or challenged, despite students in neighbouring schools showing evidence of accelerated and sustained progress when using the alternative approach.

The final condition that we identified in the core studies was that norms of collaboration and collective responsibility for student learning replaced norms of individualism and autonomy that emphasised the conditions of teaching. Nearly every core study that described school-based professional communities reported greater collaboration among teachers and more collective responsibility for students. The focus on promoting student learning was, however, sometimes more implicit than explicit. Without such a focus, collaboration can become a sharing of 'war stories' instead of a means for improving the learning of students, as shown in one supplementary study[131].

There is a risk that increased collective responsibility is perceived to undermine the teacher autonomy that is often taken as a hallmark of professionalism[132]. For some teachers, reduced autonomy may connote reduced professionalism. The charge has been made that changes in teaching over the last 20 years amount to a 'deprofessionalising' of the teaching workforce. The basis of this charge is the perception that teachers are now required to meet goals defined by others, to engage in technical management of students and curricula, and to be publicly accountable[133]. What earlier concepts of professionalism typically did not address was the issue of how to bring about change in situations where the recipients of public education were failing to benefit. To achieve such change, teacher autonomy needs to be balanced with a measure of collective responsibility and accountability.

It appears from other evidence in this synthesis, however, that reducing autonomy to the point where teachers are dictated exactly what is to be taught and how also fails to serve students well, and this could justify the above concerns. It was repeatedly shown that professional development based on tight prescription had little or no impact on student outcomes[134] or, if it did, initial improvements were not maintained[135]. For teachers to benefit from the enhanced expertise and resources that professional learning communities can offer, it appears essential that they should have some room to exercise professional discretion. Otherwise the learning opportunities offered teachers would merely emulate student drill-and-skill sessions.

Drawing on other parts of this synthesis, it appears that two conditions need to balance the autonomy and collective responsibility scales. The first is that frameworks used to guide discretionary decisions are understood in some depth so that they can serve as theoretical tools on which to base discussion and instructional decisions. The second is that judgments concerning the effectiveness of practice are focused on agreed outcomes for students. These two conditions obviously also have implications for the content of more formalised professional development.

10.4.5 Implications for professional learning and development

Participation in professional learning communities can either promote professional learning or work against it (by reinforcing the status quo). Communities that promoted professional learning in ways that impacted positively on student learning had a set of definable qualities. These included a focus on opportunities to process new understandings and their implications for teaching, the introduction of new perspectives and challenging of problematic beliefs, and an unrelenting focus on the impact of teaching on student learning. Simply giving teachers time to talk was not enough to promote either their own learning or that of their students.

10.5 Issue 5: Professional learning in secondary school contexts

In this section, we consider professional learning issues that are specific to secondary school contexts. There are a number of major differences between primary and secondary schools that might be thought to influence the kinds of teacher professional development likely to have a positive impact on student outcomes. Secondary schools are typically larger, the students are older, and the curriculum content is more sophisticated. Teachers are more subject-specialised and usually teach one or two subjects to five or six classes at a number of different year levels—instead of many subjects to a single class. High-stakes assessment is a preoccupation. Pre-service teacher training is different. And secondary school teachers are generally believed to have more specialist content knowledge but less pedagogical knowledge than their primary school counterparts.

While all these differences were alluded to in individual studies, the pattern that emerged from our synthesis was one that was overwhelmingly similar, not different, to the overall synthesis. We found no significant differences in terms of the activities provided, the learning processes, the length of time or frequency of the professional development, or where it was held or who delivered it. Even the types of teacher learning content provided were similar, though geared to different levels. On the basis of this synthesis it seems likely that, as far as effective professional learning goes, there is more variation *within* the schooling sectors than *between* them.

One feature unique to secondary schools does, however, exert enormous influence on how professional learning in the sector can and should be structured, and that is the way schools are organised into subject-based departments. This feature has been referred to as 'Balkanisation'[136]. How the different core studies dealt with this issue is discussed below.

10.5.1 Classification of studies

Eleven studies involving professional development and learning in secondary school contexts provided evidence of improved student outcomes and met our methodological criteria. A summary of these core studies is given in Table 10.2. It should be noted that the number of studies is small and that one of them[137] achieved a relatively small effect size.

We encountered a classification issue that stems from differences between countries. In terms of age, grade 8 in the United States is equivalent to year 9 in New Zealand but while grade 8 is most often the last year of junior high/middle school in the United States, year 9 is typically the first year in a New Zealand secondary school. The difficulty is compounded by the fact that junior high/middle schools in the United States vary considerably in terms of how they are organised. In some cases, they are structured similarly to a New Zealand secondary school: the teachers specialise in particular content areas and the students move from teacher to teacher throughout the day. Others are structured more like a typical New Zealand primary school: the students have one teacher who teaches a range of different subjects, and there is some specialist teaching. For this reason, it was decided to exclude United States junior high/ middle schools from this group, except where the professional development was specifically aimed at teachers of grade 8 (New Zealand year 9) students and/or the school was organised into departments.

Table 10.2. Teacher professional learning in a secondary school context: core studies

Study	Focus of the professional learning	Country	Cross-curricular or specific to a particular content area?	Who was involved?	Effect size of student outcomes
1. Adey (1999, 2004)[138]	CASE	UK	Content area specific	Whole department	**0.64**
2. Anderson (1992)[139]	Reading: special needs students	Canada	Content area specific	Individual teachers only	**2.09**

3. Bishop et al. (2005)[140]	Te Kotahitanga Social positioning of and pedagogical relationships with Māori students	NZ	Cross-curricular: information skills Content area: numeracy	Whole-school	**0.76**
4. Confrey et al. (2000)[141]	Mathematics: algebra	US	Content area specific	Whole department	**0.22**
5. D'Oria (2004)[142]	Physical education	Canada	Content area specific	Individual teachers only	Qualitative
6. Huffman, Goldberg, & Michelin (2003)[143]	Physics	US	Content area specific	Individual teachers only	**0.47** to **1.08**
7. Metcalf et al. (2000)[144]	Project Citizen	US, Latvia, and Lithuania	Content area specific	Individual teachers only	**1.00**
8. Moxon (2003)[145]	Restorative justice	NZ	Cross-curricular	Whole-school	Qualitative
9. Ross (1994); Ross et al. (1999)[146]	Cooperative Learning	Canada	Generic pedagogy (attitudes towards help giving and seeking)	Individual teachers only	**0.23** to **0.59**
10. Schober (1984)[147]	Economics	US	Content area specific	Individual teachers only	**0.68**
11. Tasker (2001)[148]	HIV/AIDs	NZ	Content area specific	Whole department	Qualitative

Several other studies described professional learning that included both primary and secondary contexts but, except for one[149], did not report student outcomes for secondary school students in ways that allowed the effect size to be calculated. Where they provided rich descriptions of professional learning specific to secondary schools, these studies were included in the supplementary category (see Table 10.3).

Table 10.3. Teacher professional learning in a secondary school context: supplementary studies

Study	**Focus of the professional learning**	**Country**	**Cross–curricular or specific to a particular content area?**	**Who was involved?**	**Effect size of student outcomes**
1. Absolum (2004a, 2004b)[150]	Assessment for Learning	NZ	Cross-curricular	Various	–
2. Ancess (2000)[151]	Providing a range of opportunities for students to learn	US	Cross-curricular	Whole-school	–

3. Appalachia Education Lab (1994)[152]	Questioning and Understanding to Improve Learning and Thinking (QUILT)	US	Cross-curricular	Whole-school	**0.17**
4. Dubner, Samuel, Silverstein, & Miller (2005)[153]	Science	US	Content area specific	Individual teachers only	**0.26** to **0.33**
5. Fisher (2001)[154]	Literacy	US	Whole-school	Whole-school	–

10.5.2 The issue of departmental structures

The organisation of secondary schools into separate, relatively autonomous, subject-based departments is the characteristic that most clearly distinguishes them from primary schools, and the characteristic that poses the greatest challenges to those who seek to change teacher practice through professional learning. Elmore has claimed that "High schools are, in many ways, the acid test of accountability policies. They are typically large, complex, and loosely-coupled organisations. They are usually balkanised into subject-based departments, each with its own distinctive culture … It is difficult to imagine a less promising institutional structure for being responsive to external pressure for change and improvement" (p. 197)[155].

Broadly speaking, there are two approaches that providers of professional learning can take in response to this issue: confine professional development to particular learning areas or attempt to transcend or remove departmental boundaries.

10.5.3 Professional learning that is specific to a particular content area

As shown in Table 10.2, all but three of the 11 core secondary school studies effectively avoided the problem of departmental divisions by specifically targeting a particular curriculum area. Clearly, if the content of the professional learning is specific to a particular curriculum, departmental boundaries are not a hindrance—they may even be an asset. Adey[156], for example, has claimed that "In secondary schools the department is the natural unit of collegiality for a subject-based innovation" (p. 167). Hubermann[157] goes further, asserting that departmental structures are so embedded that attempts to transcend departmental boundaries are based on "goofy logic": "How much collaboration can we expect between 8th grade physics teachers, 11th grade English teachers and physical education instructors? … I would rather look to the department as the unit of collaborative planning and execution in a secondary school … This is where people have concrete things to tell one another and concrete instructional help to provide one another" (p. 230).

Of the eight subject-based studies, three were school-based, while five involved individual teachers of the same subject but from different schools.

It seems to be widely accepted as a generalisation that secondary school teachers have more specialised subject knowledge but less pedagogical knowledge than their primary school counterparts. Secondary school teachers usually teach only one or two subjects, and these are most often subjects that they have studied at university level. But most have had only one year of teacher training, compared with three years for primary teachers. These differences have given rise to the adage 'Secondary school teachers teach subjects, but primary teachers teach students.' It might be expected, therefore, that professional learning opportunities for secondary school teachers would place less emphasis on their subject content knowledge and more on their pedagogical knowledge. Surprisingly, we did not find this to be the case: subject content knowledge was a major feature of the professional learning in the majority of subject-based studies of professional learning, and in nearly half of the secondary school studies as a whole[158].

There are several reasons that might explain this emphasis on content knowledge. Firstly, the increased age and intellectual sophistication of students raises the bar in terms of what counts as adequate subject knowledge. In one study, for example, some of the participating teachers were not confident in their knowledge of the algebra they were expected to teach[159]. Secondly, teachers are not necessarily specialists in the subjects that they teach. This was particularly true of newly introduced subject content. For example, in Tasker's study of teacher professional learning related to HIV/AIDs[160], the teachers were teaching a topic that they had not taught before—it was part of a health curriculum that had been introduced relatively recently. In another study, non-specialist teachers were required to teach a unit on economics that had been newly mandated by the district[161], while in yet another, a civics education module was introduced into an existing social studies curriculum[162].

10.5.4 Cross-curricular professional learning in a secondary school context

In most of the studies, difficulties associated with departmentalisation did not arise because the professional learning was limited to a particular learning area. Despite the prevalence of subject-specific professional learning there are clearly situations in which reformers would like to transcend departmental boundaries and bring about changes that are broader in scope. Using the department as the unit for professional learning may be fine when addressing issues that are specific to a particular learning area but school-wide initiatives require teachers to think and coordinate their efforts across departmental boundaries[163]. As Siskin[164] (1997) concludes, departmental divisions confront reformers with powerful barriers to school-wide communication and community.

10.5.4.1 Major structural reform

A major structural reform is one way of addressing the challenges that the departmental structure poses to teacher professional development, but only one supplementary study documented such a reform. In this study[165], a secondary school was restructured into six self-contained, autonomous, interdisciplinary teaching teams, based around particular themes. One of these teams created a programme in which students' studies of literature, mathematics, physics, and physical education were all integrated around the theme of motion. The courses were team-taught and staff implemented a 'fail one—fail all' grading policy, where all the teachers in the programme had to reach consensus on the single overall grade that was to be awarded to each student. This innovation in curriculum integration arose out of a teacher's conviction that many students avoided physics because they were intimidated by the mathematics involved and that the high language needs of their predominantly ESOL students would be better met by an integrated, cross-curricular approach to literacy. Researchers claimed that this restructuring facilitated teacher learning by providing more opportunities for teachers to observe, discuss, and be observed by their peers, and to develop a more in-depth and holistic knowledge of the individual learning needs and strengths of their students. Senior managers at the school felt that this structure enabled them to better support the teachers in their professional learning because they were dealing with a small number of teams rather than a large number of individual teachers.

All other studies of professional development either made use of existing school structures (such as subject departments) to organise the professional learning or established structures (such as cross-curricular discussion groups) that complemented rather than replaced existing structures.

As shown in tables 10.2 and 10.3, only three of the 11 core studies, and one supplementary study that had positive but smaller effect sizes than the others, involved cross-curricular professional learning and three of these four studies were school-based. In the other study[166], individual teachers from different areas of the curriculum participated in off-site professional development focused on cooperative learning. While they presumably had to relate to teachers from other curriculum areas during the professional learning and were able to successfully apply generic approaches to teaching and learning to their own particular subjects when back in the classroom, they did not have to deal with departmental barriers within their own schools.

We have identified four factors common to the three cross-curricular, school-based studies that appear to have enabled them to overcome the barriers posed by departmental boundaries and to change teacher practice in ways that resulted in improved outcomes for students:

1. Firstly, and perhaps obviously, the focus of the professional learning was on an aspect of teaching that was relevant to all learning areas. The QUILT study focused on improving teacher questioning skills; Te Kotahitanga, on improving relationships between teachers and their Māori students; and the restorative justice intervention, on improving school climate and reducing suspensions. The content of the other two cross-curricular studies could also be seen to similarly constitute generic educational activity. It seems that for cross-curricular professional learning in secondary contexts to be successful, the learning content must both be relevant and be seen to be relevant to teachers of different subjects.

2. In all three studies, leaders at senior management level committed time and resources to the project and provided public support for it. In each case, one senior staff member had formal leadership responsibility for the professional learning programme. For example, the study that documented the introduction of restorative justice policies and practices into a school reported that the principal was strongly supportive of the programme, allocating considerable resources to the professional learning in both its initial and maintenance phases and regularly and publicly backing the programme. The school appointed a restorative justice coordinator who was responsible for providing ongoing professional learning opportunities. Such leadership is particularly important and challenging in secondary schools, where departmental divisions have to be transcended in order to achieve a shared vision and common purpose.

3. All three studies used a variety of structures other than subject departments for grouping teachers for professional learning purposes. In all the studies, some sessions involved all the participants, while others engaged staff in smaller groups and/or as individuals. Three of the four studies grouped teachers according to a common class they taught, rather than by subject. Teachers involved in Te Kotahitanga[167], for example, participated in regular 'co-construction' meetings at which teachers from different curriculum areas met to discuss issues affecting the engagement of Māori students in a particular class that they all taught. They set and worked towards common targets for this class, targets such as improving attendance or increasing engagement of particular students. The restorative justice study reported similar opportunities in the form of conferences involving all the teachers of a particular class, often with the students themselves, where the discussion centred on issues and solutions. In all three studies, these cross-curricular forums supported a shift in teacher focus—away from subjects and onto students and generic issues.

4. All four studies involved some mechanism that helped teachers translate the new practice into their own classroom contexts. While this was true of all studies with positive outcomes for students, regardless of sector, it is likely to have been even more important at secondary school level because the teachers had not only to translate theory into practice, but they had to translate generic pedagogies into classrooms that were highly specialised by subject. In these studies, opportunities for individualised support were provided, usually in the form of one-to-one planning, observation, and feedback sessions.

10.5.5 Implications for professional learning and development

Despite the significant differences that exist between primary and secondary schooling, the characteristics of effective professional development were very similar for both, with only one aspect markedly different: the challenge of promoting learning across the school. This fourth consideration in no way contradicted the findings of the synthesis as a whole. We suggest, therefore, that the overall findings of this synthesis are relevant to those involved with professional learning in secondary schools, provided that the issue of departmental structures is addressed.

References

1 Core studies are those with moderate to large outcomes for students encompassing medium to broad curriculum content.

2 Absolum, M. (2004b). *ATOL programme 2004* (Report prepared for company purposes only). Auckland: Evaluation of Evaluation Associates Ltd.

3 Adey, P. (1999). *The science of thinking, and science for thinking: A description of Cognitive Acceleration through Science Education (CASE).* Innodata Monographs 2. Geneva, Switzerland: International Bureau of Education (ED442622).

Adey, P. (2004). *The professional development of teachers: Practice and theory*. London: Kluwer Academic Publishers.

4 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education, 4* (3), 179-210.**

5 Bianchini, J. (1997). Where knowledge construction, equity and context intersect: Students learning of science in small groups. *Journal of Research in Science Teaching, 34* (10), 1039-1065.

6 Cohen, E. G. & Lotan, R. A. (1997a). Creating equal status interaction in heterogeneous classrooms: Evidence from complex instruction. In R. Ben-Ari & Y. Rich (Eds.), *Enhancing education in heterogeneous schools* (pp. 249-280). Israel: Bar-Ilan University Press.

7 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream education. Phase 2: Towards a whole school approach* (Progress report and planning document). Wellington, New Zealand: Ministry of Education.

8 Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. *Teaching and Teacher Education, 11* (1), 81-95.

9 Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C. P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

10 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000). Implementation research as a means of linking systemic reform and applied psychology in mathematics education. *Educational Psychologist, 35* (3), 179-191.

11 D'Oria, T. (2004). *How I improved my teaching practice in Grade 9 boys' physical education to increase students' participation and enjoyment*. Unpublished Masters thesis, Nipissing University, Canada.

12 Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies.* London, UK: DfES.

13 Kennedy, M. M. (1999a). Ed schools and the problem of knowledge. In J. Raths & A. McAninch (Eds.), *What counts as knowledge in teaching?* (pp. 29-45). Stamford, CA: Ablex.

14 Mason, D. A. & Good, T. (1993). Effects of two-group and whole-class teaching on regrouped elementary students' mathematical achievement. *American Educational Research Journal, 30* (2), 328-360.

15 McClain, K. & Cobb, P. (2001). An analysis of development of sociomathematical norms in one first-grade classroom. *Journal for Research in Mathematics Education, 32* (3), 236-266.

16 **McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.**

17 **Moxon, J. (2003). *A study of the impact of the Restorative Thinking Programme within the context of a large multi-cultural New Zealand secondary school.* Unpublished Masters thesis, The University of Auckland, Auckland, New Zealand.**

18 Parke, H. M. & Coble, C. R. (1997). Teachers designing curriculum as professional development: A model for transformational science teaching. *Journal of Research in Science Teaching, 34* (8): 773-789.

19 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final Report). Wellington, NZ: Learning Media.

[20] Phillips, G. & Smith, P. (1997). *A third chance to learn: The development and evaluation of specialised interventions for young children experiencing the greatest difficulty in learning to read.* Wellington, NZ: New Zealand Council for Educational Research.

[21] **Phillips, J. (2003). Powerful learning: Creating learning communities in urban school reform. *Journal of Curriculum and Supervision, 18* (3), 240-258.**

[22] Ross, J. A. (1994). The impact of an inservice to promote cooperative learning on the stability of teacher efficacy. *Teaching and Teacher Education, 10* (4), 381-394.

Ross, J. A., Roleiser, C., & Hogaboam-Gray (1999). Effects of collaborative action research on the knowledge of five Canadian teacher-researchers. *The Elementary School Journal, 99* (3), 255-274.

[23] **Saxe, G. B., Gearhart, M., & Nasir, N. (2001). Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support. *Journal of Mathematics Teacher Education, 4*, 55-79.**

[24] Schober, H. M. (1984). The effects of inservice training on participating teachers and students in their economics classes. *The Journal of Economic Education, 15* (4), 282-295.

[25] Schorr, R. Y. (2000). Impact at the student level: A study of the effects of a teacher development intervention on students' mathematical thinking. *Journal of Mathematical Behavior, 19*, 209-231.

[26] Taylor, B., Pearson, D., & Rodriguez. M. (2005). The CIERA school change framework: An evidence-based approach to professional development and school reading improvement. *Reading Research Quarterly 40* (1): 40-69.

[27] Timperley, H. & Wiseman, J. (2003). *The sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement.* Wellington, New Zealand: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

[28] Vandevoort, L., Amrein-Beardsely, & A. Berliner, D. (2004). National board certified teachers and their students' achievement. *Education Policy Analysis Archives 12* (46): 1-117.

[29] Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005). *Findings from the New Zealand Numeracy Development Project 2004*. Wellington, NZ: Ministry of Education.

[30] Hohepa, M., Williams, N., & Barber, J. (2006). *Whakawhanuitia te Hinengaro/Broadening the mind: Reading to learn in te reo Māori: Reading comprehension and language development*. Final Milestone Report to Nga Pae o te Maramatanga: National Institute of Research Excellence for Māori Development and Advancement.

[31] **Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30* (3), 555-583.**

[32] Timperley, H. & Parr, J. (2002). *Evaluation of the Literacy Leadership Initiative: The Enhancement Project.* Report to the Ministry of Education, Wellington: New Zealand.

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 24).

[33] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 12).

[34] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

[35] Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[36] Timperley, H. & Robinson, V. M. J. (2001). Achieving school improvement through challenging and changing teachers' schema. *Journal of Educational Change, 2* (4), 281-300.

[37] Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[38] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

Phillips, J. (2003), loc. cit. (ref. 22).

[39] **Phillips, J. (2003), loc. cit. (ref. 22).**

[40] Timperley, H. & Phillips, G. (2003). Changing and sustaining teachers' expectations through professional development in literacy. *Teaching and Teacher Education, 19*, 627-641.

[41] **Phillips, J. (2003), loc. cit. (ref. 22).**

[42] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

Timperley, H. S. (2005a). Distributed leadership: Developing theory from practice. *Journal of Curriculum Studies, 37* (6), 395-420.

[43] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 4).**

[44] Swan, S. & White, R. (1994). *The thinking books.* London; Washington DC: Falmer Press.

[45] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

[46] Black, P. & Wiliam, D. (1998a). *Inside the black box: Raising standards through classroom assessment.* London: King's College.

Black, P. & Wiliam, D. (1998b). Assessment and classroom learning. *Assessment in Education, 5* (1), 7-75.

[47] Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research. 77* (1), 81-112.

[48] ibid.

[49] Robinson, V. M. J., Phillips, G., & Timperley, H. (2002). Using achievement data for school-based curriculum review: A bridge too far? *Leadership and Policy in Schools, 1* (1), 3-29.

[50] Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 40).

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[51] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 12).

[52] Absolum, M. (2004b), op. cit. (ref. 2).

[53] Absolum, M. (2006). *Mining the data: Learning to use student achievement data to effect change* (Project proposal submitted to the Ministry of Education). Assess to Learn Project. Auckland: Evaluation Associates.

Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 12).

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 13).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

Phillips, G. & Smith, P. (1997), op. cit. (ref. 21).

Timperley, H. & Phillips, G. (2003), loc. cit. (ref. 40).

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[54] Goldenberg, C. & Sullivan, J. (1994). *Making change happen in a language minority school: A search for coherence.* (Educational Practice Report): National Center for Research on Cultural Diversity and Second Language Learning.

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

Davis, A. (2006). *Characteristics of teacher expertise associated with raising the reading comprehension abilities of Years 5-9 students.* Unpublished doctoral thesis, The University of Auckland, Auckland, New Zealand.

[55] Education Act. No. 80 New Zealand Government. (1989).

[56] Stein, M. & Nelson, B. (2003). Leadership content knowledge. *Educational Evaluation and Policy Analysis, 25* (4), 423-448.

[57] Gronn, P. & Rawlings-Sanaei, F. (2003). Recruiting principals in a climate of disengagement. *Australian Journal of Education, 47* (2), 172-184.

Copland, M. A. (2003). Leadership of inquiry: Building and sustaining capacity for school improvement. *Educational Evaluation and Policy Analysis, 25* (4), 375-395.

[58] Gronn, P. & Rawlings-Sanaei, F. (2003), loc. cit. (ref. 57).

[59] Stein, M. & Nelson, B. (2003), loc. cit. (ref. 56).

[60] Copland, M. A. (2003), loc. cit. (ref. 57).

[61] See for example, Phillips, G. E., McNaughton, S., & MacDonald, S. (2001). *Picking up the pace: Effective literacy interventions for accelerated progress over the transition into decile one schools* (Final Report). Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/web/document/document_page.cfm?id = 6444.

Phillips, G. & Smith, P. (1997), op. cit. (ref. 21).

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[62] Details of these findings are provided in the synthesis of studies relating to mathematics (Chapter 6) and science (Chapter 7).

[63] Timperley, H., Parr, J. M., & Higginson, R. M. (2001). *Evaluation of the Literacy Leadership Initiative: The Enhancement Programme 2001*. Final Report to the Ministry of Education. Wellington, NZ: Ministry of Education.

[64] Timperley, H. & Robinson, V. M. J. (2000). Workload and the professional culture of teachers. *Educational Management and Administration, 28* (1), 47-62.

[65] Bryk, A. S. (1999). Policy lessons from Chicago's experience with decentralization. In D. Ravitch (Ed.), *Brookings Papers on Education Policy* (pp. 67-128). Washington, DC: Brookings Institution Press.

[66] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

[67] **Lipman, P. (1997). Restructuring in context: A case study of teacher participation and the dynamics of ideology, race and power. *American Educational Research Journal, 34* (1), 3-37.**

[68] Hunter, M. (1976). *Prescription for improved instruction.* El Segundo, CA: TIP.

Robbins, P. & Wolfe, P. (1987). Reflections on a Hunter-based staff development project. *Educational Leadership, 44* (5), 56-61.

Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.

[69] Hunter, M. (1976), op. cit. (ref. 68).

Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 68).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 68).

[70] Hattie, J. & Timperley, H. (2007), loc. cit. (ref. 47).

[71] Adey, P. (2004), op. cit. (ref. 3).

Goldenberg, C. & Sullivan, J. (1994), op. cit. (ref. 54).

72 Phillips, G. & Smith, P. (1997), op. cit. (ref. 21).

73 For reasons of space, these studies have not been listed separately.

74 Lipman, P. (1997), loc. cit. (ref. 67).

Cazden, C. B. (1990). Differential treatment in New Zealand: Reflections on research in minority education. *Teaching and Teacher Education, 6* (4), 291-303.

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 24).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 63).

75 **Gottfredson, D., Marciniak, E., Birdseye, A., & Gottfredson, G. (1995). Increasing teacher expectations for student achievement. *Journal of Educational Research, 88* (3), 155-164.**

Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 68).

Van der Sijde, P. (1989). The effect of a brief teacher training on student achievement. *Teaching and Teacher Education, 5* (4), 303-314.

76 Baker, S. & Smith, S. (1999). Starting off on the right foot: The influence of four principles of professional development in improving literacy instruction in two kindergarten programs. *Learning Disabilities Research & Practice, 14* (4), 239-253.

77 Robinson, V. M. J. (1993). *Problem-based methodology: Research for the improvement of practice*. Oxford: Pergamon Press.

78 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 7).

Cobb, P., Wood, T., Yackel, D., Nicolls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (1991). Assessment of a problem-centered second-grade mathematics project. *Journal for Research in Mathematics Education, 22,* 13-29.

Phillips, J. (2003), loc. cit. (ref. 22).

79 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 7).

80 Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research, 72* (3), 387-431.

81 ibid.

82 Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006), op. cit. (ref. 20).

83 Spillane, J. P., Reiser, B. J., & Reimer, T. (2002), loc. cit. (ref. 80).

84 **Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23* (2), 145-170.**

85 Putnam, R. T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29* (1), 4-15.

86 Kennedy, M. M. (Kennedy, 1999a), loc. cit. (ref. 14).

87 Robinson, V. M. J. & Lai, M. K. (2006). *Practitioner research for educators: A guide to improving classrooms and schools.* Thousand Oaks, California: Corwin Press.

88 Bransford, J., Derry, S., Berliner, D., Hammerness, K., & Beckett, K. L. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 40-87). National Academy of Education, Committee on Teacher Education. San Francisco, CA: Jossey Bass.

89 Firestone, W. A., Schorr, R. Y., & Monfils, L. F. (2004). *The ambiguity of teaching to the test: Standards, assessments, and education reform*. Mahwah, NJ: Lawrence Erlbaum.

90 Hargreaves, A. (2002). Sustainability of educational change: The role of social geographies. *Journal of Educational Change, 3* (3-4), 189-214.

91 For example, see MacLaughlin, M.W. & Talbert, J.E. (1990). The contexts in question: the secondary school workplace. In M.W. McLaughlin, J.E. Talbert, & N. Bascia (Eds.), *The contexts in question: The secondary schools: Teachers' realities.* New York: Teachers College Press.

92 Boshuizen, H. P. A., Bromme, R., & Gruber, H. (2004). *Professional learning: Gaps and transitions on the way from novice to expert*. Dordrecht: Kluwer.

93 Robinson, V. M. J. & Lai, M. K. (2006), op. cit. (ref. 87).

94 ibid.

95 Ross, J. A. (1994), loc. cit. (ref. 23).

Ross, J. A., Roleiser, C., & Hogaboam-Gray (1999), loc. cit. (ref. 23).

96 McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

97 Lai M. K. & McNaughton S. (forthcoming). Raising student achievement in poor, urban communities through evidence-based conversations. In L. Earl and H. Timperley (Eds.), *Professional Learning Conversations: Challenges in Using Evidence.* Springer Publishing

98 Spillane, J. P., Reiser, B. J., & Reimer, T. (2002), loc. cit. (ref. 80).

99 ibid.

100 **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 4).**

[101] Alton-Lee, A., McBride, T., Greenslade, M., & Nuthall, G. (1997). *Gendered discourses in social studies: Intermediate students' learning and participation during studies of Antarctic work and survival focused on women.* Report to the Ministry of Education. Understanding Learning and Teaching Project 3. Wellington: New Zealand Ministry of Education.

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

[102] Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 13).

[103] Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[104] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 7).

Moxon, J. (2003), op. cit. (ref. 18).

[105] Spillane, J. P., Reiser, B. J., & Reimer, T. (2002), loc. cit. (ref. 80).

[106] **Coburn, C. E. (2001), loc. cit. (ref. 84).**

Lipman, P. (1997), loc. cit. (ref. 67).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 24).

Timperley, H., Parr, J., & Werner, S. (2004). *Literacy professional development project: Milestone report.* Wellington, NZ: Ministry of Education.

Timperley H. & Robinson, V. M. J. (1998). Collegiality in schools: Its nature and implications for problem solving. *Educational Administration Quarterly, 34* (5), 608-629.

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 36).

[107] Lipman, P. (1997), loc. cit. (ref. 67).

[108] ibid.

Phillips, J. (2003), loc. cit. (ref. 22).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 24).

ibid. condition b.

Timperley, H., Parr, J., & Werner, S. (2004), op. cit. (ref. 106).

Timperley, H., Smith, L., Parr, J., Portway, J., Mirams, S., Clark, S., Allen, M., & Page, J. (2004). *Analysis and use of student achievement data. Final report to the Ministry of Education*. Wellington, New Zealand: Ministry of Education.

[109] Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

Samuel, C., Silverstein, M., & Dubner, J. (2004). *Columbia University's summer research program for science teachers.* Paper presented at the American Chemical Society National Meeting, Anaheim, CA.

[110] Grossman, P., Wineburg, S., & Woolworth, S. (2001). Toward a theory of teacher community. *Teachers College Record, 103* (6), 942-1012.

[111] Westheimer, J. (1998). *Among school teachers: Community, individuality, and ideology in teachers' work.* New York: Teachers College Press.

[112] King, M. B. (2002). Professional development to promote schoolwide inquiry. *Teaching and Teacher Education, 18* (3), 243-257.

Louis, K. S. & Marks, H. M. (1998). Does professional community affect the classroom? Teachers' work and student experiences in restructuring schools. *American Journal of Education, 106*, 532-575.

[113] Newmann, F. M. (1994). *School-wide professional community: Issues in restructuring schools* (Issue Report No. 6). Madison, WI: Center on Organisation and Restructuring of Schools, University of Wisconsin.

[114] **Palincsar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998). Designing a community of practice: Principles and practices of the GIsML community. *Teaching and Teacher Education, 14* (1), 5-19.**

[115] Adey, P. (2004), op. cit., p. 129 (ref. 3).

[116] Lipman, P. (1997), loc. cit. (ref. 67).

[117] Timperley, H. & Robinson, V. M. J. (2001), op. cit., case 3, (ref. 36).

[118] **Coburn, C. E. (2001), loc. cit. (ref. 84).**

[119] Annan, B., Lai, M. K., & Robinson, V. M. J. (2003). Teacher talk to improve teaching practices. *Set, Research Information for Teachers (1)*, 31-35.

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

[120] Earl, L. & Katz, S. (2005). *Learning from networked learning communities (phase 2): Key features and inevitable tensions.* Phase 2 Report of the Networked Learning Communities External Evaluation. London: DfES.

[121] Lipman, P. (1997), loc. cit. (ref. 67).

Saxe, G. B., Gearhart, M., & Nasir, N. (2001), loc. cit. (ref. 24).

Timperley, H., Parr, J. M., & Higginson, R. M. (2001), op. cit. (ref. 63).

[122] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 17).

[123] Eighteen different studies referred to these kinds of artefacts but are too numerous to list individually.

[124] Twenty different studies referred to these kinds of artefacts but are too numerous to list individually.

[125] Schorr, R. Y. (2000), loc. cit. (ref. 26).

Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005). Effects of a cooperative learning program on the

elaborations of students during help seeking and giving. *American Educational Research Journal, 42* (1), 115-151.

Caulfield-Sloan, M. B. & Ruzicka, M. F. (2005). The effect of teachers' staff development in the use of higher-order questioning strategies on 3rd grade students' rubric science assessment performance. *Planning and Changing, 36* (3/4), 157-175.

126 Eleven different studies referred to these kinds of activities but are too numerous to list individually.

127 Little, J. W. (2003). Inside teacher community: Representations of classroom practice. *Teachers College Record, 105* (6), 913-945.

128 Newmann, F. M. (1994), op. cit. (ref. 113).

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

129 Lipman, P. (1997), loc. cit. (ref. 67).

Timperley, H. & Robinson, V. M. J. (2001), loc. cit. (ref. 36).

130 Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 28).

131 Lipman, P. (1997), loc. cit. (ref. 67).

132 Hargreaves, A. & Goodson, I. (1996). Teachers' professional lives: Aspirations and actualities. In I. Goodson & A. Hargreaves (Eds.), *Teachers' professional lives* (pp. 1—27). London: Falmer Press.

Locke, T. (2001). Curriculum, assessment and the erosion of professionalism. *New Zealand Journal of Educational Studies, 36* (1), 5-23.

133 Locke, T. (2001), loc. cit. (ref. 132).

Sachs, J. (1997). Reclaiming the agenda of teacher professionalism: An Australian experience. *Journal of Education for Teaching, 23* (3), 263-275.

134 Van der Sijde, P. (1989), loc. cit. (ref. 75).

135 Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 68).

136 Hargreaves, A. & Macmillan, R. (1995). The Balkanization of secondary school teaching. In L. S. Siskin & J. W. Little (Eds.), *The subjects in question: Departmental organization and the high school* (pp. 141-171). New York: Teachers College Press.

137 **Appalachia Educational Lab. (1994a). *Collegial investigations: Shared inquiry through disciplined discussion and action research*. Charleston, WV: Author (ED403229).**

Appalachia Educational Lab. (1994b). *Questioning and Understanding to Improve Learning and Thinking (QUILT): The evaluation results. A proposal to the National Diffusion Network (NDN), documenting the effectiveness of the QUILT professional development program.* Charleston, WV: Author (ED403229).

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 10).

138 Adey, P. (1999), op. cit. (ref. 3).

Adey, P. (2004), op. cit. (ref. 3).

139 Anderson, V. (1992). A teacher development project in transactional strategy instruction for teachers of severely reading-disabled adolescents. *Teaching and Teacher Education, 8* (4), 391-403.

140 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 7).

141 Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 10).

142 D'Oria, T. (2004), op. cit. (ref. 11).

143 Huffman, D., Goldberg, F., & Michelin, M. (2003). Using computers to create constructivist learning environments: Impact on pedagogy and achievement. *Journal of Computers in Mathematics and Science Teaching, 22* (2), 153-170.

144 Metcalf, K. K., Vontz, T. S., & Patrick, J. J. (2000). Effects of Project Citizen on the civic development of adolescent students in Indiana, Latvia, and Lithuania. In T. S. Vontz & K. K. Metcalf & J. J. Patrick (Eds.), *"Project Citizen" and the civic development of adolescent students in Indiana, Latvia, and Lithuania* (pp. 125-146). Bloomington, IN: ERIC Clearinghouse for Social Studies/Social Science Education.

145 **Moxon, J. (2003), op. cit. (ref. 18).**

146 Ross, J. A. (1994), loc. cit. (ref. 23).

Ross, J. A., Roleiser, C., & Hogaboam-Gray (1999), loc. cit. (ref. 23).

147 Schober, H. M. (1984), loc. cit. (ref. 25).

148 **Tasker, G. (2001). *Students' experience in an HIV/AIDS-sexuality education programme: What they learnt and the implications for teaching and learning in health education.* Unpublished doctoral thesis, Victoria University of Wellington, Wellington, New Zealand.**

149 **Appalachia Educational Lab. (1994a), op. cit. (ref. 137).**

150 Absolum, M. (2004a). *Assess to Learn Project* (Project proposal submitted to the Ministry of Education). Auckland: Evaluation Associates.

Absolum, M. (2004b), op. cit. (ref. 2).

151 **Ancess, J. (2000). The reciprocal influence of teacher learning, teaching practice, school restructuring and student learning outcomes. *Teachers College Record, 102* (3), 590-619.**

152 **Appalachia Educational Lab. (1994b), op. cit. (ref. 137).**

[153] Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

[154] Fisher, D. (2001). Trust the process: Increasing student achievement via professional development and process accountability. *NASSP Bulletin, 85* (629), 67-71.

[155] Elmore, R. (2003). Accountability and Capacity, in M. Carnoy & R. Elmore & L.S. Siskin (Eds), *The New Accountability: High Schools and High-Stakes Testing* (pp. 195-209). New York, RoutledgeFalmer.

Siskin, L. S. (1997). The challenge of leadership in comprehensive high schools: School vision and departmental divisions, *Educational Administration Quarterly 33,* 604-623.

[156] Adey, P. (2004), op. cit. (ref. 3).

[157] See page 230 in Huberman, cited in Brown, M. & Rutherford, D. (1999). A re-appraisal of the role of the head of department in UK secondary schools. *Journal of Educational Administration, 33* (3).

[158] Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 10).

D'Oria, T. (2004), op. cit. (ref. 11).

Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005), op. cit. (ref. 37).

Metcalf, K. K., Vontz, T. S., & Patrick, J. J. (2000), loc. cit. (ref. 144).

Samuel, C., Silverstein, M., & Dubner, J. (2004), op. cit. (ref. 109).

Schober, H. M. (1984), loc. cit. (ref. 25).

Tasker, G. (2001), op. cit. (ref. 148).

[159] See, for example., Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000), loc. cit. (ref. 10).

[160] **Tasker, G. (2001), op. cit. (ref. 148).**

[161] Schober, H. M. (1984), loc. cit. (ref. 25).

[162] Metcalf, K. K., Vontz, T. S., & Patrick, J. J. (2000), loc. cit. (ref. 144).

[163] Timperley, H. & Robinson, V. M. J. (2000), loc. cit. (ref. 64).

[164] Siskin, L. S. (1997), loc. cit. (ref. 155).

[165] **Ancess, J. (2000), loc. cit. (ref. 151).**

[166] Ross, J. A. (1994), loc. cit. (ref. 23).

Ross, J. A., Roleiser, C., & Hogaboam-Gray (1999), loc. cit. (ref. 23).

[167] Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005), op. cit. (ref. 7).

11. Sustainability

If teacher engagement with new ideas and practices is to be more than a brief encounter, there are issues of sustainability to be considered. Long-term impact is likely to be more important than short-term gains. Coburn[1] described the typical scenario when a reform of some kind is initiated: a short-term influx of resources, professional development, and other forms of assistance to facilitate implementation, which then dissipates over time as the external support is withdrawn. Sustainability typically examines what happens in this latter phase[2]. For example, the central question addressed by Century and Levy[3] in their paper on sustainability was "How do we ensure that the programs we are implementing will last?" This question immediately begs another: 'What aspects of the programmes should be lasting in one year's time or in five or ten years' time?' The simple answer is 'The programme or pedagogical approaches that were promoted through the professional learning/development experience.' Given that little in teaching happens exactly as intended, and that the enactment of "surface manifestations (such as discrete activities, materials, or classroom organisation) rather than deeper pedagogical principles" is a common scenario[4] (p. 4), a more sophisticated answer is needed. One possibility is that the underlying principles of the programme/approach and the associated teacher beliefs and norms of social interaction with students are maintained over time[5]. Sustainability under these circumstances requires sufficient depth of principled knowledge for teachers to be able to recognise what is consistent and inconsistent with the changed practice being promoted.

There is a tension, however, between maintenance of particular practices or principles and the central issue addressed in this synthesis—the promotion of professional learning in ways that have positive outcomes for diverse students. To expect only that teachers will implement what others require of them, whether principles or practices, is a very limiting approach to professional learning, and one that we reject as an ideal. We would expect any definition of sustainability to include reference to ongoing professional learning that will lead to continuing improvement.

Improvement is often associated with adaptation. For example, Century and Levy (2002) define sustainability as "the ability of a program to maintain its core beliefs and values and use them to guide program adaptations to changes and pressures over time." A concern we have with this definition is that adaptation does not necessarily lead to improvement. Timperley and Wiseman[6] found that the students of teachers who made the greatest adaptations to an approach to teaching literacy, on the grounds that such adaptations better met the needs of their students, actually had poorer literacy outcomes than those whose teachers implemented the approach as intended.

A simplistic solution to this conundrum is to judge sustainability on the basis of improved student outcomes. Judgments made solely on this basis, however, are as problematic as judgments based on adaptations. It is well recognised that focusing on test scores can lead to a narrow and impoverished curriculum[7]. Alternatively, if tests are of sufficient quality that they are worth teaching to, such a focus may lead to an enriched curriculum as more worthwhile content is covered in greater depth. Given the emphasis in this synthesis on student outcomes, one of our key criteria for judging sustainability has to be continued, improved, worthwhile student outcomes. A reliance on tests as measures of improvement can have unintended consequences that impact on sustainability, such as decreased teacher morale and motivation[8]. On the other hand, increases in test scores following changed practice can boost morale and motivate teachers to persist with the changes[9].

Sometimes the conditions that make for sustainability are not considered until the end of a professional development programme—or even after it has finished. Our view is that the conditions for sustainability are set in place during the professional learning experience as much as after it. For example, if ongoing inquiry into the impact of practice on students is a condition associated with sustainability, then teachers must be given the opportunity to learn the skills to engage in such inquiry.

When mapping the studies onto the framework, we identified a number of factors in the professional learning context that may contribute to sustainability. A principal factor, alluded to above, was the extent to which the professional learning opportunities equipped teachers with the skills for ongoing inquiry into the impact of their practice on students, and whether such learning opportunities continued over time.

A second factor was whether the professional learning experiences were sufficiently principle-driven for teachers to understand how their adaptations fitted with the fundamental principles of the change agenda and their practice context. Depth of principled knowledge has been consistently identified as an essential condition for sustaining quality practice[10].

A third factor relates to the social context in which the teaching/learning was situated: in what ways did the wider policy and organisational arrangements that governed teachers' practice contexts support or inhibit the sustainability of principled practice and improved student outcomes? Particularly important were ongoing opportunities for teachers to deepen relevant knowledge and skills and to work and learn collaboratively with colleagues as they tested the impact of their teaching on student outcomes.

11.1 Methodological approach

Consistent with the selection policy used elsewhere in this synthesis, our first step was to identify those studies that reported on student outcomes after external support had been largely or completely withdrawn. This definition did not preclude all further use of external expertise but it did preclude further support from the experts associated with the programme or support of similar intensity. The outcomes reported may have improved, been maintained, or have declined. As noted above, we were mindful of the possibility that the outcomes being measured may not have been worth sustaining but we found that this was not an issue in any of the studies that reported them.

What was a problem was the small number of studies that provided information about the ongoing impact of professional development on students[11]. Some authors explained how, in an effort to maximise the chances that changes would be sustained, structures and processes were put in place while the external providers were involved with the school[12]. These typically took the form of leadership training and the provision of opportunities for teachers to meet and discuss new practices. Other authors saw sustainability in terms of the continued engagement of external providers with schools[13]. From a policy perspective, we considered ongoing dependence on providers to be problematic, with respect to both cost and the goal of developing a skilled and self-improving professional workforce. In this circumstance, professional learning would always be dependent on someone else.

> Sustainability was not neglected in the literature, but it was treated as an article of faith rather than a condition subject to empirical verification.

Sometimes, the evidence for sustainability took the form of reports from teachers that they were continuing to implement the new programme or approach[14]. The problem with such evidence is that self-reports of implementation and enthusiasm are not necessarily associated with maintenance of gains in student outcomes. Researchers who followed up the Madeline Hunter model in the United States[15], for example, received very positive reports from teachers, while student achievement declined significantly. We must reiterate that the evidence base for this chapter on sustainability is very thin, and the conclusions, therefore, should be considered speculative.

For the studies that did report student outcomes following the withdrawal of external support, those characteristics of the professional development that were identified in the introduction to this section were mapped onto the framework used for the main synthesis. These included:

- Which aspects of the professional development (behaviours, principles, theories, etc.) were expected to be sustained (stated or implied)?
- At what level (for example, classroom, year level, whole-school) was it expected that implementation would be sustained?
- What kinds of conditions for sustainability were put in place *during* the professional learning/development? (Tools for evidence-informed inquiry? A focus on theory/principle? Any other conditions?)
- What kinds of conditions for sustainability were put in place after external support was withdrawn? (Was implementation integrated in a way that was coherent with the school curriculum, state/national policy? Was implementation institutionalised through school restructuring? Was implementation institutionalised through school re-culturing?)

11.2 What works for whom to sustain improved student outcomes

Within the limitations of the small evidence base, a number of qualities were identified that were associated with sustainability. These are summarised in Overview 11.1.

Overview 11.1. Conditions found in studies that demonstrated sustainability

The professional development content

- A strong theoretical understanding provided the foundation for principled changes to practice.
- Teachers were equipped with the skills to inquire into the impact of their teaching on student learning, particularly to understand students' thinking when problematic.

Organisational conditions

- Leaders provided conditions for collective, evidence-informed inquiry, and for improved pedagogical content and assessment knowledge.

  New teachers were systematically inducted into the school's approach to professional learning and new principals continued with the approach.
- Ongoing engagement was motivated by an identified problem with student outcomes for which the participating teachers and their leaders continued to take responsibility and believed they had the capacity to solve.
- Theories were developed that located solutions to the problem in the educational opportunities provided by the school.

  Solutions were consistent with the theories.

  Progress was monitored at an organisational level and adjustments made as required.
- Competing initiatives and policy directions were minimised.

11.2.1 Professional development content

What was common to all the core studies that demonstrated ongoing improvement in student outcomes[16] was the emphasis on equipping teachers with a strong theoretical knowledge (as the basis for principled changes to practice) and the skills to inquire into the impact of their teaching on student learning—particularly in relation to understanding the thinking of students who are experiencing difficulties. The theoretical base gave teachers the tools to understand *what* they needed to change; the evidence identified *when* change was needed and whether it was successful.

Franke et al.[17] elaborated this theory–evidence interface in their research into the sustainability of the Cognitively Guided Instruction approach to mathematics. For these authors, their engagement with teachers was driven by two principles. The first was to focus teachers on the ideas underlying the development of children's thinking about mathematics. The second was, building on teachers' existing knowledge, to create continually-evolving organising frameworks of children's mathematical thinking so that teachers were able to respond to the evidence of observations and inquiry. They believed it essential that providers gave teachers a theoretical framework on which to base their thinking about their students' mathematical understanding and make instructional decisions: theory was the tool that enabled them to respond to the evidence. This approach resulted in consistent gains in students' mathematical thinking and contrasted markedly with more prescriptive approaches described in other sections of this synthesis. The authors[18] offered this explanation of the process:

> Self-sustaining, generative change does not involve acquiring a set of procedures to implement with fidelity; rather, it frequently entails teachers making changes in their basic epistemological perspectives, their knowledge of what it means to learn, as well as their conceptions of classroom practice. It means conceptualising teacher change in terms of teachers becoming ongoing learners … For change to become generative, teachers must engage in practice that serves as a basis for their continued learning. (pp. 67–68)

These authors tested the extent to which their beliefs were realised in practice by following the development of three teachers' thinking over a period of four years. They found that two of the teachers engaged in the inquiry processes described above but at a relatively superficial level. These teachers monitored what worked for their students and tested the effectiveness of what they had learned in the professional development programme in their own practice contexts. They learned that students could construct strategies to solve a variety of types of problems and this finding supported their continued use of classroom routines that involved children inventing their own solutions. Their own knowledge, however, remained relatively static.

The third teacher engaged in more generative change. She inquired into the strategies her students were using to solve problems, then struggled to understand the teaching implications. Understanding her students' thinking was her primary goal, and, by engaging at this level, her own knowledge continued to grow and her practice to evolve.

The three other classroom-based studies that reported sustained or improved student outcomes also focused on developing teachers' inquiry processes, training them to use evidence of the impact of their teaching on student learning, together with their understanding of the underlying theoretical principles, to guide improvements to practice. In one of these studies, developed as a case study in Appendix 1, an encounter with a powerful theory of disability led a teacher to rethink her understandings of students with disabilities, how she interacted with them, and how she portrayed them to other students. Working with her new understandings, she used an adaptation of Swann and White's[19] 'thinking books' activity to access and analyse her five-year-old students' thinking about disability and then adapted her practice in response.

Another of the studies by McNaughton et al.[20] combined an evidence-informed approach and the development of theoretical tools in a three-phase intervention that improved the reading comprehension of culturally and linguistically diverse students. The first phase involved a close examination of the students' strengths and weaknesses, together with current teaching practice, in order to understand the students' learning needs and the instructional match (or mismatch). The researchers then discussed with teachers and leaders competing theories about the 'problem' and evaluated the evidence to determine which theory was likely to be valid. The evidence-informed activities continued into the second phase, but with the addition of focused professional development designed to develop teachers' theoretical understandings and teaching strategies.

In the third phase, most of the responsibility for professional learning shifted onto the clusters of schools themselves. There were four components to this. The first was ongoing analysis of student achievement data, feedback, and critical discussion with school leaders, which continued with the assistance of a researcher. Leaders took responsibility for discussing the trends and their implications with teachers. The next two components were the responsibility of the school: continuation of the learning circles that were developed in the earlier phases, and the development of planned inductions into teaching and professional learning for new staff. The fourth component was a teacher-led conference, in which school teams developed action-research projects designed to assess different aspects of their programmes. A researcher helped them formulate research questions and focus their papers.

The order of theory and evidence-informed inquiry was reversed in an intervention reported by Timperley[21]. In this intervention, teachers engaged in intensive professional development focused on early literacy acquisition. Their beliefs were engaged and challenged as they came to understand the approach being advocated and the theory underpinning it. Students' acquisition of reading skills was accelerated. After the formal external input came to an end, senior staff from within the schools concerned took on the responsibility of ensuring that their teachers continued to be supported to develop evidence-informed inquiry processes. At regular intervals, the leaders and teachers interrogated students' rates of progress in reading and identified those who were not making adequate progress. Using the theoretical understandings acquired during the earlier professional development as tools, teachers adapted their practice to maximise the learning opportunities for these students. Teachers were increasingly motivated as analysis confirmed their students' progress.

The following three studies lend support to the claim that sustainability is associated with the acquisition of theoretical understandings and the skills to use evidence as the basis for instructional decision making and judging effectiveness. They differ from the core studies in that they relate either to specialist programmes (operating outside the regular classroom), or in that the outcomes for students were either mixed or not sustained.

The first of these studies[22] involved training specialist teachers in a structured programme of lessons designed to accelerate the acquisition of early literacy skills by young students. Known as Reading Recovery, the programme operated outside the normal classroom; it has been implemented in a wide range of countries with very similar outcomes reported. It was similar to other interventions with sustained outcomes in that its theoretical underpinnings formed a major part of the training and decision making was strongly evidence-informed. It was different from other interventions in that the structure of individual lessons was fairly much prescribed, although teachers did have discretion to respond to individual student needs within the prescribed structure.

The second study related to England's literacy and numeracy strategies project[23]. Although methodologically sound, it fell between our criteria for core and supplementary studies because the impact of the intervention on student outcomes was relatively small. Given its national significance and the sustained outcomes (even though short of government expectations), this project has features that we must consider. In common with the interventions documented in the first four studies above, this project used evidence to identify problems and to monitor progress (in this case, at both national and local levels). Teachers regularly collected data on progress toward curriculum targets. Attention was given to the teaching–learning relationship, with a strong focus on students' work and what this meant for next teaching steps. An early adaptation to the strategy was to allow greater responsiveness to the needs of diverse learners. Although it was difficult to be sure from the written accounts, it appears that the strategies were represented to teachers less theoretically than was the case in those interventions that had greater impact on student outcomes.

What these strategies shared with Reading Recovery, however, was a more prescriptive lesson structure and content. It may be that when programmes are 'brought to scale', a greater degree of prescription is required for both implementation and sustainability purposes. But, given the small evidence base for this conclusion, exactly what should be prescribed remains uncertain.

The next study demonstrates how certain kinds of prescription, in the absence of evidence-informed teacher inquiry, do not lead to sustained student outcomes. The researchers were following up the successful implementation of the Madeline Hunter model[24] of school improvement. During the first three years of the programme, teachers received intensive training in lesson structure and pedagogical practices, underpinned by the theoretical rationale. The training was described as "relatively prescriptive". Substantive gains in reading and mathematics plus improved student engagement were apparent and the programme received wide publicity. The gains were associated with high levels of implementation integrity. The final year of the programme was designed so that principals and teachers would take over and accept responsibility for sustaining the programme. While for each of the first three years teachers received ten days' training, in the fourth this was reduced to participation in a two-day retreat with two further days for follow-up observations and consultations for those who wanted them. Teachers were encouraged to write their reflections, and these were invariably positive; collegial coaching was encouraged; weekly or bi-monthly staff meetings held at each school provided opportunities for teachers to continue to grow professionally and to share ideas.

Much to the surprise of the researchers, classroom observations during this fourth year showed that implementation was highly variable, and student achievement scores in reading and mathematics dropped significantly. The teachers who diverged most from the model had lower rates of student engagement. The authors of the study[25] explained the decline in this way:

> … innovative practices [that] teachers learn will not be maintained unless teachers and students remain interested and excited about their own learning. A good staff development program will create an excitement about learning to learn. The question is how to keep the momentum, not merely maintain previously learned behaviour. If teaching tools gained in training programs aid teachers to be reflective and regenerative, to consider which strategies to use under which conditions, to estimate what is known and what needs to be learned, teachers may continue to grow after the intervention stops. Unless teachers internalise teaching strategies so that they feel comfortable using the strategies and teaching is made easier and more fun, teachers will stop using the strategies when the staff developers leave. Strategies that have been learned superficially will eventually be disregarded. (p. 137)

11.2.2 Organisational conditions

All but one of the three studies that met our sustainability criteria were school- rather than individual-based. In all three, the context supported conditions that have been identified as essential for ongoing teacher learning: leaders actively promoted teachers' development of theories of effectiveness by analysing the evidence of what was or was not working for students experiencing problems; discussions about teaching were always related to implications for learning; and teachers met regularly to interrogate data and used their increasingly sophisticated theoretical knowledge to solve learning problems.

Teacher turnover is inevitably a threat to sustainability. In the two studies that reported sustained student outcomes[26], this threat was managed by ensuring that new teachers were inducted into the schools' inquiry-based practices. Induction of management is probably a more difficult issue, particularly where the employing authority doesn't appreciate the need for stability in the school's theoretical and methodological approaches. The study by Timperley highlights how destabilising it can be for a school when a new principal is appointed who ignores the evidence and advocates alternative theories of effectiveness.

Other supplementary studies that identified organisational conditions supportive of sustainability did not meet our methodological and/or outcomes criteria. They nevertheless lent weight to the above findings and added to our understanding of organisational conditions that promote sustainability.

Enthusiastic claims for sustainability were found in three United States studies, one of which actually involved three different cases, which were championed by school leaders[27]. Unfortunately these studies did not meet our methodological criteria because they provided too little information on student outcomes and, in some cases, the professional development itself. Some common themes were nevertheless evident. In each situation, engagement was motivated by a problem with student outcomes that the participating teachers and leaders accepted some responsibility for solving. The leaders strongly conveyed the twin messages that the current situation was unacceptable and that the school had both an obligation and the capacity to make a change. Theories were developed that located the solutions to the identified problem in the educational opportunities the school provided. Inquiry was made into the effectiveness of teaching practice. Ancess[28] concluded that teacher inquiry into their own practice, in relation to a particular group of students for whom they have set specific goals, can be a rich source of teacher learning and a powerful opportunity for improving student performance[29].

In all these studies, teachers were given considerable discretion as long as their efforts were based on the agreed theory of the problem, fell within a broad framework of agreed solutions, and were having the desired impact on student outcomes. In all the studies, the effectiveness of teachers' efforts as they made changes was continually checked against the impact on students. This impact was judged by means such as test results and analyses of students' work.

In all the three studies, teachers participated in school-based professional learning communities for the purpose of planning, solving ongoing problems, and reviewing student progress. The schools moved to a more collegial style of operation and organisational arrangements were restructured to allow this to happen. In the three cases studied by Ancess, this restructuring also provided a different kind of experience for the students. It should be noted that, while restructuring was carried out in response to identified needs, it was not seen as a solution in itself: "teacher learning and practice, restructuring, and student outcomes … are interconnected in an interdependent constellation and their relationship varies in detail, is context specific, unpatterned, reciprocal, and dynamic rather than linear and static" (p. 615).

Two[30] of the three studies took place in environments of high accountability due to the requirements of state standards. The schools recognised that they were not meeting these standards and, rather than rejecting them, decided to change the quality of the education being offered. In the third study[31], local and school-based target setting was used both as a tool and an incentive for generating more effective teaching practice and school organisation.

A fourth supplementary study followed up the impact of different comprehensive school reform models on students with limited English proficiency. Datnow et al.[32] found that five of thirteen schools continued to use their various models with high implementation integrity. This study was not included in the core group because the achievement outcomes for the schools involved were described only as "generally equivalent" to those of students from matched-comparison schools. However, the researcher's analysis identified three conditions likely to lead to sustained practice. The first related to alignment—in particular, the importance of policies and priorities being aligned and predictable. The capacity of teachers to continue with reform practices was compromised by competing accountabilities and competing pedagogical practices and curricular foci. The second condition was continuity of leadership committed to the reform. The third related to teachers' social constructions of language-minority, immigrant students. Constructions that characterised these students as low-ability and lacking in basic skills were a constraint on continued implementation.

11.3 Bringing it all together

As we noted in the introduction to this section, the evidence base for sustainability in teacher professional learning is disappointingly thin. For this reason, we must consider any conclusions tentative. In the few studies that provided evidence of sustained, substantive student outcomes, we found that the professional development had equipped teachers with a strong theoretical base that served as a tool to make principled changes to practice, plus with the skills to inquire into the impact of their teaching on the learning of their students—particularly in relation to understanding their students' problematic thinking. These two elements were missing from the only study that reported a decline in student outcomes.

This evidence is consistent with the conditions seen to promote professional, self-regulated learning. As identified in the introduction, self-regulated learners can answer three questions: 'Where am I going?', 'How am I going?', and 'Where to next?'[33] Teachers who had both inquiry skills and content knowledge, and who received support from their leaders, were provided with these conditions. They consistently looked for the answers to these questions as they considered the impact of their teaching on the learning of their students. The question 'Where am I going?' was sometimes framed explicitly in terms of state standards, but more often in terms such as effective mathematical problem-solving[34] or reading comprehension closer to national levels of achievement[35]. The answer to the question 'How am I going?' was found in an analysis of how effective their teaching had been in helping their students progress toward their goals. The answer to the 'Where to next?' question was guided by a detailed and theoretically sophisticated knowledge of curriculum content and student progressions.

When it comes to particular teaching practices, it is not clear how much prescription is optimal. The most successful interventions allowed teachers considerable autonomy to develop teaching programmes within the constraints of agreed theories and possible solutions. The two studies that had 'gone to scale' were more prescriptive about lesson structure and content. There is insufficient evidence on which to base claims about what should be prescribed and what should be discretionary.

The practice context of teachers inevitably impacted on sustainability. If they expected their teachers to engage in evidence-informed inquiry and theoretical development it was important that school leaders made it clear that these activities were core business and that they created the infrastructure to support them. Leaders had an active role to play in re-culturing their schools so that they became evidence-informed.

Ongoing engagement of this kind requires a purpose. In the studies that reported improved outcomes, initial engagement was usually motivated by a problem with student outcomes, which teachers and leaders accepted some responsibility for and which they believed they had the capacity to change. Continued engagement required the same conditions.

A key finding of this synthesis has been that teachers need to have time and opportunity to engage with key ideas and integrate those ideas into a coherent theory of practice. Changing teaching practice in ways that have a significant impact on student outcomes is not easy. Policy and organisational contexts that continually shift priorities to the 'next big thing', with little understanding/evaluation of how current practice is impacting on desired outcomes for students, undermine the sustainability of changes already under way. Innovation needs to be carefully balanced with consolidation if professional learning experiences are to impact positively on student outcomes.

References

[1] Coburn, C. E. (2003). Thinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher, 32* (6), 3-12.

[2] ibid.

[3] Century, J. R. & Levy, A. J. (2002). *Sustaining change: A study of nine school districts with enduring programs.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

[4] Coburn, C. E. (2003), loc. cit. (ref. 1).

Spillane, J. P. (2000). Cognition and policy implementation: District policy-makers and the reform of mathematics education. *Cognition and Instruction, 18* (2), 141-179.

[5] Coburn, C. E.(2003), loc. cit. (ref. 1).

[6] Timperley, H. & Wiseman, J. (2003). *The sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement.* Wellington, New Zealand: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

[7] Cuban, L. (2002). Answering tough questions about sustainability. Retrieved 16 May, 2004, from http://sustainability2002.terc.edu/invoke.cfm/lsc_project/214

St John, M. (2001). Airplane thoughts about sustainability. Retrieved 28 February, 2005, from

http://sustainability.terc.edu/index.cfm/page/492

[8] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003). *Watching and learning 3: Final report of the external evaluation of England's National Literacy and Numeracy Strategies*. London, UK: DfES.

[9] Dubner, J., Samuel, C., Silverstein, M., & Miller, J. (2005). *Research experiences for science teachers: The impact on students.* Paper presented at the Hawaiian International Conference on Education, Hawaii.

Samuel, C., Silverstein, M., & Dubner, J. (2004). *Columbia University's summer research program for science teachers.* Paper presented at the American Chemical Society National Meeting, Anaheim, CA.

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 6).

[10] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 8).

Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23* (2), 145-170.

Century, J. R. & Levy, A. J. (2002), op. cit. (ref. 3).

[11] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education, 4* (3), 179-210.**

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26* (4), 499-553.

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993). Using children's mathematical knowledge in instruction. *American Educational Research Journal, 30* (3), 555-583.

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005). *Findings from the New Zealand Numeracy Development Project 2004.* Wellington, NZ: Ministry of Education.

Hunter, M. (1976). *Prescription for improved instruction*. El Segundo, CA: TIP.

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.

Robbins, P. & Wolfe, P. (1987). Reflections on a Hunter-based staff development project. *Educational Leadership, 44* (5), 56-61.

Stallings, J. & Krasavage, E. M. (1986). Program implementation and student achievement in a four-year Madeline Hunter follow-through project. *The Elementary School Journal, 87* (2), 117-137.

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 6).

[12] Absolum, M. (2004a). *Assess to Learn Project* (Project proposal submitted to the Ministry of Education). Auckland: Evaluation Associates.

Absolum, M. (2004b). *ATOL programme 2004* (Report prepared for company purposes only). Auckland: Evaluation of Evaluation Associates Ltd.

Higgins, J., Irwin, K., Thomas, G., Trinick, T., & Young-Loveridge, J. (2005), op. cit. (ref. 11).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 11).

Parr, J., Timperley, H., Reddish, P., Jesson, R., & Adams, R. (2006). *Literacy Professional Development Project: Identifying effective teaching and professional development practices for enhanced student learning.* Milestone 5 (Final Report). Wellington, NZ: Learning Media.

Timperley, H., Parr, J., & Werner, S. (2004). *Literacy professional development project: Milestone report*. Wellington, NZ: Ministry of Education.

[13] Aladjem, D. K. & Borman, K. M. (2006). *Summary findings from the national longitudinal evaluation of comprehensive school reform.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

[14] ibid.

Adey, P. (2004). *The professional development of teachers: Practice and theory.* London: Kluwer Academic Publishers.

[15] Hunter, M. (1976), op. cit. (ref. 11).

Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 11).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 11).

[16] **Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000), loc. cit. (ref. 11).**

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C.-P., & Loef, M. (1989), loc. cit. (ref. 11).

Fennema, E., Franke, M., Carpenter, T. P., & Carey, D. (1993), loc. cit. (ref. 11).

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 11).

Timperley, H. & Wiseman, J. (2003), op. cit. (ref. 6).

[17] Franke, M. L., Carpenter, T. P., Fennema, E., Ansell, E., & Behrend, J. (1998). Understanding teachers' self-sustaining, generative change in the context of professional development. *Teaching and Teacher Education, 14* (1), 67-80.

[18] ibid.

[19] Swan, S. & White, R. (1994). *The thinking books.* London; Washington DC: Falmer Press.

[20] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 11).

[21] Timperley, H. (2005). Instructional leadership challenges: The case of using student achievement information for instructional improvement. *Leadership and Policy in Schools, 4* (1), 3-22.

[22] Schmitt, M. C., Askew, B. J., Fountas, I. C., Lyons, C. A., & Pinnell, G. S. (2005). *Changing futures: The influence of Reading Recovery in the United States*. Worthington, OH: Reading Recovery Council of North America.

[23] Earl, L., Watson, N., Levin, B., Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B., & Volante, L. (2003), op. cit. (ref. 8).

[24] Robbins, P. & Wolfe, P. (1987), loc. cit. (ref. 11).

Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 11).

[25] Stallings, J. & Krasavage, E. M. (1986), loc. cit. (ref. 11).

[26] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 11).

Timperley, H. (2005), loc. cit. (ref. 21).

[27] **Ancess, J. (2000). The reciprocal influence of teacher learning, teaching practice, school restructuring and student learning outcomes. *Teachers College Record, 102* (3), 590-619.**

French, R. (2001). Great job, now do it better. *Journal of staff development, 22* (4), 26-28.

Hirshman, J. (1996). Lingelbach Elementary School: A case study of a Chapter 1 school wide project. *Journal of Education for Students Placed at Risk, 1* (2), 135-146.

[28] **Ancess, J. (2000), loc. cit. (ref. 27).**

[29] **ibid. pp. 616-617.**

[30] French, R. (2001), loc. cit. (ref. 27).

Hirshman, J. (1996), loc. cit. (ref. 27).

[31] **Ancess, J. (2000), loc. cit. (ref. 27).**

[32] Datnow, A., Borman, G., Stringfield, S., Overman, L. T., & Castellano, M. (2003). Comprehensive school reform in culturally and linguistically diverse contexts: Implementation and outcomes from a four-year study. *Educational Evaluation and Policy Analysis, 25* (2), 143-170.

[33] Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research 77* (1), 81-112.

[34] Franke, M. & Kazemi, E. (2001). Learning to teach mathematics: Focus on student thinking. *Theory into Practice, 40* (2), 102-109.

[35] McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004), loc. cit. (ref. 11).

12. Gaps in the Evidence

Although we have been able to identify a number of specific attributes of professional development and draw some conclusions about their effect on student outcomes, this is a relatively undeveloped field of educational research. As we proceeded, we found major gaps in the knowledge base and these limited what we were able to conclude. Specific shortcomings identified were: the weak theory base for professional learning; limited information concerning the qualities of effective providers, including those in the tertiary sector; a lack of research into the role of information technologies in promoting professional learning; and a lack of research into the mentoring of beginning teachers. Other shortcomings, specific to the New Zealand context, included the limited amount of research into Māori-medium education and the education of Pasifika students.

12.1 A theory of teacher learning

There is extensive empirical evidence and theoretical development relating to children's learning, what promotes it, and what limits it. The empirical evidence relating to the professional learning of teachers is sparse. Empirical articles are typically theory-free; theoretical articles are typically evidence-free. In Chapter 2 of this synthesis we developed our own theoretical framework as a basis to analyse the studies. It proved useful but cannot be considered adequate as a theory of professional learning. More work is needed.

12.2 Qualities and training of effective providers

While we have identified the qualities of effective professional learning experiences, we have been unable to say much about the qualities of effective providers because the studies usually did not consider the matter. From our analysis of what works and does not work, it is apparent that the extremes do not work—providers who dictate being perhaps marginally more effective than those who leave improvements entirely up to the teachers. But this simplistic dichotomy does not identify the qualities of effective providers in the middle ground. Until we have a well-developed theory of teacher professional learning, we will be left with relatively undeveloped theories about the qualities needed by providers, and the training they require in order to be effective.

What is alarmingly absent from the literature, given the amount of dedicated funding and time received, is the role of tertiary education in promoting the type of professional learning likely to impact positively on the diversity of students in our schools. In most educational jurisdictions, tertiary providers—usually universities—train and credential teachers and provide ongoing opportunities to learn. The evidence related to their effectiveness is very thin. In our core studies, we identified a few action-research projects, but these were typically local and under-theorised. The impact of tertiary courses on a wider scale was absent.

12.3 The role of information technologies in promoting professional learning

We can no longer consider information technologies new. Why, then, do they appear to be absent from or play such a small role in promoting professional learning? The potential seems great but the evidence is negligible. A few of our core studies mentioned the use of information technologies in passing, but such use was not analysed for its impact. How information technologies can be used to promote or limit professional learning needs to be part of any theory of professional learning (see 12.1 above) if their potential is to be realised.

There are studies of interventions that increased teachers' confidence in using computers as a learning tool[1] but these did not meet our methodological criteria, typically because they relied on teacher reporting of outcomes.

12.4 Mentoring of beginning teachers

A specific search was undertaken to locate literature on the mentoring of beginning teachers. No studies that documented outcomes for students were found. The focus of mentoring in the initial phase of teachers' careers appears to have been on easing teachers through what Achinstein and Barrett refer to as 'practice shock'[2]. In this state, beginning teachers often find themselves concentrating on controlling students, which—of particular relevance to this synthesis—can have the effect of setting up "a cultural mismatch that causes novices to see diversity as a problem" (p. 1). These authors also observe that the most frequent concern of mentors is affective teacher outcomes, with the occasional link to changes in teaching practice but not to student outcomes.

While this affective focus may help reduce rates of teacher attrition in the critical early stages of learning to teach, it is worth considering how the assumptions that typically underpin such mentoring may impact on students in the future. In a review of the literature on mentoring, undertaken in the context of a standards-based reform, Wang and Odell[3] identified three different approaches.

The first and most common of these was a humanistic perspective, exemplified by Achinstein and Barrett[4] (referred to above). While this approach may support and help retain beginning teachers, a problem is that beginning teachers' goals, content, and processes appear rarely to be challenged. Wang and Odell[5] concluded their analysis of this approach by stating: "the accumulated evidence indicates that such mentoring does not necessarily guarantee that novice teachers will learn better teaching than they would have learned without mentors" (p. 494).

The second approach was that of a situated apprentice, in which beginning teachers are assisted by their mentors to adapt to the existing norms and cultures of teaching. The mentors' job is to provide the necessary techniques and information. The strength of this approach is that teachers are supported to acquire a context-related 'toolbox'; its weakness is that it is typically insular and ignores the deeply-rooted, invisible yet crucial conceptual conflicts that beginning teachers invariably experience.

This weakness in the apprenticeship model is addressed in the third approach identified by Wang and Odell[6]: the critical constructivist approach. In this approach, important knowledge is constructed by novices and mentors through collaborative inquiry. Novices are encouraged to pose questions and challenges related to their teaching practice. Wang and Odell express concern, however, that this approach often pays little attention to helping beginning teachers develop the specific teaching goals, knowledge, and strategies that they need.

Also of concern in this approach is the focus on the self-referenced world of the participants. When Morton[7] described her use of a critical constructivist approach, she repeatedly emphasised the mutual respect that existed between herself and those she was mentoring, describing how one teacher became more relaxed and the other more confident. Yet she expressed disappointment that after a year of intensive mentoring, neither teacher "used children's written work to reflect on what instruction was needed … [and] the children were losing out with less interesting learning experiences" (p. 68). She also expressed concern that one of the two teachers believed that people living in poverty were lacking moral qualities and that "what the children needed was drill and skill work rather than learning activities supporting more expansive higher level thinking" (p. 69).

Although it is probably unrealistic to expect the mentoring of beginning teachers to have a direct impact on student outcomes, it is of concern that none of the approaches outlined above appears to use students as the reference point for the mentoring. All are referenced to the adults involved, their ability to cope emotionally, and their acquisition of survival techniques. Problematic beliefs are expected and accepted.

In the main part of this synthesis we have uncovered considerable evidence that positive outcomes for students are typically associated with professional development that increases teachers' pedagogical content knowledge in the context of a focus on the teaching–learning relationship. If existing beliefs and practices are not engaged in the process, student outcomes are unlikely to improve. A reasonable conclusion, therefore, is that if beginning teachers are mentored in ways that reinforce the divide between teaching and learning, and if pedagogical content knowledge is not addressed, it is unlikely that this mentoring will shape their beliefs and practices in ways that will bring the greatest benefit to the full diversity of their students.

12.5 Māori-medium studies

No studies situated in Māori-medium education met our criteria for inclusion as core studies. Two met our criteria for supplementary studies[8]. One core study was specifically focused on Māori students, but in English-medium settings[9]. This mirrors what we found in the international literature: a dearth of studies specifically focused on promoting professional learning that led to improved outcomes for indigenous peoples. Developing an evidence base of this kind is imperative for New Zealand—and for the well-being of many elsewhere.

12.6 Pasifika education

We located numerous studies focused on migrant populations, such as Hispanic students in the United States, but despite networking with the Pasifika community, we were unable to locate any that were specifically concerned with promoting the professional learning of teachers of Pasifika students in New Zealand. Some studies did so indirectly, in that they were situated in schools with high Pasifika populations[10], but these did not provide information that related specifically to the needs of Pasifika students. This is another gap urgently in need of filling.

References

1 Gilmore, A. (1994). Information technology in the classroom: An evaluation of professional development for teachers. *New Zealand Journal of Educational Studies, 29* (1), 21-36.

2 Achinstein, B. & Barrett, A. (2004). (Re)framing classroom contexts: How new teachers and mentors view diverse learners and challenges of practice. *Teachers College Record, 106* (4), 716-746.

3 Wang, J. & Odell, S. (2002). Mentored learning to teach according to standards-based reform: A critical review. *Review of Educational Research, 72* (3), 481-546.

4 Achinstein, B. & Barrett, A. (2004). loc. cit. (ref. 2).

5 Wang, J. & Odell, S. (2002). loc. cit. (ref. 3).

6 ibid.

7 Morton, M. L. (2005). Practicing praxis: mentoring teachers in a low-income school through collaborative action research and transformative pedagogy. *Mentoring and Tutoring, 13* (1), 53-72.

8 Hohepa, M., Williams, N., & Barber, J. (2006). *Whakawhanuitia te Hinengaro/Broadening the mind: Reading to learn in te reo Māori: Reading comprehension and language development.* Final Milestone Report to Nga Pae o te Maramatanga: National Institute of Research Excellence for Māori Development and Advancement.

Trinick, T. & Stephenson, B. (2005). An evaluation of Te Poutama Tau 2004. In J. Higgins & K. Irwin & G. Thomas & T. Trinick & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Project 2004* (pp. 56-65). Wellington, NZ: Ministry of Education.

9 Bishop, R., Berryman, M., Powell, A., & Teddy, L. (2005). *Te Kotahitanga: Improving the educational achievement of Māori students in mainstream education. Phase 2: Towards a whole school approach* (Progress report and planning document). Wellington, New Zealand: Ministry of Education.

10 **McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.**

Phillips, G. E., McNaughton, S., & MacDonald, S. (2001). *Picking up the pace: Effective literacy interventions for accelerated progress over the transition into decile one schools* (Final Report). Wellington, NZ: Ministry of Education. Available at: http://www.minedu.govt.nz/web/document/document_page.cfm?id = 6444.

Timperley, H. & Phillips, G. (2003). Changing and sustaining teachers' expectations through professional development in literacy. *Teaching and Teacher Education, 19*, 627-641.

Timperley, H. & Robinson, V. M. J. (2001). Achieving school improvement through challenging and changing teachers' schema. *Journal of Educational Change, 2* (4), 281-300.

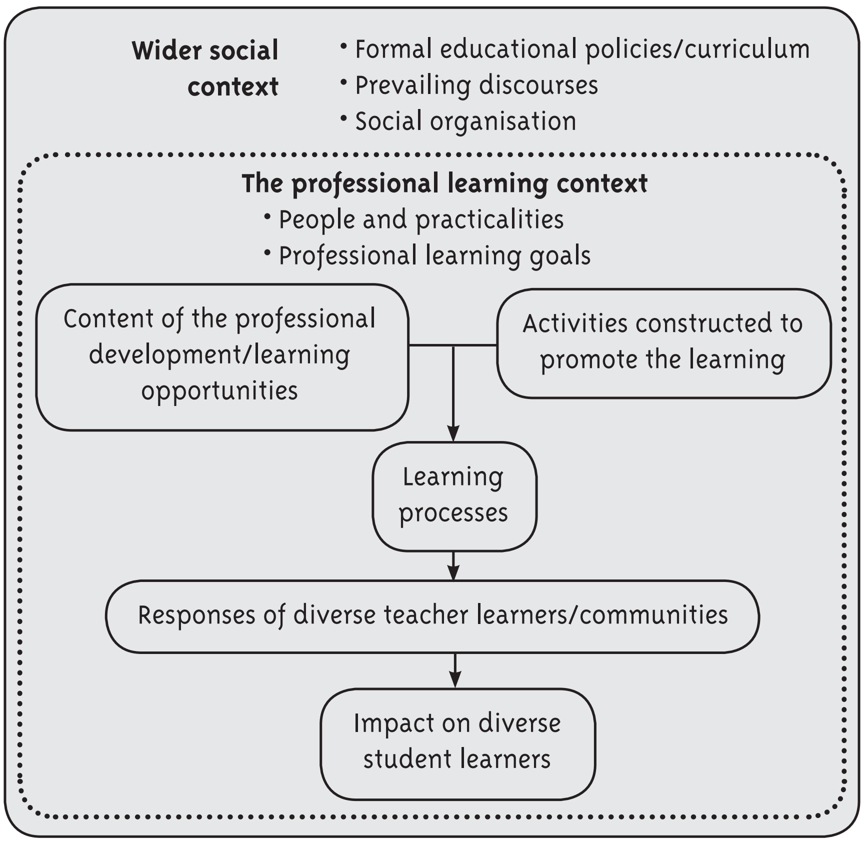
Timperley, H., Smith, L., Parr, J., Portway, J., Mirams, S., Clark, S., Allen, M., & Page, J. (2004). *Analysis and use of student achievement data. Final report to the Ministry of Education*. Wellington, New Zealand: Ministry of Education.

Timperley, H. & Wiseman, J. (2003). *The sustainability of professional development in literacy. Part 2: School-based factors associated with high student achievement.* Wellington, New Zealand: Ministry of Education. Available at: http://www.minedu.govt.nz/index.cfm?layout = document&documentid = 8638&data = l.

Appendix 1. Case Studies

In this section we present eight case studies that demonstrate how the different aspects of the theoretical framework presented in Chapter 4 (see Figure 4.2) and used throughout the synthesis have come together in a variety of situations. These case studies show how the principles, theories, and new learning shared by the providers have been translated, developed, applied, and adapted by teachers in the authentic contexts of their schools and classrooms. By means of these cases we wish to illustrate the complexity and variety of possible approaches and to prompt readers to consider implications for their own practice. Shulman (1996)[1] suggested that by engaging with theory as it is embedded in practice, we can "move up and down, back and forth, between the memorable particulars of cases and the powerful generalisations and simplifications of principles and theories. Principles are powerful but cases are memorable. Only in the continued interaction between principles and cases can practitioners and their mentors avoid the inherent limitations of theory-without-practice or the equally serious restrictions of vivid practice without the mirror of principle" (p. 201).

Figure 4.2. Framework for analysing the effectiveness of professional learning experiences

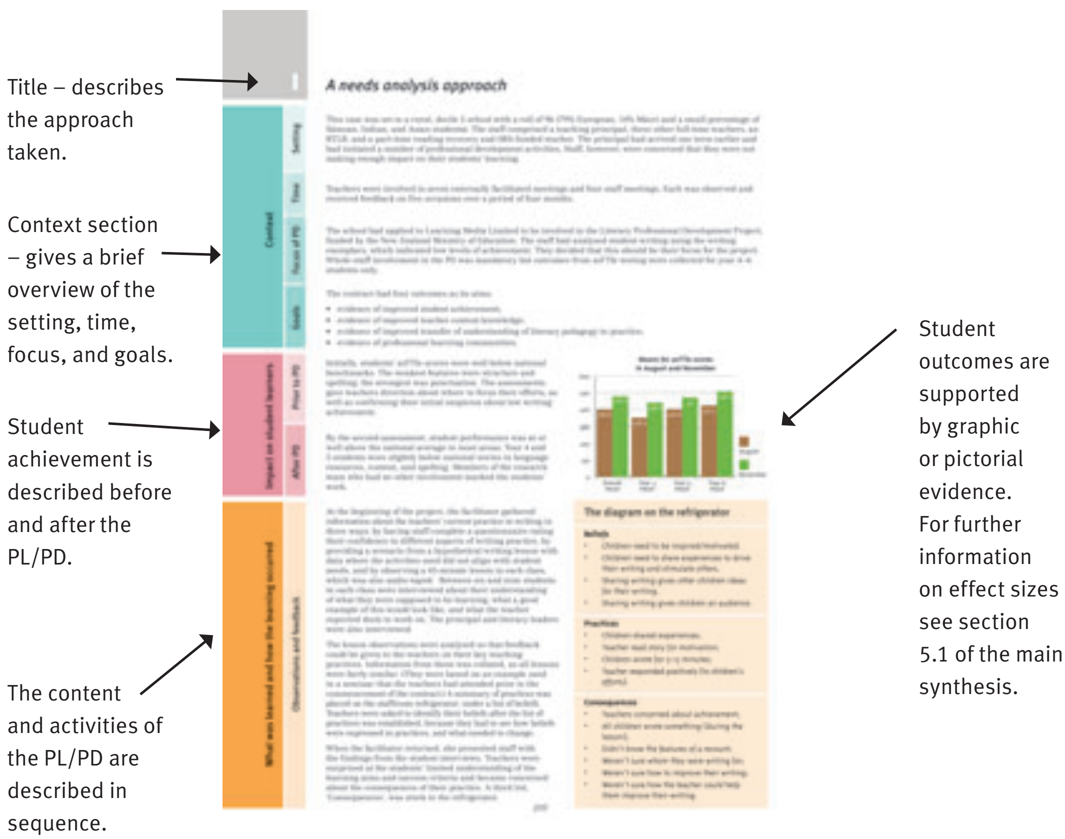


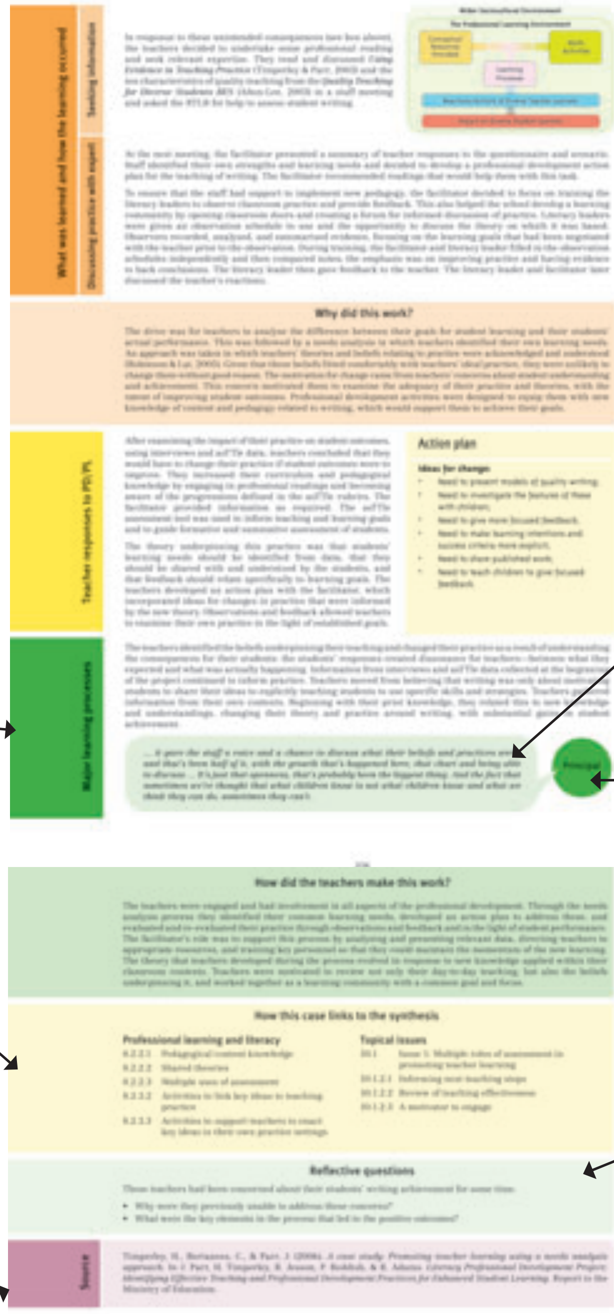
All the cases in this section are from New Zealand contexts because those found in the literature on professional learning were not written up in sufficient detail, meaning that we had to be able to go back to the providers and researchers concerned in order to find the further information we required.

The layout of the cases follows the framework used to synthesise the studies. The content is an accurate representation of the research, rearranged to make the links to the synthesis clear. We begin each case with a brief description of the context, including the setting, time frame, focus of the professional development, and goals. The student outcomes are also discussed at the beginning of each case as they were our first consideration when selecting studies for the synthesis. The second section is concerned with what was learned and how the learning took place. It looks at the content and activities of the professional learning sequence. The third section looks at teachers' responses to the professional development and how they translated new learning into practice. Note how this section demonstrates the importance of teachers having agency in the learning process, not simply seeing professional development as something that is done to them. The fourth section defines the main professional learning processes. There are also two boxes in which we attempt to provide a more theoretical explanation of why the processes described were effective. At the end of each case we provide specific links back to the synthesis so that readers can explore particular aspects in greater depth. The questions for reflection are designed to help readers draw on the key features of each case and make links back to their own practice. References are provided for those who wish to explore the cases in more detail.

The cases

1. A needs analysis approach (Timperley et al., 2006)
2. Translating theory into practice (Alton-Lee et al., 2000)
3. Developing a research–practice collaboration (McNaughton et al., 2004)
4. Using assessment to build teaching capability (Absolum, 2004)
5. Using evidence of student thinking to inform pedagogy (Higgins, 2004)
6. Re-culturing and restructuring to solve a problem (Moxon, 2003)
7. Establishing a culturally responsive pedagogy of relations (Bishop et al., 2006)
8. A constructivist, cooperative approach to learning (Tasker, 2002)





The major learning process is described – see section 2.2 for further information.

Speech bubbles contain direct quotes from those involved – the pictures in the boxes are teachers, students, or providers.

Boxes focus on the principles, which underpinned the success of the case.

Links to the synthesis are provided to refer the reader to other sections of interest.

Reflective questions are provided for discussion and to help readers make links to their own practice.

The original studies are listed from which the cases were condensed.

A needs analysis approach

Context

Setting

This case was set in a rural, decile 5 school with a roll of 96 (79% European, 14% Māori, and a small percentage of Sāmoan, Indian, and Asian students). The staff comprised a teaching principal, three other full-time teachers, an RTLB, and a part-time reading recovery and ORS-funded teacher. The principal had arrived one term earlier and had initiated a number of professional development activities. Staff, however, were concerned that they were not making enough impact on their students' learning.

Time

Teachers were involved in seven externally facilitated meetings and four staff meetings. Each was observed and received feedback on five occasions over a period of four months.

Focus of PD

The school had applied to Learning Media Limited to be involved in the Literacy Professional Development Project, funded by the New Zealand Ministry of Education. The staff had analysed student writing using the writing exemplars, which indicated low levels of achievement. They decided that this should be their focus for the project. Whole-staff involvement in the PD was mandatory but outcomes from asTTle testing were collected for year 4–6 students only.

Goals

The contract had four outcomes as its aims:

- evidence of improved student achievement;
- evidence of improved teacher content knowledge;
- evidence of improved transfer of understanding of literacy pedagogy to practice;
- evidence of professional learning communities.

Impact on student learners

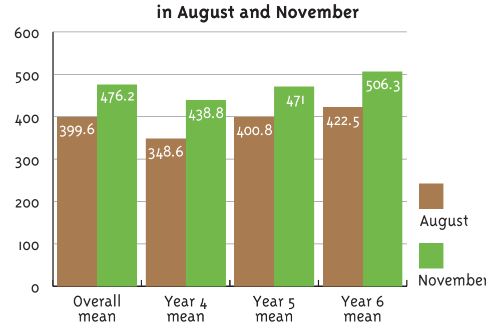
Prior to PD

Initially, students' asTTle scores were well below national benchmarks. The weakest features were structure and spelling; the strongest was punctuation. The assessments gave teachers direction about where to focus their efforts, as well as confirming their initial suspicion about low writing achievement.

After PD

By the second assessment, student performance was at or well above the national average in most areas. Year 4 and 5 students were slightly below national norms in language resources, content, and spelling. Members of the research team who had no other involvement marked the students' work.

Means for asTTle scores in August and November



What was learned and how the learning occurred

Observations and feedback

At the beginning of the project, the facilitator gathered information about the teachers' current practice in writing in three ways: by having staff complete a questionnaire rating their confidence in different aspects of writing practice, by providing a scenario from a hypothetical writing lesson with data where the activities used did not align with student needs, and by observing a 45-minute lesson in each class, which was also audiotaped. Between six and nine students in each class were interviewed about their understanding of what they were supposed to be learning, what a good example of this would look like, and what the teacher expected them to work on. The principal and literacy leaders were also interviewed.

The lesson observations were analysed so that feedback could be given to the teachers on their key teaching practices. Information from these was collated, as all lessons were fairly similar. (They were based on an example used in a seminar that the teachers had attended prior to the commencement of the contract.) A summary of practices was placed on the staffroom refrigerator, under a list of beliefs. Teachers were asked to identify their beliefs after the list of practices was established, because they had to see how beliefs were expressed in practices, and what needed to change.

When the facilitator returned, she presented staff with the findings from the student interviews. Teachers were surprised at the students' limited understanding of the learning aims and success criteria and became concerned about the consequences of their practice. A third list, 'Consequences', was stuck to the refrigerator.

The diagram on the refrigerator

Beliefs

- Children need to be inspired/motivated.
- Children need to share experiences to drive their writing and stimulate others.
- Sharing writing gives other children ideas for their writing.
- Sharing writing gives children an audience.

Practices

- Children shared experiences;
- Teacher read story for motivation;
- Children wrote for 5–15 minutes;
- Teacher responded positively (to children's efforts).

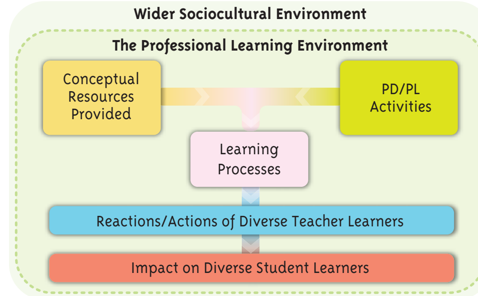
Consequences

- Teachers concerned about achievement;
- All children wrote something (during the lesson);
- Didn't know the features of a recount;
- Weren't sure whom they were writing for;
- Weren't sure how to improve their writing;
- Weren't sure how the teacher could help them improve their writing.

What was learned and how the learning occurred

Seeking information

In response to these unintended consequences (see box above), the teachers decided to undertake some professional reading and seek relevant expertise. They read and discussed *Using Evidence in Teaching Practice* (Timperley & Parr, 2003) and the ten characteristics of quality teaching from the *Quality Teaching for Diverse Students BES* (Alton-Lee, 2003) in a staff meeting and asked the RTLB for help to assess student writing.



Discussing practice with expert

At the next meeting, the facilitator presented a summary of teacher responses to the questionnaire and scenario. Staff identified their own strengths and learning needs and decided to develop a professional development action plan for the teaching of writing. The facilitator recommended readings that would help them with this task.

To ensure that the staff had support to implement new pedagogy, the facilitator decided to focus on training the literacy leaders to observe classroom practice and provide feedback. This also helped the school develop a learning community by opening classroom doors and creating a forum for informed discussion of practice. Literacy leaders were given an observation schedule to use and the opportunity to discuss the theory on which it was based. Observers recorded, analysed, and summarised evidence, focusing on the learning goals that had been negotiated with the teacher prior to the observation. During training, the facilitator and literacy leader filled in the observation schedules independently and then compared notes; the emphasis was on improving practice and having evidence to back conclusions. The literacy leader then gave feedback to the teacher. The literacy leader and facilitator later discussed the teacher's reactions.

Why did this work?

The drive was for teachers to analyse the difference between their goals for student learning and their students' actual performance. This was followed by a needs analysis in which teachers identified their own learning needs. An approach was taken in which teachers' theories and beliefs relating to practice were acknowledged and understood (Robinson & Lai, 2005). Given that these beliefs fitted comfortably with teachers' ideal practice, they were unlikely to change them without good reason. The motivation for change came from teachers' concerns about student understanding and achievement. This concern motivated them to examine the adequacy of their practice and theories, with the intent of improving student outcomes. Professional development activities were designed to equip them with new knowledge of content and pedagogy related to writing, which would support them to achieve their goals.

Teacher responses to PD/PL

After examining the impact of their practice on student outcomes, using interviews and asTTle data, teachers concluded that they would have to change their practice if student outcomes were to improve. They increased their curriculum and pedagogical knowledge by engaging in professional readings and becoming aware of the progressions defined in the asTTle rubrics. The facilitator provided information as required. The asTTle assessment tool was used to inform teaching and learning goals and to guide formative and summative assessment of students.

The theory underpinning this practice was that students' learning needs should be identified from data, that they should be shared with and understood by the students, and that feedback should relate specifically to learning goals. The teachers developed an action plan with the facilitator, which incorporated ideas for changes in practice that were informed by the new theory. Observations and feedback allowed teachers to examine their own practice in the light of established goals.

Action plan

Ideas for change:

- Need to present models of quality writing;
- Need to investigate the features of these with children;
- Need to give more focused feedback;
- Need to make learning intentions and success criteria more explicit;
- Need to share published work;
- Need to teach children to give focused feedback.

Major learning processes

The teachers identified the beliefs underpinning their teaching and changed their practice as a result of understanding the consequences for their students: the students' responses created dissonance for teachers—between what they expected and what was actually happening. Information from interviews and asTTle data collected at the beginning of the project continued to inform practice. Teachers moved from believing that writing was only about motivating students to share their ideas to explicitly teaching students to use specific skills and strategies. Teachers gathered information from their own contexts. Beginning with their prior knowledge, they related this to new knowledge and understandings, changing their theory and practice around writing, with substantial gains in student achievement.

… it gave the staff a voice and a chance to discuss what their beliefs and practices were, and that's been half of it, with the growth that's happened here, that chart and being able to discuss … It's just that openness, that's probably been the biggest thing. And the fact that sometimes we've thought that what children know is not what children know and what we think they can do, sometimes they can't.

Principal

How did the teachers make this work?

The teachers were engaged and had involvement in all aspects of the professional development. Through the needs analysis process they identified their common learning needs, developed an action plan to address these, and evaluated and re-evaluated their practice through observations and feedback and in the light of student performance. The facilitator's role was to support this process by analysing and presenting relevant data, directing teachers to appropriate resources, and training key personnel so that they could maintain the momentum of the new learning. The theory that teachers developed during the process evolved in response to new knowledge applied within their classroom contexts. Teachers were motivated to review not only their day-to-day teaching, but also the beliefs underpinning it, and worked together as a learning community with a common goal and focus.

How this case links to the synthesis

Professional learning and literacy

8.2.2.1 Pedagogical content knowledge

8.2.2.2 Shared theories

8.2.2.3 Multiple uses of assessment

8.2.3.2 Activities to link key ideas to teaching practice

8.2.3.3 Activities to support teachers to enact key ideas in their own practice settings

Topical issues

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

10.1.2.1 Informing next teaching steps

10.1.2.2 Review of teaching effectiveness

10.1.2.3 A motivator to engage

Reflective questions

These teachers had been concerned about their students' writing achievement for some time.

- Why were they previously unable to address these concerns?
- What were the key elements in the process that led to the positive outcomes?

Source

Timperley, H., Bertanees, C., & Parr, J. (2006). *A case study: Promoting teacher learning using a needs analysis approach.* In J. Parr, H. Timperley, R. Jesson, P. Reddish, & R. Adams. *Literacy Professional Development Project: Identifying Effective Teaching and Professional Development Practices for Enhanced Student Learning.* Report to the Ministry of Education.

2

Translating theory into practice

Context

Setting

Ms Nikora was the deputy principal and reception class teacher at a school located on the suburban/rural margin of a New Zealand city. The school was decile 3 with a roll of 125. One student in the school had spina bifida and used a wheelchair.

Time

This study represents just one part of the teacher's continuing exploration into creative uses for 'thinking books', in which students record their thoughts about their learning.

Focus of PD

The focus of this professional development was to explore ways to develop inclusive practice through a social studies programme in a new entrant classroom. Ms Nikora had attended two university teacher education courses, 'Social Contexts of Learning' and 'Theory into Practice', which included training in action research and provided opportunities to apply this training in the classroom.

Goals

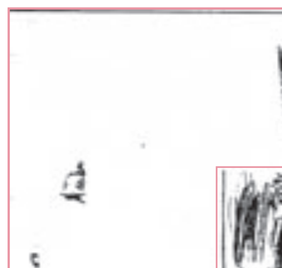
The goal of this learning journey was to draw upon new theories and understandings about students with disabilities to address Ms Nikora's increasing awareness of the marginalisation of Zack, a senior student with spina bifida. Her specific aims were to:

- include Zack as a respected and valued member of the school community;
- increase understanding about spina bifida to reduce students' fears and misunderstandings;
- have Zack recognised as a person with needs and abilities rather than an embodiment of his disability;
- prepare students to interact positively with others with disabilities that they might encounter in the future.

Impact on student learners

Prior to PD

Students' responses in their 'thinking books' and the comments they made during the unit were the main sources of information used to assess changes in attitudes and understandings. The pictures at right are both by the same child. The first was their drawing of a wheelchair before Zack had explained its use and the second was after his explanation.



After PD

By the end of the unit, Zack had moved from being on the outer to being in the midst of the group. A year later, of the 11 students who had been in Ms Nikora's class and were still at the school, eight remembered Zack for his role as an older peer helper in their classroom. Only one child remembered no details other than that he had been in a wheelchair.

What was learned and how the learning occurred

Cognitive dissonance

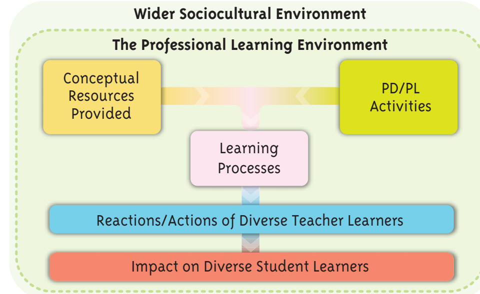
Ms Nikora planned to work with her students to support Zack's inclusion in the school community. The catalyst was a playground incident, witnessed by a number of her new entrant students, in which Zack had a seizure and collapsed. This incident brought the students' fear and lack of understanding to the surface, raising the teacher's concern both for her students and for how their attitudes would affect Zack in the future. To address the issue directly, Ms Nikora decided to educate her students about spina bifida.

Seeking information

In the research of Christine Rietveld (2002), Ms Nikora encountered two models of how disability can be viewed by the community. This research provided her with a framework for her planning, as she considered how she could introduce inclusive educational practice in her classroom. Rietveld documented contrasting cases of students with Down's syndrome. These highlighted the possibilities and advantages of inclusive practice using a social constructivist approach (see definitions on the next page) instead of coming from a personal tragedy position. She also drew on Swan and White's (1994) thinking book approach, which facilitated students' use of metacognitive strategies by having them record what they had learned and their questions about what they were learning. As part of her earlier action research, Ms Nikora had used thinking books to address issues of inclusion and diversity with her students in science, so she decided to repeat the action research cycle in social studies.

What was learned and how the learning occurred

Analysing current and constructing new practice



The teacher applied elements of theory in order to incorporate the new learning into her current teaching practice. She used a curriculum-focused approach to inform the students about spina bifida and to help them interact appropriately with Zack within the school community.

Four strategies were used:

- social studies curriculum integration;
- critique of the 'personal tragedy' position;
- multiple positionings;
- curriculum application in the school community.

She used the students' responses in their thinking books and conversations to adapt her teaching to their emerging needs and understandings.

The **'personal tragedy'** model posits disability as a problem or deficit located within the individual and in need of 'fixing'. Operating from this model, a person may feel pity or charity, which, however sincere, lead them to deal with individuals with disabilities in compensatory rather than educational ways.

Expert support

Ms Nikora also drew on the expertise of her university course lecturers who provided her with information on the broad theory surrounding social contexts and the 'social constructivist' model. She also learned how to use action research to explore the application of research and theory in a practical context.

The **'social constructivist'** model rejects a remediation focus and sees disability not as the result of the person's impairment but as a product of contextual, social factors that create barriers and limit opportunities for full participation.

Why did this work?

Ms Nikora used an action research approach to explore the interplay between theory, research, and practice. Her motivation was to teach her students alternative responses to people with disabilities. To do this, she focused on research that could inform her theory about what the alternative behaviours and attitudes might be and provide possibilities for new practice that she could integrate into her current practice. The theory guided her choice of resources and the learning experiences she planned for her students, as well as the way she introduced Zack to the class, to ensure that he was framed not just as a child in a wheelchair, but as 'one of us'. The theory also helped her as she responded to her students' thinking—as revealed in their thinking books and conversations—enabling her to critique 'personal tragedy' responses and to model a social constructivist position.

Teacher responses to PD/PL

Dissonance

While Zack had been in the school for some time—he was a year 5 student—Ms Nikora had not acted until she became aware of the dissonance between the theory she had encountered in her studies and the responses of students following the playground incident. It was a new theory, supported by relevant research, and her awareness that she could improve this situation by applying this learning to her current practice, that resulted in her learning and changing her practice to resolve the problem.

How own practice impacted on diverse students

Ms Nikora became aware that her current practice was not helping her students deal with diversity in the school community. She planned to build new teaching and learning links into her social studies curriculum to address the issue, emphasising the social studies aim, 'to enable children's participation in a changing society as confident, informed and responsible citizens'. Her selection of resources was strongly influenced by her aim to critique the 'personal tragedy' model. The key resource was a story and pictures about Tyler, a four-year-old boy with spina bifida, who spends Christmas in hospital having an operation (Smythe, 1996). This story allowed the students to compare their Christmas experiences with Tyler's, and to learn about spina bifida. Ms Nikora was judicious, however, about which components of the kit to use.

The resource had something about developing a sympathetic relevant understanding … and I remembered the readings I had done in … 'Theory into Practice' and the lecture about the personal tragedy side of it and that word 'sympathy' just didn't work for me … I thought the children would relate it straight back to the personal tragedy—'Oh, you poor little thing!' …

Teacher

Learning resources

Knowing how students learn

Ms Nikora's knowledge of how her students learned was both part of the theory that informed her decisions and the method of inquiry she used to assess her practice. She provided a range of tasks and contexts to help her students learn about spina bifida and, throughout the unit, considered how this content was working with the students. She had them illustrate the current focus of the study in their thinking books, together with the metacognitive strategies they were using. She also used students' comments and behaviours as indicators of how they approached and viewed a student with a disability.

Theoretical tool used to inform practice

Ms Nikora used her new theory not just to set goals but to decide how to achieve them. She used the idea of multiple positionings to frame disability as a social construction rather than a personal tragedy. Zack was first introduced to the class some weeks before the unit was to begin as an older peer helper. This was to provide a context where his strengths and abilities were self-evident and directly helpful to the students. He was positioned as a member of a tutor programme staffed by older students, rather than as different or disabled. The teacher then arranged for Zack to address the class, positioned as an expert resource person on spina bifida. In the students' third encounter with Zack, he was positioned as 'one of us' rather than 'other'. Students and their tutors were asked to draw a picture showing what they were good at. Zack shared his strength as a cricketer and Ms Nikora used this to win his acceptance by the group of students who admired sporting expertise.

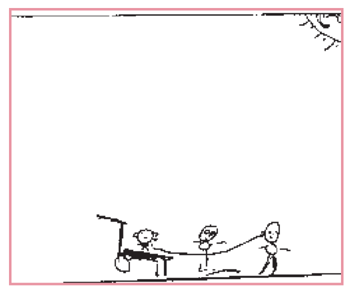
> *I have learnt today that Zack (is) good at playing cricket and William (is) good at playing soccer.*
>
> Student

Major learning processes

Assimilating new knowledge

Throughout the unit Ms Nikora used the 'personal tragedy' model as a tool to help her to reflect on the students' responses to Zack. Rather than challenging students whose responses reflected a personal tragedy focus, she provided evidence of Zack's competencies and modelled informed, respectful, and appropriate ways of interacting with him.

By integrating social constructivist theory with her knowledge and use of the social studies curriculum and using techniques such as reframing students' views of a child with a disability through multiple, positive positionings of him, the teacher/researcher acted to resolve the dissonance between students' current behaviours and attitudes and a new and more appropriate approach.



> *You don't just teach people by showing you know! You can teach them by telling!*
>
> Student

How did the teacher make this work?

Ms Nikora taught her students to frame disability as a social construction rather than a personal tragedy. This theory posits that disability should not define a person and that multiple positionings are possible for an individual. Barriers in specific contexts create limitations. Rather than 'fix' the individual, these barriers to learning and inclusion need to be overcome using a problem-solving approach. The teacher used thinking books to access students' metacognitive responses to learning situations so that she could reflect on the effectiveness of her practice and continuously adapt it to meet both her students' learning needs and her own teaching goals.

How this case links to the synthesis

Reframing teachers' social constructions of students

9.2.1.1 Infrastructural supports

9.2.1.5 Prevailing discourses

9.2.2.3 New vision for teaching, learning, and relationships

9.2.2.4 An emphasis on pedagogical relationships

9.2.3.1 Professional instruction followed by multiple opportunities to learn

9.2.3.2 Activities that integrated theory and practice

9.2.3.3 Examining student outcomes and understandings

9.2.4.1 Creating dissonance with current position

Reflective questions

Zack had been in this school for some time.

- What factors helped Ms Nikora to recognise that there was a problem with the way other students were responding to him?
- What enabled her to act so constructively?

Source

Alton-Lee, A., Rietveld, C., Klenner, L., Dalton, N., Diggins, C., & Town, S. (2000). Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion. *International Journal of Inclusive Education, 4* (3), 179-210.

3

Developing a research–practice collaboration

Context

Setting

The seven decile 1 schools in this study were all involved in a New Zealand Ministry of Education schooling improvement initiative in South Auckland. The total population consisted of students from years 4 to 8, with equal proportions of males and females. The major ethnic groups were Sāmoan (33%), Māori (20%), Tongan (19%), and Cook Islands (15%). Approximately half of these students had a home language other than English. Schools opted into the initiative but all teachers in the participating schools were required to take part. The schools concerned had registered their dissatisfaction with the rates of progress of students in senior classes and were seeking ways to leverage off the recent progress observed in the junior classes.

Time

The study lasted for three years and was implemented in three phases. In the first phase, data were analysed and teachers and researchers engaged in discussion of students' strengths and learning needs. The second phase involved professional development sessions designed to develop teachers' content knowledge and fine-tune instructional practices. The third phase was aimed at sustaining the benefits of the initiative, primarily through teacher-led action research projects.

Focus of PD

The intervention aimed to identify relationships between teaching and learning that were impacting on the achievement of diverse school populations. The focus of the professional development was to discover the specific reading comprehension strengths and needs of students and to design effective teaching practices to address these needs.

Goals

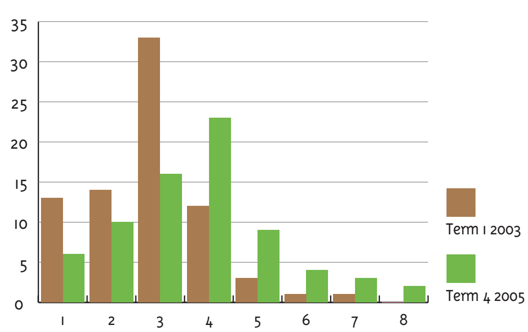
The goals of the professional development were to identify practices that were effective in teaching reading comprehension and to fine-tune these in order to meet the specific needs of the specific school populations concerned. The overall aim was to raise the reading comprehension of students who were performing below national expectations.

Impact on student learners

Prior to PD

Students' scores on the STAR test (which consists of four subtests: word recognition, sentence comprehension, paragraph comprehension, and vocabulary) indicated that they were able to decode text well, but their comprehension was well below that expected for students of a similar age, nationally. The paragraph comprehension subtest was of most concern as this was the area where students were furthest behind their peers.

Stanine distribution for term 1 2003 and term 4 2005



After PD

By the end of the third phase of the intervention, there had been an average overall gain of 0.97 of a stanine. This represents approximately one year's progress over and above national expectations of student progress for this period. By the end of the project, the average student scored in the 'average band of achievement' (stanines 4–6) and 10% were in the 'above average' band (stanines 7–9).

What was learned and how the learning occurred

Identifying needs through research

Prior to this professional development, teachers in the participating schools had been trained in the analysis of student achievement data. The capacity of school leaders to critically analyse achievement data was evaluated by a researcher and found to be up to standard, although leaders needed further support to make links between the data and teaching practice.

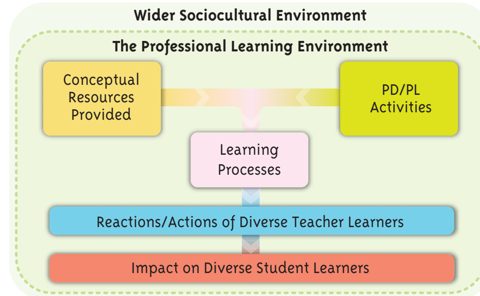
In the first phase of the intervention, the focus was on critically analysing and discussing student achievement data and teacher practice in professional learning communities. The idea was to identify student and instructional needs so that subsequent intervention could be based on the specific profiles of the schools. This was achieved using a two-step process. The first step involved a close examination of student strengths and weaknesses and teaching practice to determine the effectiveness of current instruction and provide an understanding of teaching and learning needs as they related to reading. The second step consisted of raising competing theories about the cause of the problems, and evaluating the evidence for each.

Teachers learned to use standards of accuracy, coherence, and improvability, and to work together with researchers to ensure that valid conclusions were drawn. 'Accuracy' relates to ensuring that claims are based on fact—either accurate data or clear understandings of what others think or do. 'Coherence' involves looking at the big picture to ensure that any solution to a problem will not create problems elsewhere. 'Improvability' refers to the need for theories to be testable and able to be revised—to meet changing situations, identify faulty reasoning, and allow for erroneous assumptions to be corrected. Theories needed to incorporate feedback loops so that unintended consequences of any actions can be identified and theories altered accordingly.

What was learned and how the learning occurred

Integrating theory and practice

In the second phase of the intervention, while they continued to collect information on teaching practice and student outcomes, teachers also participated in workshops and activities based on the findings from the previous phase and the dimensions of effective teaching. These sessions combined an introduction to the theoretical principles and research-based ideas with teachers' own investigations and classroom practice. There were ten workshops in all, each followed by a task designed to support teachers to translate theory into practice. Once tasks had been completed, the next workshop began with a discussion of findings and a sharing of resources relating to the topic. The box below outlines the content of the workshops and the follow-up tasks, together with the associated activities or aspects of the professional development (other than listening to provider experts).



	Content	Tasks
1	An introduction to theoretical concepts of comprehension related to the profiles of teaching and learning.	Teachers examined their individual classroom achievement profiles and compared these with school and cluster-wide patterns.
2	A focus on strategies, in particular the issues of checking for meaning, fixing up confusion, and strategy use in text.	Teachers increased the instructional focus on checking for meaning.
3	The introduction of theories and research related to the role of vocabulary in comprehension. Professional readings.	Teachers designed a simple study that looked at building vocabulary through teaching, and carried it out in their classrooms.
4–5	The significance of the density of instruction and repeated practice with a particular focus on increasing access to rich texts including electronic texts.	The task mirrored the emphasis of the workshop, with teachers analysing the range and types of books available in their classrooms and student engagement.
6–7	The concepts of incorporation of cultural and linguistic resources, building student awareness of the requirements of classroom tasks, and features of reading comprehension.	Observation and analysis of these features of the instruction.
8–9	Transcripts of videotaped classroom lessons were used to exemplify patterns of effective teaching in different settings—such as guided or shared reading—so that teachers could develop the practice of examining and critiquing each other's practices. Topics requested by teachers, such as the role of homework and teaching and learning in bilingual settings.	Teachers planned to create learning circles, where colleagues would observe aspects of teaching (such as building vocabulary) in each other's classrooms and discuss with one another what these observations indicated about effectiveness.
10	Teachers were given the opportunity to review their collaborative teaching and learning observations.	

Sustaining the change

The literacy leaders and the researchers planned the third phase of the intervention together. The collection and critical discussion of cluster-wide data continued, as did the learning circles developed in the previous phase. Schools experienced high rates of staff turnover, averaging one third of teachers in the cluster each year, so induction processes were developed that included professional learning opportunities to ensure that new staff understood their school's literacy focus.

During this phase, teams of teachers developed their own action research projects, often with a pre- and post-testing component, to check aspects of their teaching programmes. Teams generated their own questions and the researchers helped the teachers shape them and develop processes for answering them. Two research meetings were held in six of the seven schools—the seventh school had a change of principal and literacy leader and declined to develop projects. Eleven of the research projects were presented at a teacher-led conference in the fourth term of that year. Ninety percent of teachers in the cluster attended, along with other professional colleagues including literacy advisors.

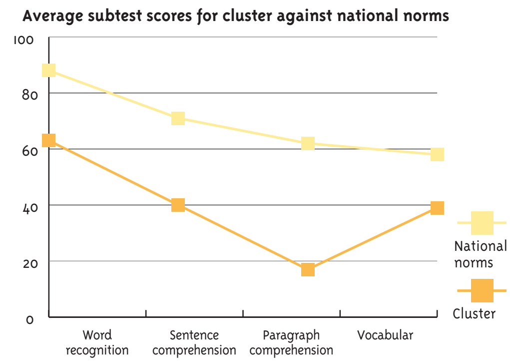
Why did this work?

The teachers and researchers used contextualised evidence as a basis for informed decision making about teaching and learning. All the participants were involved in the subsequent needs analysis, not just the providers. Because teachers had had agency in the decision-making process, they were engaged by the content of the workshops. The tasks following each workshop were designed to support teachers to translate new learning into practice. Any issues identified went onto the agenda to be discussed with both peers and experts. These discussions were an opportunity for teachers to share their successes and concerns and it was here that the protocols were established for professional learning communities that would later function independently. The stage was now set for the third phase of the intervention, in which new learning was embedded into core practice and teachers began to inquire critically into their own practice. The teachers from the school that declined to participate in the action research projects showed their continued interest by attending the teacher-led conference held at the end of the year. This underscores the importance of supportive and proactive leaders.

Teacher responses to PD/PL

Actively engaging and changing practice

In the first phase of the professional development, teachers identified their students' strengths and weaknesses and then proposed competing theories that could link the achievement data they had gathered to observations of their own practice. As they could have addressed their students' low achievement in reading comprehension by following any of a number of different, competing approaches, they decided to investigate, rather than assume, what students really needed. One example of this concerned paragraph comprehension, which had been identified as an area of weakness. Paragraph comprehension was assessed through cloze passages (passages with some words omitted). Students were required to read these passages and find appropriate words to fill the gaps. The average subtest scores for the cluster on the STAR test are shown in the graph. The following conversation shows how comprehension, rather than decoding, was identified as the weakness.



Researcher: What does this graph tell you about students' strengths and weaknesses?

Teacher 1: Decoding is their strength. The word recognition subtest is pretty close to national norms.

Researcher: So what does that mean, educationally that is?

Teacher 1: They can bark at text but can't understand what they are reading.

Teacher 2: Yeah. Look at paragraph comprehension. It is very weak. On average, they are only scoring 20%!

Teacher 3: That is really low. That's about 4 out of 20, isn't it?

Teacher 2: Yes. Their vocabulary is pretty weak too. It might be linked.

Teacher 4: We should look at the other year levels too. Are they all equally weak at paragraph comprehension? Is this a problem across the whole school?

When the researchers analysed the test in greater detail, they noticed that students appeared to be over-predicting, or guessing. Their mistakes made sense up to the point where they had made them, but not in the context of the whole sentence. Observations of how teachers taught reading comprehension showed that they rarely asked students to check if their predictions were consistent with the information from the text. The researchers theorised that this could be why students did not check their answers in the cloze passages to see if they made sense. The members of the teachers' learning community checked the theory against examples from their own practice and agreed that it was plausible, so they decided to incorporate more checking into their teaching programmes. The workshops in the second phase responded to the needs that the teachers had identified, and the teachers' findings informed subsequent practice.

Enhanced regulation of learning

During the third phase, teachers developed action research projects. The purposes behind these were: to strengthen teachers' professional learning communities, to embed the practice of gathering and critically analysing evidence, and to ensure that what had been learned in the second phase of professional development was utilised. The projects chosen linked closely to the areas identified in the initial phase and included: increasing students' vocabularies, increasing factual information in narrative writing, skimming and scanning, instructional strategies to increase the use of complex vocabulary in writing, reviewing the effects of a new assessment tool on teaching practice, redesigning homework to raise literacy levels, and the use of critical thinking programmes. These projects encouraged teachers to draw on evidence about teaching and learning from their own contexts and to fine-tune their practices through critical analysis and problem solving, supported by professional learning communities. The support of researchers was still available, but by this stage the learning communities were developing the skills to review and enhance their own practice and to develop their own theories independently.

Major learning processes

Developing a community of inquiry

The roles of researcher and school changed as the project went through its three phases. The researchers initially were providers of external expertise. They then became part of the learning community. Finally, they had a support role, providing specific help in areas identified by the school. By the third phase, the schools were driving the professional development, as is evidenced by the teacher-run conference, induction processes to support new staff, and appraisal to ensure that teachers continued with their new learning and action research projects. Schools were able to source new funding so that, while they were driving their own learning, they could still access support from external providers as required. The elected chairperson of the initiative explained the importance of the collaboration between the external providers and the schools:

The goal was to raise achievement, and unless we were able to inquire into the causes underlying the lack of achievement, we were just going to perpetuate what we'd been doing. We could say the words, but we didn't know what the problem was. We needed someone who would challenge what we kept saying was the problem and what we were doing about the problem. We couldn't have done it on our own … We needed a teacher, an analyst, a problem solver, a research-literate individual … We needed someone to challenge our assumptions, develop our skills in using achievement information, expand our thinking, and enable us to become evidence-based decision makers.

Teacher

How did the teachers make this work?

The focus of the professional development was on joint problem solving by teachers and researchers around evidence that the teachers had gathered themselves or which they agreed was accurate and valid. The teachers, in collaboration with the researchers/providers, identified the direction that the professional development should take by means of critical analysis and discussion of evidence. Where there were more than one possible explanation for a finding, competing theories were raised and the whole staff came together as a professional learning community to investigate and find the most plausible explanation. Through this process, teachers gradually developed the skills to inquire into the effectiveness of their own practice and worked together as a community to review and refine their practice in light of agreed evidence.

How this case links to the synthesis

Professional learning and literacy

8.2.1.3 Engagement of expertise

8.2.2.1 Pedagogical content knowledge

8.2.2.2 Shared theories

8.2.2.3 Multiple uses of assessment

8.2.3.2 Activities to link key ideas to teaching practice

8.2.3.4 Creating professional learning communities

Topical issues

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

10.2 Issue 2: The role of school leaders in promoting professional development

10.4 Issue 5: Professional learning communities

Chapter 11 Sustainability

Reflective questions

These teachers had been involved in substantial professional development in reading comprehension.

- How did this approach build upon the teachers' current understandings?
- What leading key elements in the process leading from problem identification to sustaining practice led to improved student outcomes?

Source

McNaughton, S., Lai, M. K., MacDonald, S., & Farry, S. (2004). Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand. *Australian Journal of Language and Literacy, 27* (3), 184-197.

4

Using assessment to build teaching capability

Context

Setting

This case was situated in a cluster of 14 schools in Northland and involved 70 teachers and 1600 students. The Ministry of Education funded the providers, Evaluation Associates, but schools met all other costs. In 13 of the schools, over 50% of the students were Māori; in the other school, approximately 10%.

Time

The professional development spanned two years. In the first, the capacity of lead teachers was developed; in the second, these lead teachers facilitated the same activities with the other teachers in their schools.

Focus of PD

The professional development aimed to raise the reading achievement of all students by improving teachers' use of assessment-for-learning strategies. In the first year, the team focused on developing school management's and lead teachers' understanding of the principles and practices that underpinned assessment for learning. This was done through a series of approximately eight regional workshops alternating with school visits. In the second year, the facilitators supported the lead teachers (who had to be classroom teachers) to undertake similar professional development activities with their colleagues. These activities were tailored to the needs of each school.

Goals

The goal of the professional development was to raise student achievement and reduce disparities through changed teaching practice. It was explicit and emphasised from the beginning.

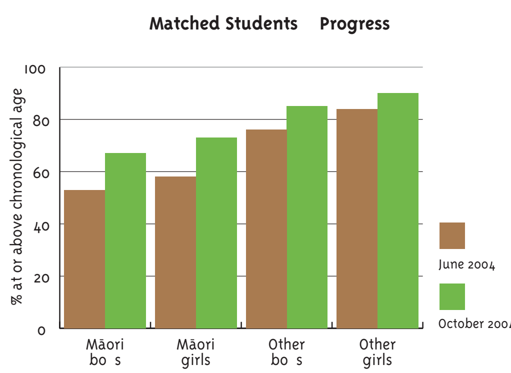
Impact on student learners

Prior to PD

Evaluation Associates collected baseline and outcomes data so that they could evaluate effectiveness in a systematic way. They were able to show substantial effect sizes in reading using the PM Benchmarks for years 1–4 and PROBE for years 5–8. In the 45 classes where fewer than 90% of students were reading at or above expectations, students' reading ages were calculated and compared to their chronological ages to determine whether they were reading above, at, or below the expected level.

After PD

The graph shows how the proportion of students reading at or above their chronological age changed over five months from June to October 2004. The overall effect size was 0.62, with all groups of students showing greater numbers in the desired achievement band and Māori boys showing the greatest gains.



What was learned and how the learning occurred

Establishing a framework of competencies

To achieve these shifts, Evaluation Associates developed a 'competencies matrix' that identified six teacher competencies that they considered essential when implementing assessment-for-learning practices: building partnerships for learning, clarity about what is to be learned, assessment literacy, promoting further learning, active reflection, and clarity about next learning steps. Each of these competencies was divided into four stages and included four to six dimensions representing differing levels of effective practice. The following example shows the first and final stages of the 'active reflection' competency.

Active reflection: competency five

Stage one

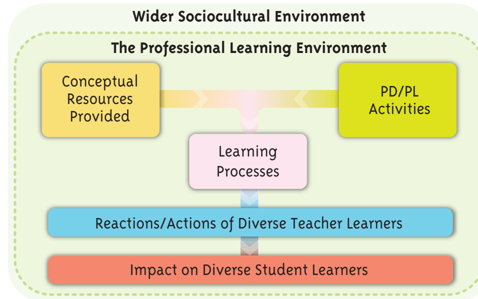
- Teacher reflection occurs independently of students, can be divorced from good assessment information about outcomes or process, and often centres on surface features of the lesson or enjoyment.
- Teachers regularly ask students to share work at the end of a lesson and discussion often centres on surface features.

Stage four

- Both teachers and students routinely reflect, and talk reflectively, about what is intended to be learnt, where they have got to, and where they will go next. They also routinely reflect about the learning process. This may often be seen as a formal plenary session, or a learning diary or peer reflection or student conference.

What was learned and how the learning occurred

Identifying current practices and future goals



The competencies matrix, initially introduced through the workshops, was central to promoting teacher learning. The matrix encompassed most of the fundamentals of teaching, including theoretical frameworks, curriculum and pedagogical knowledge, new ways of thinking about assessment, and explicit standards for teaching practice. It was brought to life through classroom demonstrations and video presentations so that teachers could see that it was not just an abstract, theoretical concept. Perhaps the most important activity was the collaborative evaluation of where, for a particular competency, an individual teacher's classroom practice fitted on the matrix, based on a videotape of that teacher's lessons. A major focus of the professional development was to support teachers to review their progress against the competencies and decide on next teaching steps.

Improved practice was not considered an end in itself but was explicitly linked to its impact on students. In each lesson videotaped for the purpose of evaluating a teacher's progress, students were interviewed so that their understanding of the lesson could be analysed. Student achievement was also analysed. Assessments provided teachers with student learning progressions and an understanding of new possibilities for their students. Assessment information was not the exclusive property of teachers—it was shared with students and parents. In this way, it was integral to students' learning. Behind this practice was the competency 'building partnerships for learning with students and parents'. In the process, students learned how to use assessment to improve their own learning.

Students have taken on more responsibility for their learning. They're there to be involved in their own learning.

Teacher

Student

Having a goal is like having a shining star to guide you through the darkness and into the light.

Multiple opportunities to reflect and learn

Central to the professional development was the use of active reflection as a tool for inquiring into and improving teaching practice. Reflection was more than a vague musing about one's practice; it was thinking about it in relation to six dimensions: reflection about learning, self- or peer-assessment, reflection about the level of student engagement, reflection about sense of partnership, professional reflection, and students being taught to be routinely reflective. Each of these dimensions was explicitly described according to the four stages. As one teacher said:

There is a constant cycle of reflection about children's learning, asking, 'How can I improve my practice so that children think about their own learning?'

Teacher

The professional development activities were deliberately designed to mirror the principles and practices the teachers were being asked to use. These activities were sometimes designed by the provider and sometimes constructed with teachers. The professional development initially focused on individual, in-class activities, but as facilitators found that they were repeating the same information, they decided to provide more workshops for groups of teachers. 'Quality learning circles' gave teachers the opportunity to discuss with lead teachers and colleagues the challenges involved in changing practice.

Why did this work?

The professional development had several features that contributed to its success. First, a clear goal of raising student achievement and changing teacher practice to this end was established. Second, teachers were provided with a carefully constructed matrix of practices that describe the fundamentals of teaching (theoretical frameworks, curriculum and pedagogical knowledge, assessment and standards) in relation to effective formative assessment practices. Next, teachers were motivated to change practice by evidence that highlighted discrepancies between their current practice and more effective practice, and given the support they needed. Finally, teachers were given multiple and ongoing opportunities to learn, situated in their practice context, so that they could constantly review progress and decide what next to change.

Teacher responses to PD/PL

Actively engaging and applying new theory and practice

The competencies matrix was used to challenge teachers' current practice and create a vision for more effective practice. Baseline and endpoint assessments of each teacher's practice on each of the six competencies showed that, on average, the performance of lead teachers was at stage 4 by the end of the year, and all teachers had improved.

I now do lots of checking, getting feedback from the students and making sure they know where they're going.

Teacher

Teacher

There is more learning talk in cascade groups, syndicates, school-wide, through formal and informal conversations.

Multiple opportunities to learn were provided throughout the professional development. These were designed to challenge teachers' existing beliefs and practices. The challenges were typically undertaken using evidence-based inquiry processes. For example, one facilitator described how video demonstrations of particular teaching practices often left teachers feeling that they could not implement the demonstrated practices in their own classrooms, with their own students. She described how she typically encouraged them to try out the new (and seemingly unattainable) practice in a safe environment—for example, with a small group of students—then revisit the possibilities for change.

My understanding of what I'm teaching has become clearer to me, more structured, and more logical. Therefore, planned learning activities are more focused on the learning intention.

Teacher

Major learning processes

Engagement and application of new theory and practice

It is reasonable to conclude from student outcomes and teacher comments that the most common teacher reaction to the professional development was to become actively engaged and apply new theory and practice. One teacher said simply that, as a result of using assessment-for-learning approaches, *"I am more motivated to teach."* The use of the lead teacher model to develop leadership within participating schools was a purposeful part of the process.

Teacher

This has made us aware that previously we did loads of meaningless summative assessment—now it is useful, powerful, formative assessment. Students have opportunity to view running records and comprehension results and talk about what they see with their peers, and students look forward to assessment because they know it's a tool—not a test.

How did the teachers make this work?

The role of the lead teachers was crucial to the success of the project. The project director emphasised the importance of backing from the top: *"The support for the professional development from the senior management team is critical."* Equipping the lead teachers to drive the project within their own schools meant that there was continuing support for teachers plus a commitment to ensure that new learning was sustained. Multiple opportunities to review, revise, and refine practice allowed teachers to make changes in line with their developing theoretical knowledge and to translate this into their existing contexts in safe and manageable ways. The effectiveness of the pedagogical approach in raising student achievement and deepening teachers' understanding of how to enhance student learning—along with positive student feedback—motivated teachers to incorporate new practice into their daily teaching.

How this case links to the synthesis

Summary of findings

2. The context of professional learning and development
3. The content of professional learning and development
4. Activities constructed to promote professional learning
5. Learning processes

Topical issues

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

10.2 Issue 2: The role of school leaders in promoting professional development

Chapter 11 Sustainability

Reflective questions

Teachers were able to make substantial shifts in both their practice and the achievement of their students.

- What features of this project enabled teachers to use information about student learning to make these improvements?
- What aspects of the project were put in place to sustain the changes in practice?

Sources

Absolum, M. (2004a). *Assess to Learn Project* (Project proposal submitted to the Ministry of Education). Auckland: Evaluation Associates.

Absolum, M. (2004b). *ATOL programme 2004* (Report prepared for company purposes only). Auckland: Evaluation Associates.

Absolum, M. (2006). *Mining the data: Learning to use student achievement data to effect change* (Project proposal submitted to the Ministry of Education). Assess to Learn Project. Auckland: Evaluation Associates.

5

Using evidence of student thinking to inform pedagogy

Context

Setting

The Numeracy Development Project (NDP) is a national project that has (at the time of writing) involved approximately 690,000 students and 23,000 teachers. Initially, as part of a planned roll-out to all schools, individual schools were invited to participate. It is anticipated that eventually all teachers at the target year levels will have been involved. There is an expectation that senior management will participate in the professional development but this does not always happen. All schools appoint a lead teacher but the role is variously interpreted.

Time

Each teacher is provided with 13.2 hours of professional development in the first year. They participate in six to eight workshops of 2.5 hours' duration and receive at least three in-class observations followed by feedback with the facilitator. Facilitators make decisions about the timing and form of the professional development in consultation with the lead teacher(s). In the second year, teachers participate in up to 8 further hours of professional development.

Focus of PD

The professional development emphasises the development of strategic thinking and mathematical knowledge through discussion of multiple solutions to problems. This contrasts with the prevailing models of practice, which typically stressed completion of written mathematical exercises following textbook progressions.

Goals

The numeracy project is a system-wide initiative to raise students' achievement in mathematics and develop teacher knowledge of teaching mathematics. It came about in response to the recommendations of the Mathematics and Science Taskforce (1997).

Impact on student learners

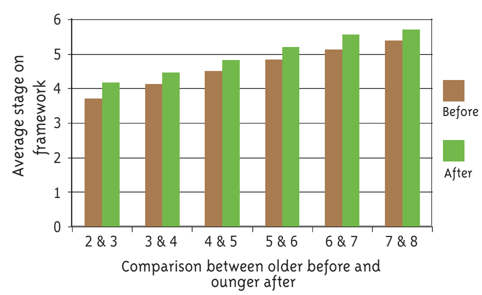
Prior to PD

An important component of the project is the Number Framework, which consists of a sequence of global stages describing the mental processes students use to solve problems with numbers. At lower stages on the framework the steps are smaller than at upper stages, so progress appears greater. Prior to PD, students in the early years of school progress approximately a stage per year on addition/subtraction. Progress for students in the middle years of primary school is about half a stage per year. In years 7–8, average progress on addition/subtraction is about a fifth of a stage per year.

After PD

Since the project's beginnings in 2000, the students of the teachers involved have consistently shown substantive progress, measured against the Number Framework. The overall effect size is 0.34, with average effect sizes of 0.39 for multiplication/division (see graph at right, showing 2006 data) and proportion/ratio. The effect size for addition/subtraction is smaller at 0.24. Groups with an average effect size above the overall average include Pasifika students (0.40), Māori (0.35), and students from low-decile schools (0.38). These effect sizes are based on 2005 and 2006 data and compare students after a year on the project with slightly older students (those in the next year level) before the project started. (For example, year 2 NDP students at the end of 2005 were compared with year 3 pre-NDP students at the start of 2005.) The project has evolved as ongoing evaluations have informed its implementation. A network of stakeholder and participating groups has contributed to the review process.

Average stage on framework for students compared with previous year's cohort



PD/PL activities

Creating dissonance

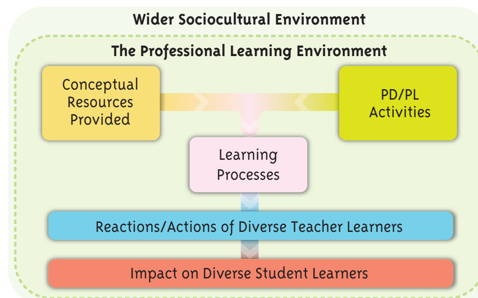
In the early stages of the PD, the focus was typically on challenging teachers' previously held assumptions about student learning of mathematics. They learned to use a diagnostic interview to determine the level at which each student was thinking, measured against progressions on a number framework. As they interviewed their students, teachers were often surprised to find that their previous judgments were inaccurate. This challenged them to examine their current practice, expectations of students, and beliefs about teaching mathematics. Their discomfort with their current practice provided the rationale and motivation for them to engage with a different model of teaching.

… some of the results really blew me away, it was the processes, what they knew … I had children who I had expected to do better, but they didn't, and I had some children who I expected to be at a certain level and [they] ended up being quite high up in terms of their cognitive processes, but they didn't give me the answer, I had just assumed, oh no, you're this level … It got rid of all my preconceived ideas.

Teacher

Modelling new practice

As teachers are adult learners with considerable practical experience and existing professional knowledge, it was necessary to give them evidence that alternative practices were relevant and effective. To provide such evidence, providers modelled recommended teaching approaches in individual teachers' classrooms with their own students. They were often able to elicit explanations from students in ways that the teachers had not thought possible. Teachers were motivated to change as their beliefs about what students could learn were challenged and as they saw convincing alternative practice modelled.



Provider

It takes time, but a very effective thing that this contract has done is to be in [the teacher's] classroom with their children, modelling what it looks like and what's possible. We model with your kids and they say, "I never knew that kid knew that", or "This is where this is coming from." I think the effective thing has been going in there facing their classroom and the fact that you keep on coming back … You are able to talk with the teacher about underlying concepts.

Developing content knowledge

Underpinning the professional development was an assumption that effective teaching practice is informed by strong content knowledge. Different theories of motivation suggest different approaches to addressing this issue. Workshops on the number framework and the diagnostic interview were a mandatory feature of the project. Providers met the need for further content knowledge in separate workshops or, following a more integrated approach, addressed them as gaps became evident in the course of professional development activities.

The number framework describes increasingly sophisticated stages of strategy and mathematical knowledge. A graduated teaching model provides teaching approaches for each stage of the framework. This combination of learning resources gave teachers a theoretical framework for thinking about numeracy progressions, and appropriate activities for use with students. Facilitator and video demonstrations plus teachers' own use of the diagnostic interview helped them unpack the stages of mathematical thinking exemplified on the framework.

Refining new practice

Teachers received detailed instructional activities and resources, but how they were used varied depending on the professional development provider. They were sometimes used as a resource for students and sometimes as a resource to support teachers' development of theoretical ideas.

The theoretical approach to facilitation was implicit rather than explicit. For this reason, on-the-ground facilitation approaches varied considerably from one Ministry of Education contract to another. This allowed providers to be responsive to the contexts in which they worked and to the specific needs of their groups of teachers. It also supported the development of understandings, beliefs, and goals that were shared by providers and teachers.

Why did this work?

The project had a clear goal of raising student achievement and developing teacher knowledge. Teachers were motivated to change when they saw evidence of discrepancies between perception and reality, relating to students' mathematical understanding and capacity to learn, and as they were provided with theoretical frameworks on which to base new practice.

The content focused on three related tools: the number framework, the diagnostic interview, and the teaching model. The number framework described increasingly complex stages of mathematical thinking. The diagnostic interview provided a means to establish where students' thinking fitted on the framework. The graduated teaching model equipped teachers to introduce their students to increasingly abstract representations of mathematical ideas. This close connection between assessment of student understanding and teaching activities was a major factor in achieving changes in teacher practice.

Teacher responses to PD/PL

Learning resources

The professional development was deliberately situated in syndicate or whole-school groupings to foster the development of professional learning communities. Providers encouraged senior management and lead teachers to facilitate teacher discussion of issues related to the professional development and to examine student progress. One lead teacher described the process of supporting teachers to change their practice in this way:

Getting staff through that realisation that their professional judgment, their listening to the children, their looking at the child … to say, 'OK, right, I'm quite confident that they've got that understanding, they're using that strategy, they're ready to move on.'

Lead teacher

Developing new understandings

Teachers contextualised the framework in terms of their own practice by using it and interviewing students to determine their mathematical understandings. The close connection between assessment of understanding and teaching activities was a major feature of this project. By linking content knowledge and pedagogy, teachers were better able to understand the level that their students were working at and what their next teaching steps should be.

Provider

Success for most of [the teachers] has been undeniable when they see the results, and they can tell you about their kids far more than they ever could. It has been about building teacher knowledge, their own, personal knowledge in maths.

Teachers viewed their professional learning as adding to their repertoire of teaching strategies and they were often surprised by the degree of change their practice underwent. Repeated opportunities to develop their own understandings, link these to the framework, observe the provider modelling practice with their own students, and discuss underlying concepts and theories allowed teachers to connect the theoretical framework, the teaching model, and the teaching activities, and to gradually embed new practice in their own contexts.

[The way I teach] has changed completely. I am shocked when I look back to my teaching prior to ANP. My teaching is targeted more closely to individual needs … the framework is at the centre of my teaching now. Teaching strategies as well as knowledge were new to me.

Teacher

Teacher reactions

Major learning processes

Interviews, surveys, and case study observations of teaching practice showed that most teachers found the process challenged their current assumptions about what aspects of mathematics should be taught, how to teach it, and how students learn. Many teachers reported that engagement with the professional development process led to reconstructing previously held views. Teachers were able to articulate the ways in which theory underpinned their practice and chose activities in terms of the teaching purpose, informed by the mathematical framework.

Such substantive differences in approaches to teaching meant that implementation of selected aspects of the new approach was likely to create a misalignment between new and existing practice and create substantial cognitive dissonance. In order to achieve the accelerated stage gains, the most common reaction of the professional development was active engagement and application of new theory and practice while participating in the professional development. The extent to which the new practices are sustained is not known, although the development of the lead teacher model may assist in maintaining gains.

How did the teachers make this work?

Teachers came to understand how their practice needed to be aligned with the learning needs of their students. Using the diagnostic interview, they came to better understand their students' mathematical thinking. The framework helped them to determine next learning steps for their students and to be aware of developmental progressions in student thinking.

Through multiple and ongoing opportunities to apply their new learning in the context of their own classrooms, teachers were able to translate their new learning into practice. Another benefit of applying new practice was that teachers' own mathematical knowledge was deepened. As they better understood what their students could and should be learning, their commitment to using new pedagogical methods was strengthened. Student outcomes confirmed that their shifts in practice had been effective.

How this case links to the synthesis

Professional learning and mathematics

6.2.1.5 External expertise

6.2.1.8 Prevailing discourses and models of practice

6.2.2.2.1 Teachers' knowledge of how students learn mathematics

6.2.2.3 Assessment

6.2.3.1 Activities to create dissonance/problematise existing practice

6.2.3.2 Activities that helped teachers translate theory into practice

Overview 6.3: Activities constructed to promote the professional learning

6.2.3.5 Examining student outcomes and understandings

Topical issues

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

10.1.4.3 Where to next?

10.3 Issue 3: Teachers' existing theories

10.3.5 Sequence of change

Reflective questions

Teachers were able to make substantial shifts in both their practice and the achievement of their students.

- What features of this project enabled teachers to use information about student learning to make these improvements?
- What aspects of the professional development motivated teachers to change their practice?

Sources

Higgins, J. (2004). *An evaluation of the Advanced Numeracy Project 2003* (Report to the Ministry of Education).

Young-Loveridge, J. (2005). Patterns of performance and progress on the numeracy projects: Analysis of 2004 data. In J. Higgins & K. Irwin & G. Thomas & T. Trinick & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Project 2004* (pp. 5-20, 115-127). Wellington, NZ: NZ Ministry of Education.

6

Re-culturing and restructuring to solve a problem

Context

Setting

This case was set in a large suburban, decile 6 secondary school with an ethnically diverse roll of approximately 2,500 students: 55% European, 20% Māori, 10% Asian, 6% Sāmoan, 2% Cook Islands Māori, 2% Tongan, 1% Niuean, and 4% other. The teaching staff of 150 included three levels of management. The Ministry of Education had noted high suspension and stand-down rates and required the school to act to reduce these.

Time

Senior management, middle management, and support personnel were involved in an initial 3-day facilitator training session on restorative justice practices, conducted by an external facilitator. This was followed by a half-day workshop for the general teaching staff. Ongoing whole-staff development was facilitated by those trained as internal facilitators, with refresher courses by the external facilitator. The project began in 2002 and, at the time of writing, has continued to develop.

Focus of PD

The principal and guidance counsellor decided to explore restorative justice practices as an alternative to removing disruptive students from the school. Staff involvement in the PD was mandatory. A cohesive, whole-school behaviour management programme was proposed to support staff in their day-to-day managing of student behaviour. This programme continues to be developed and refined in response to needs.

Goals

The goals of the restorative justice approach included:

- a reduction in student suspensions, stand-downs, expulsions, and exclusions;
- an improvement in the social/emotional environment of the school.

Impact on student learners

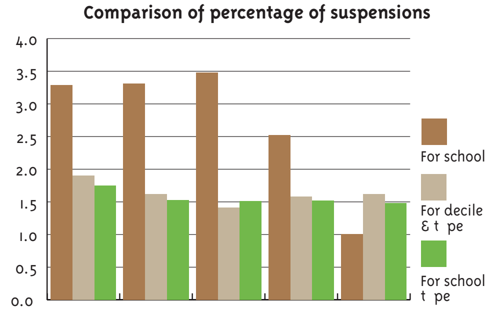
Prior to PD

Prior to the implementation of the project, the school had taken a confrontational and punitive approach to dealing with disruptive or destructive behaviour. Suspension and stand-down rates were well above those of similar schools.

After PD

The project was initiated in 2002 and fully implemented from the beginning of 2003. As can be seen in the graph to the right, suspensions fell by 22.5% over the next two years. By 2004, the number of suspensions was lower than average for both decile and school type. Since the restorative justice programme was put into operation, academic achievement has improved (as shown by NCEA results, and asTTle scores for year 9 and 10 students).

Comparison of percentage of suspensions



	2000	2001	2002	2003	2004
Series 1	3.29%	3.31%	3.48%	2.52%	1.04%
Series 2	1.90%	1.62%	1.41%	1.58%	1.62%
Series 3	1.75%	1.53%	1.51%	1.52%	1.48%

Student

I got a lot of ideas on what people think and feel about the same problems and probably how to solve them.

There is a more collaborative, relaxed atmosphere. The restorative justice identity of the school has built an expectation of connection, relating. Teachers and students live the philosophy. It has changed the culture of the school.

Teacher

What was learned and how the learning occurred

Cognitive dissonance

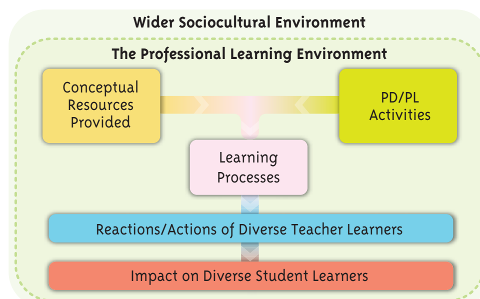
The high stand-down and suspension rates were symptomatic of wider issues of student behaviour and school culture that were already concerning the staff and management. The school's practice had been based on a model of students being held responsible for their actions—a model that located the deficit within the individual. In response to the directive from the Ministry of Education and in line with their goal of improving the school's social and emotional environment, management began to search for alternative methods of dealing with disruptive or harmful student behaviour.

Seeking information

The head of guidance initially suggested the restorative justice programme after attending a conference where the principles of restorative practice had been presented. The head of guidance and the principal began researching restorative practice by means of professional readings. They then decided to use the expert who had presented at the conference to train selected staff as facilitators and to provide workshops for the whole staff. This externally provided professional development involved presentations of restorative philosophy and practice, discussions with colleagues regarding implications for their own practice, demonstrations of the kinds of interactions that would promote reconnection with students and build or enhance teacher–student relationships, and opportunities to role-play these with colleagues.

Receiving tools/structures to use with students

While restorative justice has a philosophy of connectedness, relationships, and respect, it was first introduced to the staff as a behaviour management tool to help teachers deal with disruptive students in their own classrooms. The focus on meeting an immediate and recognised need was an important consideration when initially engaging teachers. Teachers were given tools and structures to help them to build positive, constructive relationships with students. These took the forms of: language with which to engage in restorative conversations; questioning processes; and a progressive structure of referrals to specialised staff for support.



Co-constructing new practice

Once all staff members were trained in implementing restorative practices, the process of embedding the concepts and philosophy into the unique context of the school community began. Development of 'The Massey Way' required research, analysis, and consultation with the entire community—teachers, students, parents, and beyond—in order to identify clear objectives, principles, and values that could be integrated with restorative philosophy and practice.

Since then, staff researchers have explored the implementation and the impact of changed practice in terms of the original goals for the project. They have made recommendations that have shaped further development of the philosophy and practice within the school.

Extensive analysis of data relating to attendance, achievement, and exclusions, together with surveys of teachers, students, and parents involved in restorative conferences, has helped the school assess the effectiveness of restorative practices and adapt them more effectively to the context. Community building, mutual accountability, and shared responsibility are recurring themes in feedback.

In order to identify objectives that would be widely endorsed, the board of trustees consulted extensively with all major stakeholders, taking into account the Treaty of Waitangi, the special character of the school, the aspirations of tangata whenua, community expectations, national education priorities, and feedback from staff, students, and parents.

To maintain the 'critical mass' essential for the sustainability of the programme, training opportunities have been provided for new teachers and new internal facilitators (drawn from all departments within the school).

Facilitator

I think there should be more shadow coaching … to make sure that everyone is delivering the same message in the same way.

There are frequent opportunities to share how the programme is working, discuss concerns, and make suggestions, so that it can continue to be adapted to meet the specific needs of the school and community. Conferences are documented so that lessons learned from one situation can be used to inform other, similar situations.

We need a standard procedure across the school, rather than being dependent on deans … the process becomes more transparent and predictable.

Teacher

A further opportunity for sharing and reflecting on the school's success has come through telephone conferences with other schools. Mentoring of colleagues, coaching prior to conferences, and preparing summaries of feedback have helped facilitators to both share their expertise and develop their facilitation skills.

Why did this work?

This programme was introduced in response to dissonance created by recognition that current practice was failing to address behaviour issues. Teachers were given knowledge and then materials directly applicable to their own needs and contexts and asked to provide feedback on how these worked for them. School leaders were involved in initiating the programme and as members of the internal facilitation team. Once the staff were trained, the board of trustees consulted with the whole school community to develop a set of shared goals and objectives. The programme continues to be informed and shaped by research, fact finding, and discussion around issues of effectiveness. The philosophy, objectives, and practices have provided the basis for a learning community committed to a shared set of values and beliefs. Shared ideals and continued dialogue ensure that the restorative practices remain relevant and dynamic.

Teacher responses to PD/PL

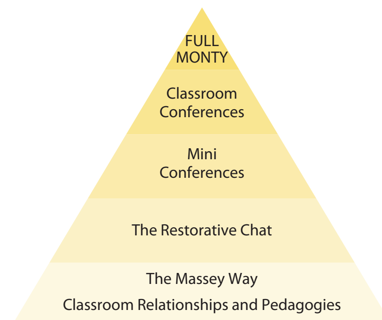
Implementing as required

After being introduced to them in workshops, teachers used restorative practices as a new approach to behaviour management. Positive reactions from students, and the effectiveness of this approach in reducing undesirable behaviour, convinced teachers of its worth. The time involved, which had been viewed as a barrier to implementation, was now seen as an investment. Gradually, the implementation became ingrained in practice and began to affect the culture of the school.

Actively engaging and applying new theory and practice

The principle of reflection, repair, and reconnection is at the heart of restorative practice. It is underpinned by a philosophy of locating the deficit in the relationship and engaging in restorative dialogue when interpersonal connections have been damaged. This philosophy, together with the shared objectives, has promoted the growth of a staff learning community.

Pyramid of restorative practices



The philosophy has been given strong support by leadership. This can be seen in the fixed-term management position created for the coordinator and the establishment of a leadership team (which includes representatives from all departments) to drive change, model and evaluate practice, and continue to research effectiveness. From this base, 'The Massey Way' has moved beyond behaviour management towards a whole-school philosophy where relationships are central—things are done with, rather than to, students. Students have been reframed as partners in their own education.

Teacher

[We have] grown a culture of mutual collaboration.

Through active consultation with the school community, school leadership has ensured that all those affected by decisions have shared input and understandings, gaining support and building relationships that extend beyond the school grounds.

Researcher

The school continues to monitor the process, learn from its experiences, and further develop the restorative model.

The school philosophy has encouraged staff to seek further professional learning opportunities in support of other needs as they have become apparent. The school has, for example, become part of the Te Kotahitanga project and some staff have participated in additional workshops on restorative practices.

Major learning processes

Rethinking relationships

Dissonance was created for the teachers when they recognised that current behaviour management practices were not effective in reducing the incidence of suspensions and exclusions or promoting a positive social and emotional climate in the school. Leadership sought alternative practices, which were implemented and found to be effective. The positive effects of the new practice led staff to embrace the underlying principles and philosophy, which influenced the school's social and emotional environment and thus the relationships between members of the school community—particularly teacher–student relationships. This led to students being reframed as active participants in their own education rather than passive recipients of knowledge.

How did the school make this work?

The staff were motivated to improve behaviour management in their classrooms. Effective tools were made available and met the perceived need, resulting in positive attitudes towards the programme. As a result, the principles and philosophy of restorative justice were embraced and used to address the wider objectives, principles, and values negotiated with and shared by the community. Dedicated leadership, a strong research base, community consultation, and a dynamic approach to adapting the philosophy to the school's unique context have encouraged the construction of new practices, and systems to support them.

How this case links to the synthesis

Reframing teachers' social constructions of students

9.2.1.2 Voluntary or compulsory

9.2.1.4 Leadership

9.2.1.7 Professional learning goals

9.2.2.1 Integration of theory and practice (see also Box 8.7)

9.2.2.4 An emphasis on pedagogical relationships

9.2.3.1 Professional instruction followed by multiple opportunities to learn

9.2.4.1 Creating dissonance with current position

Topical issues

10.2 Issue 2: The role of school leaders in promoting professional development

10.4 Issue 4: Professional learning communities

10.5 Issue 5: Professional learning in secondary school contexts

Chapter 11 Sustainability

Reflective questions

Changes went beyond the classroom to re-culturing and restructuring throughout the school.

- How did the school actively engage in solving the problem and apply new theory and practice?
- What factors allowed it to change successfully?

Source

Moxon, J. (2003). *A study of the impact of the Restorative Thinking Programme within the context of a large multi-cultural New Zealand secondary school.* MA (Education) thesis, Auckland, NZ.

7

Establishing a culturally responsive pedagogy of relations

The sociocultural environment

Context

Te Kotahitanga is a project that aims to improve outcomes for Māori students in mainstream New Zealand high schools. The first phase involved 11 teachers in four schools; the focus was on students in years 9 and 10. In the second phase, professional development was offered to all staff in the original four schools. The third phase took in another 12 schools. In the fourth phase (2006), 21 more schools joined the project. The focus of research in phase 4 is on the replicability of the programme as it is scaled up to include new schools and on the sustainability of the reform in the 12 phase 3 schools. Participation is voluntary. In the early phases, only 20–50% of the staff in any particular school was involved (except in the case of two small schools). Each year 30 new teachers from each school are brought into the project, so that by the end of the second year there are up to 60 to 70 teachers, which in some cases is the whole staff.

Time

At the time of writing, the project is in its fifth year, with some schools in their third year of involvement. The professional development consists of an initial three-day induction hui, followed by a term-by-term cycle of formal observations, follow-up feedback, group co-construction meetings, and targeted shadow coaching. Other activities such as new knowledge, new teaching strategies, and/or new assessment procedures are introduced on an 'as needs' basis.

Focus of PD

The emphasis of the project is on reducing disparity in educational outcomes for Māori students. The project aims to help teachers reflect critically on the assumptions they make about their relationships and interactions with Māori students and to interrogate their own roles in the perpetuation of low academic achievement, high rates of suspension, and high absenteeism. Professional development supports participating teachers to implement the Effective Teaching Profile (ETP) in their classrooms.

Goals

The goals of Te Kotahitanga include:

- challenging teachers' assumptions about their Māori students and classroom dynamics;
- having teachers adopt a pedagogical approach consistent with the Effective Teaching Profile;
- improving educational outcomes for Māori students.

Impact on student learners

Prior to PD

Prior to participating in the project, many of the teachers attributed difficulties experienced by Māori students to personal and home deficiencies. This was particularly true in their assumptions about the causes of low achievement, high absenteeism, and disruptive behaviour. Some of the teachers had responded by providing classroom activities with a low level of cognitive challenge. Student engagement, achievement, and attendance were all below acceptable levels.

Student

I think we don't pass and we fail because of the way they teach you. I just don't like it.

She doesn't even congratulate you if you've done something good or anything. She doesn't smile either. Yeah, I've never seen Miss smile.

Student

After PD

Following their involvement in the project, teachers reported that they had reconsidered their attitudes towards Māori students in their classes; they talked about changed relationships, improved rapport, and enhanced interactions. Observers noted that the cognitive level of lessons had increased, reflecting teachers' higher expectations of their students.

Research conducted in the 12 schools in 2004–5 showed that 78% of Māori students observed were engaged for 80–100% of the lesson—up from 59%. The greatest increase occurred between the second and third observations, coinciding with the greatest change in teaching practice. Observer ratings of work completed increased from 3.6 to 4.2, measured on a 5-point scale. The attendance of Māori students also improved, with a decrease in unexplained absences. Stand-downs had decreased in six of the schools, as had suspensions in 10. While the total number of stand-downs remained similar over the three years, the number of suspensions decreased.

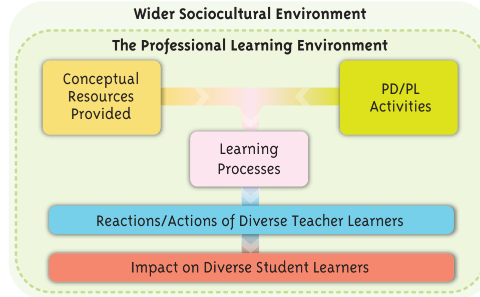
The research project showed that as Te Kotahitanga teachers became more proficient in their use of the ETP, their Māori students improved in numeracy and literacy achievement. While other variables may partly account for these positive gains, the totality of the evidence demonstrates that the participating teachers, across multiple schools, built their knowledge, skills, and capacities through implementation of the ETP.

For longitudinal evidence about the impact of Te Kotahitanga on the first full cohort of students from participating schools, see the later section in this case: Impact on student success in terms of NCEA.

What was learned and how the learning occurred

Creating cognitive dissonance

To engage teachers in rethinking their (deficit) theories in a constructive manner, Te Kotahitanga used kaupapa Māori 'collaborative storying' to give authority to the voices of participants. Teachers were presented with stories (compiled in an earlier phase of the project) from students (engaged and non-engaged), parents, whānau, principals, and teachers, expressing their perception of the influences that shape student engagement and achievement. Each of these groups had markedly different perceptions of what it was actually like to be a Māori student. The most divergent views were the ones expressed by the teachers and the students.



The teachers attributed the difficulties experienced by Māori students to deficiencies in the students themselves and in their backgrounds. They pathologised the students' lived experiences, with many believing that Māori learners were simply less capable of educational achievement because of limited language skills and poor home backgrounds. In contrast, the students' own stories focused primarily on their classroom experiences and their relationships and interactions with teachers. They spoke about the negative attitudes and beliefs they experienced and their feelings of being excluded. They also identified positive relationships, where teachers knew and trusted them and made an effort to know them as Māori. Further, they described how they believed their achievement could be enhanced if their teachers would use alternative pedagogical approaches that essentially were more discursive and inclusive than the expert–novice transmission model that they most often experienced.

Developing new understandings

The style used throughout the professional development drew upon wider kaupapa Māori understandings, along with those of the students. Teacher learning experiences mirrored those they were being asked to use with their Māori students. Rather than tell teachers what changes they should make, opportunities were provided for them to engage in dialogue about issues that they themselves had identified. In this way they were able to formulate needs as mutually agreed goals, and co-construct new theories.

The research and professional development team was responsible for implementation of the programme in participating schools. Some members of this team acted as regional coordinators, providing in-school support for in-school facilitation teams, who then provided professional development for participating teachers.

GEPRISP: the Te Kotahitanga professional development model

Goal: To improve the educational achievement of Māori students	**Examine** Māori students' current experiences.	Challenge teacher **Positioning**.	New **Relationships**	New **Interactions**	New **Strategies**	**Plan** for all this to happen.

Teachers experienced models of practice that could enhance their classroom dynamics. While the emphasis was on how teachers perceived their Māori students and the expectations they had of them, the marae setting and protocols followed during the initial three-day hui helped teachers to understand reo and tikanga appropriate for the classroom. Teachers were introduced to the Effective Teaching Profile and discussed how it differed from more traditional approaches. Teachers began to see how Māori students learn within the framework of a culturally responsive pedagogy of relations.

What was learned and how the learning occurred

Observations and feedback

Evidence from the research showed that the hui experience on its own could not provide the depth of understanding teachers needed in order to change their practice in ways that would impact on student outcomes. They needed further opportunities to acquire new pedagogical approaches and learn new ways of interacting with their Māori students. These opportunities were provided in the form of a series of structured classroom observations based on the Effective Teaching Profile, followed by one-to-one learning conversations involving teacher and facilitator. At first, the facilitators provided much of the feedback. As the teachers became more familiar with how the different components of teaching practice interacted, they began to take more of a leading role themselves, analysing data, seeking solutions, and co-constructing new practice. This might involve collaborative lesson planning, adapting the learning environment or curriculum, or provider modelling of next steps. Shadow coaching was used to support the implementation of planned changes. Such coaching stressed the importance of the teacher–facilitator relationship, mirroring the kind of working relationship teachers were encouraged to have with their students.

Co-constructing new practice

Regular, collaborative, co-construction meetings were also held at each school with a school-based facilitator. These meetings gave teachers an opportunity to analyse the ways in which their practice was impacting on the learning of a particular class. Data on student attendance, participation, and achievement was gathered for formative purposes and teachers engaged in collective problem solving to identify changes in practice that would lead to progress.

The Te Kotahitanga Effective Teaching Profile

Effective teachers of Māori students create a culturally appropriate and responsive context for learning in their classroom.

In doing so they demonstrate the following understandings:

a. They positively and vehemently reject deficit theorising as a means of explaining Māori students' educational achievement levels.

b. Teachers know and understand how to bring about change in Māori students' educational achievement and are professionally committed to doing so.

In the following observable ways:

1. **Manaakitanga** – They care for students as culturally located human beings.
2. **Mana motuhake** – They care for the performance of their students.
3. **Whakapiringatanga** – They are able to create a secure, well-managed learning environment by incorporating routine pedagogical knowledge with pedagogical imagination.
4. **Wananga** – They are able to engage in effective teaching interactions with Māori students in Māori.
5. **Ako** – They can use strategies that promote effective teaching interactions and relationships with their learners.
6. **Kotahitanga** – They promote, monitor, and reflect on outcomes that lead to improvements in achievement for Māori.

Why did this work?

Cultural and cognitive dissonance was created by exposing teachers to the considerable gap that exists between the assumptions that typically underpin teacher analysis of classroom dynamics and the actual experience of students, as revealed in their stories. By using the relatively non-confrontational approach of presenting stories from different groups, the context was created for an alternative understanding of classrooms, and an opportunity offered to teachers to reflect critically on the part they might play in student learning. To ensure the requisite depth of learning, repeated, intensive opportunities were provided for teachers and facilitators to identify and solve problems that surfaced in the course of the cycle of hui, observations, feedback, co-construction meetings, and shadow coaching.

Teacher responses to PD/PL

Dissonance

As they examined the stories, teachers were able to reflect on the changes in beliefs and practice that they would need to make in order to see change in their students. They wanted to know how they could go about addressing aspects of their classrooms that may be impacting negatively on their Māori students, and improving educational outcomes for Māori.

While teachers were motivated to change their practice, the initial hui could not provide sufficient depth of learning for them to do so. They needed opportunities to engage with the new learning in their own contexts and to increase their knowledge and understanding.

Teacher

What it made me realise was that there are a lot of things … that had got squeezed out because of (my) concern for getting through the content of the curriculum.

Teacher

I have been teaching for 32 years and I tell you what this project has done for me—it has rejuvenated me, and not just practically in the classroom, but reflecting on the teaching too.

Teacher

None of us will progress this year unless we support each other and work together.

Active engagement in new theory and practice

Observations and feedback, shadow coaching, and co-construction meetings gave teachers repeated opportunities to refine their practice in the light of data gathered specifically to discover how effective they were being in terms of their interactions with students. Measures of student engagement and participation were discussed and practice changed accordingly. Typically, the most significant changes in the pattern of interactions did not occur until the third observation, suggesting how difficult it was for teachers to change fundamental aspects of their practice, even when motivated to do so.

Co-construction meetings gradually became more and more focused, with teachers analysing how their practice was impacting on their students.

Two elements of effective practice that led to improved student outcomes were high expectations and the creation of a nurturing and supportive environment.

Student

You can tell he respects us, because when it comes to learning big time he's always there. If we don't understand something, he doesn't talk to us like little babies, he talks to us like young adults.

Student

Why become a teacher if all you care about is teaching students then going home? I reckon they would feel better if they knew they had taught a student rather than when their payday comes.

Cognitive reconstruction

By creating dissonance with their existing beliefs, it was the students' stories that acted as a catalyst for teachers to engage in the professional development that followed. The stories motivated teachers to review their philosophical positions and, from there, to try and change their practice. The process was gradual, achieved through opportunities to implement new, more discursive teaching methods (that is, providing multiple opportunities for students to engage with learning in a variety of ways), and build constructive relationships with their students. Teachers' new practice was co-constructed with facilitator support, using knowledge based on the Effective Teaching Profile.

How did this work?

The teachers started by evaluating the effectiveness of their practice for their students, accepting responsibility for the effect of their teaching, becoming more self-critical, and taking greater agency. The Effective Teaching Profile provided a clear focus for teacher and facilitator efforts. It was used as a source of knowledge and to inform observations and follow-up discussions. Teachers had sufficient time to make the necessary changes, as well as support that helped them to maintain focus and refine practice. Rather than implement a programme, they reconstructed their practice based on new principles, knowledge, and understandings.

Impact on student success in terms of NCEA

In 2006, the first full cohort of students from participating schools reached year 11, providing an opportunity to assess the impact of Te Kotahitanga on National Certificate of Educational Achievement (NCEA) level 1 results. An analysis by the New Zealand Qualifications Authority (NZQA) showed that the increase in the percentage of Māori and Pasifika students gaining NCEA level 1 from Te Kotahitanga schools was greater than the increase for students from non-Te Kotahitanga schools (comparing 2006 results with 2005 results and weighting for decile[1]).

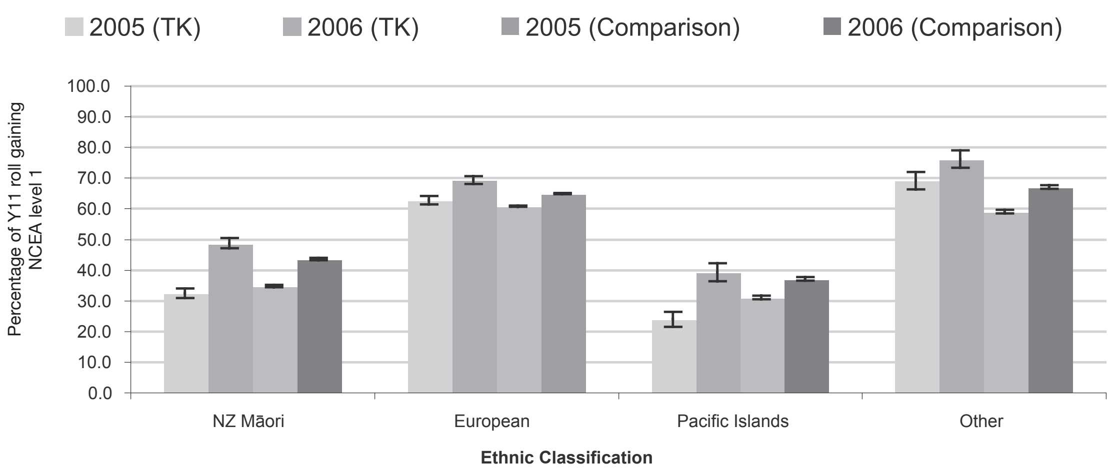
The following table shows that between 2005 and 2006 an increased percentage of students from all ethnic groups gained NCEA level 1 in both Te Kotahitanga and non-Te Kotahitanga schools. But the increase for Māori and Pasifika students from Te Kotahitanga schools was much greater, indicating that the programme was having a long-term positive impact on these students in addition to its immediate positive impact across the student body. The 16.4% increase in 2006 for Māori students represents a 50% increase over the 2005 levels of attainment.

Success in NCEA level 1, 2005–06
(comparing students from Te Kotahitanga schools with those from non-Te Kotahitanga schools and the national cohort)

Ethnicity	Te Kotahitanga schools							National cohort (decile weighted)[2]
	Year 11 students on roll (number)		Year 11 students gaining NCEA level 1					
			Number		Percent		Increase (percentage points)	
	2005	2006	2005	2006	2005	2006	2005–06	
NZ Māori	973	952	312	461	32.1	48.4	16.4	8.9
European	1210	1302	756	899	62.5	69.0	6.6	4.1
Pacific Islands	292	282	69	110	23.6	39.0	15.4	6.1
Other	263	231	181	175	68.8	75.8	6.9	8.1

The graph below shows NCEA level 1 data for 2005 and 2006 by ethnicity. The standard error bars at the top of each column allow the reader to make informal judgments of the statistical significance of the changes across years: where error bars do not overlap, the difference can be regarded as significant (confidence level = approximately 95%). It can be seen that all four ethnic groupings made gains that were significant, whether from Te Kotahitanga or comparison schools.[3]

The magnitude of the gain for Māori is quite remarkable: in 2005, prior to the intervention, the percentage of Māori students in the Te Kotahitanga schools that gained NCEA level 1 was significantly lower than the national percentage for Māori—in 2006 it was significantly higher. In one of the schools involved, 18.8% of Māori gained NCEA level 1 in 2005 (n = 64)—the following year the percentage was 63.9% (n = 61).



Percentage of year 11 students gaining NCEA level 1, by ethnicity

How this case links to the synthesis

Reframing teachers' social constructions of students

9.2.1.5 Prevailing discourses

9.2.1.7 Professional learning goals

9.2.2.2 Identifying problems with the teaching–learning relationship as a motivator to engage (see also Box 9.9)

9.2.2.3 New vision for teaching, learning, and relationships (see also Box 9.10)

9.2.2.4 An emphasis on pedagogical relationships

9.2.3.1 Professional instruction followed by multiple opportunities to learn

9.2.3.2 Activities that integrated theory and practice

9.2.4.1 Creating dissonance with current position

Topical issues

10.4 Issue 4: Professional learning communities

10.5 Issue 5: Professional learning in secondary school contexts

Chapter 11 Sustainability

Reflective questions

Teachers in this project achieved fundamental changes in both their teaching practice and student outcomes.

- What allowed them to reconceptualise their interactions with Māori students?
- What factors allowed them to change successfully?

Source

Bishop, R., Berryman, M., Cavanaugh, l., Teddy, L., & Clapham, S. (2006). *Te Kotahitanga Phase 3 Whakawhanaungatanga: Establishing a Culturally Responsive Pedagogy of Relations in Mainstream Secondary School*. Ministry of Education Research Division. Wellington.

Available at: www.educationcounts.edcentre.govt.nz/publications/homepages/te-kotahitanga/index.html

The analysis of NCEA results is by Dr Michael Johnston, Research and Knowledge Services, New Zealand Qualifications Authority.

1 The national data have been weighted to reflect the decile profile of the Te Kotahitanga schools. That is, the NCEA level 1 achievement rates nationally for each decile level were multiplied by the number of Te Kotahitanga schools at each decile level, the products were summed, and the result was divided by the total number of Te Kotahitanga schools (12) to give a decile-weighted national average.

2 See above note.

3 Note that because these data have been aggregated, they do not reveal variability of impact as a result of the differing proportions of teachers participating in each school (critical mass effect) or variation in the conditions supporting changes in practice.

8

A constructivist, cooperative approach to learning

Context

Setting

This case is situated in a semi-rural, decile 4 secondary school with a roll of approximately 550. It draws its students from middle to lower socio-economic families. Most students in the school are pākehā, with a small proportion of Māori and a few Asian students. The class concerned was a year 12 transition class of 11 boys and 11 girls, all pākehā. The school had put the students in a non-academic stream because none had passed the year 11 qualification. They were timetabled for 4 periods of transition a week.

Time

Teachers participated in three workshops. The first was for three and a half days; the second, one day; the third, one half day. Between workshops, the teachers were given opportunities to plan collaboratively, implement, and consult with their school communities. The total time frame was approximately six months. This case focuses on one particular teacher.

Focus of PD

The aim of this project was to help young people gain a positive sense of their own sexuality and encourage them to develop knowledge, attitudes, and skills that would lead to healthy sexual decisions. This was to be achieved by:

- empowering secondary school teachers to develop and implement quality HIV/AIDS-sexuality education in their schools;
- documenting the process so that it would provide a model for further health education, especially HIV/AIDS-sexuality education.

Goals

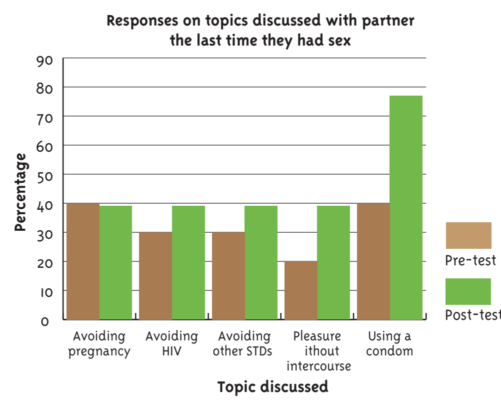
The goals were:

- for students to gain accurate and relevant knowledge about the transmission and prevention of HIV;
- to make students aware of the harmful effects of discrimination, prejudice, and the labelling of certain groups as 'at-risk' of contracting HIV/AIDS;
- to demonstrate the correct use of condoms and encourage those who were sexually active or who would be so in the future to use them when engaging in sexual intercourse, regardless of whether other forms of contraception were being used.

Impact on student learners

Prior to PD

Evidence of student learning came from pre- and post-assessments, classroom observations (students expressed their views in small-group and whole-class situations), learning journal entries, interviews, and formal tests. At the start of the programme, only 60% of students reported that they had had a condom available when they last had sex, and of those, only 66% reported actual use of a condom. A majority of students, particularly males, expressed discriminatory attitudes towards people living with HIV, perceived that only specific groups were at risk of HIV infection (men who have sex with men, prostitutes, and drug users), and attributed blame to those infected with HIV. A pre-test was used to assess students' confidence to discuss and negotiate the use of a condom, their knowledge of the importance of doing this, and their knowledge of how to correctly use a condom.



After PD

The table shows the responses students gave when asked what they had discussed with their partner the last time they had sex. The responses suggest that students were able to discuss contraception, which possibly indicated likely future use of condoms. Four months after the start of the intervention, 92% of students reported that they had had a condom available when they had last had sex, and 77% had used one. Following the intervention, students had greater factual knowledge about HIV, greater tolerance, and fewer discriminatory and blaming attitudes. This was true of both genders, but the difference was greatest for males. The excerpt below shows one student's increased confidence in being able to 'sort out' contraception issues with a partner.

Interviewer: *Whose responsibility is it in a relationship for contraception?*

Student: *Both.*

Impact on student learners

After PD

Interviewer: *So how would you go about doing that?*

Student: *Talking to each other about what we need.*

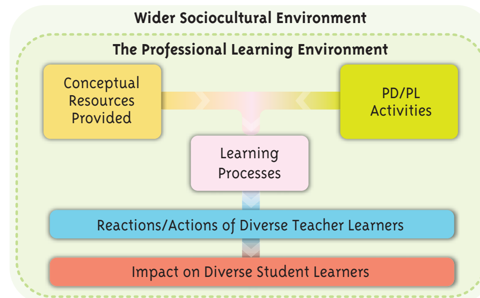
Interviewer: *Have your views changed, do you think, since doing this unit of work?*

Student: *A wee bit. Just knowing what to do and how to sort it out.*

What was learned and how the learning occurred

Creating dissonance

The aim of the professional development was for teachers to encourage students to examine the physical, social, mental, emotional, and spiritual dimensions of HIV/AIDS-sexuality by promoting a holistic model of health and well-being. It was important that teachers were prepared to provide opportunities for students to critically reflect on the attitudes and values of the communities and society to which they belonged. Critical reflection was especially important when exploring attitudes to heterosexism and homophobia, and when helping students to identify ways in which they could support themselves and others when on the receiving end of intolerance and discrimination.



Workshops modelled the processes that teachers would use with their students. Teachers engaged in critical reflection as they examined their own ideas, beliefs, and practice. The object was to create dissonance that would lead to changed practice. To help teachers examine social justice issues related to heterosexism, homophobia, and HIV/AIDS, people from the wider community, including prostitutes and members of the Aids Foundation, were invited to share their experiences of living with HIV. It was intended that this would strengthen teachers' commitment to HIV/AIDS-sexuality education and deepen their appreciation of equity and diversity issues.

I didn't think I was homophobic but I had to face up to this. — Principal

Enhancing teacher knowledge

A safe, supportive, trust environment was established for the participants. They would need, in turn, to establish such an environment for their students. This approach was informed by research relating to the socio-emotional aspects of learning—the reciprocal roles played by thinking and feeling in the learning process. Because the desired outcome was increased awareness of social justice issues relating to discrimination and stereotyping, it was necessary for teachers (and later, the students themselves) to develop empathy for those in marginalised groups. The participants were given opportunities to develop empathy by meeting people who had direct experience of HIV and by being given factual information that was at odds with the myths and prejudices that surround HIV/AIDS. The approach that teachers would use with their students was modelled by the professional development.

Teachers were given a wide selection of resources to meet the needs of diverse learners. Rather than prescribe what resources to use and when, the facilitator gave teachers a framework they could use for building their own classroom programmes to meet learner needs.

The researcher/facilitator adopted the role of 'critical friend' for the duration of this project, learning alongside the teacher but slightly distanced from the working context, able to bring a different perspective and a more extensive knowledge base. A trusting, reciprocal relationship was established, which provided support for the teacher and high expectations of improved practice.

Co-constructing new practice

The researcher met with the teacher to revise a nine-lesson unit of work that she and two other teachers who had attended the workshop the year before had planned. The original learning outcomes were retained, but the activities were redesigned. Some of these were unfamiliar to the teacher and for this reason involved a degree of personal risk—especially with the researcher present in the room. For example, she was initially uncomfortable when demonstrating how to use condoms, when providing opportunities for students to practise this, and when addressing issues of homophobia and heterosexism.

The teacher and researcher met after each of the first eight lessons. The teacher would reflect on the lesson, the researcher would share observations, and then they would discuss how the activities might be refined. They also discussed the next lesson and how particular strategies might be used to meet the intended learning outcomes.

Teacher: *I think when you have been teaching for a while you tend to be comfortable with what you do, but you're never sure about how it rates. I got very positive feedback … When I developed the programme and we did it together, well that was great as I learned a lot. I picked up ideas and perhaps took things a bit further than I would have.*

Why did this work?

There was clear alignment of the learning content and the learning activities. Teachers became learners, participating in the processes, in this way engaging simultaneously with both the content and the pedagogy. Dissonance was created by means of factual information and opportunities to hear first-hand the experiences of people from their own community living with HIV/AIDS. In this way, teachers' personal beliefs and experiences were recognised, and they were able to clarify their thinking in a collaborative environment. The provision of a safe learning environment was recognition that learning is shaped not only by new information, but also by social, emotional, and cultural processes. The provider worked cooperatively with the teacher to plan a programme that would see new learning translated into practice. By co-constructing the programme with the teacher, supporting her to review and revise her own practice, and positioning herself as a facilitator rather than an expert, the provider modelled the kind of relationship that the teacher could then develop with her students. The provider enhanced the teacher's professionalism by encouraging her to exercise her own judgment about the content and processes she should use in her classroom.

Teacher responses to PD/PL

Building learning communities

The nurturing of learning communities was a vital component of this professional development. To ensure that a supportive community was established in each participating school, schools had to have three teachers and a parent representative involved in the project. These four participants were able to support each other in collaboratively planning and implementing workshops for the staff and wider community and in planning classroom programmes. Each school belonged to a cluster of six schools, meaning that participants were also part of a wider learning community. Cluster group members were able to support, share, reflect, and learn with one another during the workshops and by maintaining contact afterwards. The facilitator supported teachers to develop a shared vision and commitment to HIV/AIDS-sexuality education and to create and maintain an atmosphere of trust in which ideas could be challenged and critiqued safely.

The teacher mirrored this approach with her class by establishing an environment that was responsive to student learning needs and by adopting a facilitative role in which power was shared. Students were encouraged to openly express their ideas and challenge each other. The classroom climate was one that valued caring, trust, and confidentiality and promoted active and enjoyable learning. She built and nurtured this community by continuously reflecting on how her students were responding to the learning activities.

Student

She really gets involved with the class. She gets in the circle. She doesn't believe in having a desk to hide behind and barriers and that kind of thing. If you've got any questions, she always answers them. She never puts anyone down. She's the best teacher I've got. She teaches us so much. She gets to our level. She doesn't think, well, like, 'I'm the teacher and you're the kids and you'll do it my way, and what I say is all that matters.' She doesn't get in the class's way. She's one of us.

It's never a case where the teacher is the fount of all knowledge and in my style of teaching I see myself as a facilitator rather than a teacher. That's why I teach very often in a circle. And I consciously explain to the kids that I will sit as part of the group so that all the views are exchanged.

Teacher

Translating theory into practice

The teacher effectively implemented in her classroom the elements of the approach she learned during the professional development. She planned and put into practice many of the pedagogical processes, strategies, and skills that had been modelled, responded to feedback from her students, and engaged in a process of shared reflection with the facilitator. In this way, she became familiar with the sequence of activities and gained the confidence to use them. For example, after trying one activity in the classroom, the teacher received powerful feedback from her students and saw positive results in their learning. This reinforced her commitment to the approach she had seen modelled and led her to use similar activities in other situations. In her final interview, the teacher said she thought that making the theory underpinning the practice continuously transparent during the teacher development process supported teachers to develop their own theories and to become more autonomous by learning to make tacit, intuitive theories explicit.

By creating a supportive learning environment and structuring her programme in accordance with the principles presented in the professional development, the teacher was able to achieve her goal of involving her students in the learning within an emotionally and physically safe environment.

Major learning processes

Constructing a new approach

The professional development provided teachers with both the catalyst for change and the means by which it could be implemented. The teacher used her new knowledge and the resources provided to plan sequences of learning in collaboration with the providers. By deliberately reflecting on how each lesson had gone and by refining her practice in the light of student responses and provider feedback, she was able to successfully apply new theory and understandings to her particular context. Through this process, she began to develop her personal theory, which could then inform subsequent practice.

… from a health teacher's point of view I didn't have that science, biology background … I was aware that [my knowledge] was lacking … I'm using the model but a lot of this theory … I can see it and I can understand it, but I didn't consciously know it.

Teacher

How did the teachers make this work?

The teachers were engaged and had involvement in all aspects of the professional development. Through the needs analysis process they identified their common learning needs, developed an action plan to address these, and evaluated and re-evaluated their practice through observations and feedback and in the light of student performance. The facilitator's role was to support this process by analysing and presenting relevant data, directing teachers to appropriate resources, and training key personnel so that they could maintain the momentum of the new learning. The theory that teachers developed during the process evolved in response to new knowledge applied within their classroom contexts. Teachers were motivated to review not only their day-to-day teaching, but also the beliefs underpinning it, and worked together as a learning community with a common goal and focus.

How this case links to the synthesis

Summary of findings

1. The context of professional learning and development
2. The content of professional learning and development
3. Activities constructed to promote professional learning
4. Learning processes

Topical issues

10.1 Issue 1: Multiple roles of assessment in promoting teacher learning

10.5 Issue 5: Professional learning in secondary school contexts

Reflective questions

The teacher in this case achieved changes in both her teaching practice and her students' learning outcomes.

- What supported the teacher to re-conceptualise her health education pedagogy?
- What factors enabled her to change successfully?

Source

Tasker, G., (2002). *Students' experience in an HIV/AIDS-sexuality education programme: What they learnt and the implications for teaching and learning in Health Education.* PhD Thesis. Victoria University, Wellington, New Zealand.

Appendix 2. Methods and Procedures

2.1 Locating the studies

A comprehensive attempt was made to identify studies that might be relevant for the purposes of this Best Evidence Synthesis. Initial database searches via ERIC (Educational Research Information Centre) used combinations of keywords: 'professional development', 'staff development', 'in-service teacher education', and 'student outcomes'. Studies were selected and included on the basis of evidence that demonstrated links between teachers' professional development/learning, changes in teachers' classroom practice, and student learning outcomes. The initial searches yielded only 57 studies. Further searches were conducted, using combinations of other keywords related to particular subject areas, research programmes, diverse student groups, and learning outcomes (Table A 2.1). This was followed by a search—manually and online—of specific journals and abstracts of theses and dissertations, accessed through the libraries of the University of Auckland and the University of Canterbury. Further searches were carried out via the websites of institutions known to be involved with professional development, following up the extensive material provided by the Ministry of Education, and making use of personal contacts with researchers and practitioners. The combined searches yielded a total of 217 studies; these were grouped under 95 entries for analysis (see Table A 2). The detailed references for these studies are in the relevant sections.

Table A 2.1. Combinations of keywords for database searches for studies

Professional learning/ development	**Subject area**	**Research-based programmes known nationally and internationally**	**Diverse students**	**Learning outcomes**
• professional development • professional learning • staff development • in-service teacher education	• science • reading • writing • english • mathematics • social studies • physical education • history • geography • economics	For example: • Gender Equity Program • Te Kotahitanga • The New Zealand Numeracy Development Project • Literacy Development Project • Success for All • Cognitively Guided Instruction • Cognitive Acceleration through Science Education • Complex Instruction	• regular students • gifted students • low-achieving students • students with physical disabilities • students with learning disabilities • students with non-English-speaking backgrounds • students with behavioural or emotional problems • minority students from low-income district areas	• academic outcomes • personal outcomes (self-esteem, self-efficacy, attitudes towards learning, etc.) • social outcomes (school climate and classroom climate, attachment to school, etc.)

Table A 2.2. A list of studies included for analysis and synthesis

	Studies from New Zealand
1	(Absolum, 2004a, 2004b, 2006): Assess To Learn / Assess for Learning
2	(Alton-Lee et al., 1997; McBride, n.d.; Nuthall, 2000): Gender Equity Program
3	(Alton-Lee et al., 2000): Inclusive Practice
4	(Anand & Bennie, 2002, 2004, 2005; Askew, Fountas, Lyons, Pinnell, & Schmitt, 2003; McDowall et al., 2005): Reading Recovery
5	(Bishop & Berryman, 2005; Bishop et al., 2005): Te Kotahitanga
6	(Britt et al., 1993): Mathematics
7	(Cazden, 1990): Differential treatment in New Zealand. Reflections on research in minority education
8	(Christensen, 2003; Trinick, 2005; Trinick & Stephenson, 2005a): Te Poutama Tau (Numeracy Development Project)
9	(Davis, 2006): The Performance Enhancement North Waikato Schooling Improvement Project
10	(English & Bareta, 2005, 2006; Parr et al., 2006): National Literacy Professional Development Project
11	(Fung, 2006; Fung et al., 2004): Collaborative Reasoning: Critical Thinking Based Learning and Instruction
12	(Higgins, 2004a, 2004b; Higgins et al., 2005; Irwin, 2004; Matos, 2004; Thomas & Tagg, 2004; Thomas & Tagg, 2005b; Young-Loveridge, 2004, 2005): The New Zealand Numeracy Development Project
13	(Jones & Moreland, 2003, 2005; Moreland, 2003; Moreland & Jones, 2000; Moreland, Jones, & Northover, 2001): Technology
14	(McNaughton et al., 2004): Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand
15	(Moore, 1998, 2000; Moore & Island Bay Primary School, 2000): Information Literacy NZ context
16	(Phillips & Smith, 1997): A Third Chance to Learn – Literacy
17	(Phillips et al., 2001): Picking Up the Pace
18	(Rau, 2004): He Matai Matatupu: Assessment for Māori Medium Literacy Learning
19	(Symes & Timperley, 2003; Timperley, 2005): Using student achievement data to inform programme improvement
20	(The Restorative Practices Development Team, 2003; Moxon, 2003; Thorsborne, Armstrong, & Moxon, 2004): Restorative Practices in Massey High School
21	(Tasker, 2001): An HIV/AIDS sexuality education program
22	(Timperley et al., 2001): Literacy Leadership
23	(Timperley & Phillips, 2003; Timperley & Robinson, 2001; Timperley, Smith, et al., 2004; Timperley & Wiseman, 2003): Strengthening Education in Mangere and Otara
24	(Tuuta et al., 2004): Evaluation of the Te Kauhua Māori Mainstream Pilot Project

	Studies from the UK
25	(Adey, 1999, 2004; Shayer, 1999); (Adey, 2006); (Leat, 1999): Cognitive Acceleration through Science Education
26	(Askew, Brown, Rhodes, Johnson, & Wiliam, 2003; Poulson & Avramidis, 2003): Effective Teachers of Numeracy and Literacy, which underpins the NNS & NLS in UK
27	(Baines, Blatchford, & Kutnick, 2003; Blatchford et al., 2005; Blatchford & Kutnick, 2003; Blatchford, Kutnick, Baines, & Galton, 2003; Rubie-Davies et al., 2005): The Social Pedagogic Research into Group-work Project
28	(Basit, 2003; Beard, 1999; Brown, Millett, Bibby, & Johnson, 2000; DfES, 2002, 2003; Earl et al., 2003; McNulty, 2005; Smith & Hardman, 2000): National Literacy Strategy (NLS) and National Numeracy Strategy (NNS)
29	(Flecknoe, 2000): Continuing professional development to raise pupils' achievement
30	(Wood & Sellers, 1996): A problem-centered mathematics
	Studies from the US
31	(Allred, 1998; Flay & Allred, 2003; Ji, Segawa, Burns, & Campbell, 2005): Positive Action Program
32	(Ancess, 2000): The reciprocal influence of teacher learning, teaching practice, school restructuring, and student learning outcomes
33	(Anderson, 1992; Anderson & Roit, 1993): Transactional strategy instruction
34	(Appalachia Educational Lab, 1994a, 1994b; Barnette, 1995; Barnette, Walsh, Orletsky, & Sattes, 1995; Todnem & Warner, 1994): Questioning and Understanding to Improve Learning and Thinking
35	(Ashworth, 1999; Carlson & Francis, 2002; Grossen & Ewing, 1994; MacIver & Kemper, 2002): Direct Instruction
36	(Baker & Smith, 1999): Early childhood: literacy
37	(Bianchini et al., 1995; Cohen et al., 2002; Bianchini, 1997; Cohen, 1994; Cohen, 1997; Cohen & Lotan, 1997b; Dahl, 1997; Ellis & Lotan, 1997; Filby, 1997; Good, Burross, & McCaslin, 2005; Lotan, Cohen, & Morphew, 1997; Swanson, 1997): Complex Instruction
38	(Bond, Smith, Baker, & Hattie, 2000; Goldharber & Antony, 2004; Indiana Professional Standards Board, 2002; Iovacchini, 1998; Vandevoort et al., 2004): National Board Certified Teachers
39	(Borman et al., 2005a; Florida Center for Reading Research, n.d.; Slavin & Madden, 2003): A meta-analysis of Success for All
40	(Bowers, Cobb, & McClain, 1999; Cobb et al., 2003; McClain & Cobb, 2001; Cobb, 2004; Cobb, Stephan, McClain, & Gravemeijer, 2001; Cobb et al., 1991; Cobb, Wood, & Yackel, 1990): Mathematics
41	(Briars & Resnick, 2000): The essential elements of standards-based school improvement
42	(Brown & Thomas, 1999): Professional Development School Model
43	(Buysse, Sparkman, & Wesley, 2003; Cutter, Palincsar, & Magnusson, 2002; MacLean, 1997; Magnusson & Palincsar, 1995; Palincsar et al., 2000; Palincsar et al., 2001; Palincsar et al., 1998): The GIsML (a guided inquiry approach to science teaching & learning)
44	(Caron, 2004; Liou, 2003; Metcalf et al., 2000; Rossi, 1997; Vontz, Metcalf, & Patrick, 2000): Project Citizen
45	(Carpenter, Fennema, & Franke, 1996; Carpenter, Fennema, Franke, Levi, & Empson, 2000; Carpenter et al., 1989; Carpenter, Franke, & Levi, 2003; Fennema et al., 1996; Fennema, Carpenter, & Peterson, 1989; Fennema et al., 1993; Franke, Carpenter, Fennema, Ansell, & Behrend, 1998; Franke & Kazemi, 2001; Knapp & Peterson, 1995; Oakes, Franke, Quartz, & Rogers, 2002): Cognitively Guided Instruction
46	(Cardelle-Elawar, 1995): Effects of metacognitive instruction on low achievers in mathematics problems

47	(Caulfield-Sloan & Ruzicka, 2005): Using higher-order thinking questioning
48	(Coburn, 2001): Collective sense-making about reading
49	(Confrey et al., 2000): Maths: university–school collaboration in redesigning curriculum units
50	(Cook et al., 1999; Haynes, Comer, & Hamilton-Lee, 1988; Haynes & Emmons, 1997): School Development Program
51	(Curriculum Research and Development Group, University of Hawaii, 2002; Education Development Center, 2003; National Staff Development Council, 2002; Yamamoto, 1997): Foundational Approaches in Science Teaching
52	(Datnow, Borman, et al., 2003): A meta-analysis of Success for All (for students with limited English proficiency)
53	(D'Oria, 2004): Physical education
54	(Dubner et al., 2005; Samuel et al., 2004): Research Experiences for Science Teachers
55	(Fishman et al., 2003): Standards-based reform
56	(Fletcher, Strong, & Villar, 2005; Villar & Strong, 2005): A comprehensive mentoring program for beginning teachers
57	(French, 2001): A story of a successful school-based professional development program
58	(Fisher, 2001; Fisher, Frey, & Williams, 2002): Linking teacher and student learning to improve professional development in systemic reform
59	(Goldenberg & Sullivan, 1994): A bilingual program for Latino students learning English and Spanish
60	(Gottfredson et al., 1995): Increasing teacher expectations for student achievement
61	(Hakkarainen, 2004; Lipponen, Rahikainen, Hakkarainen, & Palonen, 2002; Nason & Woodruff, 2003; Scardamalia & Bereiter, 1996; Tan, Yeo, & Lim, 2005): CSILE
62	(Hamilton & Gingiss, 1993): Sexuality education
63	(Hirshman, 1996): A Chapter I Schoolwide Project
64	(Huffman et al., 2003): Using computers to create constructivist learning environment: ICT and achievement
65	(Hunter, 1976; Robbins & Wolfe, 1987; Stallings & Krasavage, 1986): Madeline Hunter's Instructional Theory into Practice
66	(Ishler, Johnson, & Johnson, 1998; Jenkins, Antil, Wayne, & Vadasy, 2003; Mason & Good, 1993; Stevens & Slavin, 1995): Cooperative learning
67	(Jinkins, 2001): Linking professional learning to teacher decision making and its impact on emergent readers
68	(Kahle et al., 2000): Standards-based teaching
69	(Kennedy, 1998): A meta-analysis of maths programs
70	(Klingner et al., 2004; Vaughn, 2001; Vaughn, Hughes, Schumm, & Klingner, 1998; Vaughn & Klingner, 1999): Collaborative Strategic Reading Program for students with learning disabilities
71	(Leshowitz et al., 1993) : Critical thinking for learning disabilities
72	(Lipman, 1997): A case study of teacher participation and dynamics of ideology, race, and power
73	(Little, 2003): Inside teacher community, representations of classroom practice
74	(Maheady & Harper, 1991): Classwide peer tutoring
75	(McKenzie et al., 1993): Physical education
76	(Montes, 2002): CAPE (Content Area Program Enhancement) for English Language Learners

77	(Mucherah et al., 2004): Don't laugh at me
78	(National Writing Project, 2002, 2005, 2006; Pritchard, 1987): National Writing Project
79	(Norton, 2001): Alabama Reading Initiative
80	(Parke & Coble, 1997): Teachers designing curriculum as professional development
81	(Phillips, 2003; Reyes & Phillips, 2001, 2003): Houston Annenberg Challenge
82	(Raghavan et al., 2001): Standards-based reform
83	(Saxe et al., 2001): A study of three contrasting approaches to professional support
84	(Schacter & Thum, 2005): Teacher Advancement Program
85	(Schober, 1984): Economics
86	(Schorr, 2000) Mathematic Thinking
87	(Taylor et al., 2005): The CIERA school change framework
88	(Wilson et al., 2001): A case of successful teaching policy in Connecticut
	Studies from other countries
89	(Angrist & Lavy, 2001): Mathematics in Jerusalem public schools
90	(Doppelt, 2003): Implementation and assessment of project-based learning in a flexible environment: Israel
91	(Fresko et al., 1990): Mathematics: Israel
92	(D'Oria, 2004): Physical Education: Canada
93	(Ross, 1994): Teacher efficacy in using cooperative learning: Canada
94	(Ross et al., 1999): Effects of collaborative action research on the knowledge of five Canadian teacher-researchers: Canada
95	(Rowe et al., 2005): Special needs: Australia
96	(Van der Sijde, 1989): Teacher training in maths instruction: the Netherlands
97	(Veenman et al., 2005): Cooperative Learning: the Netherlands

2.2 Mapping the studies into the framework

The framework we used for mapping the studies had 56 subcategories, grouped under eight main categories (see Table A 2.3). Section 2.2.1 discusses the procedure for achieving reliability for the entries under the first six main categories and their subcategories. Section 2.2.2 explains the procedure for Category VII entries (impact on diverse student learners) and how effect sizes for quantitative student outcomes were calculated if they were not reported in the studies. Section 2.2.3 discusses the procedure for Category VIII entries and for establishing reliability in assessing the methodological adequacy of the documentation relating to student learning processes and outcomes.

Table A 2.3. Main categories and subcategories of the framework

I.	The sociocultural environment	
	1	Country
	2	National educational policies
	3	Who initiated the professional learning/development
	4	Year levels
	5	Focus of the professional learning/development
	6	Practitioners' prevailing discourse prior to professional development
	7	School structures, culture, and practice
	8	The professional learning environment
	9	Expertise utilised
	10	Infrastructural support (Ministry of Education level: time and money)
II.	The content of the professional learning/development opportunities	
	1	The discipline
	2	Curriculum knowledge
	3	Pedagogical / pedagogical content knowledge
	4	Assessment knowledge
	5	Standards
	6	Teachers' knowledge about students
	7	Linguistic and cultural knowledge related to content area
	8	Theoretical tools/principles (going beyond immediate practice)
	9	Own practices and new possibilities in relation to a standard of practice
	10	How own practice impacts on diverse student learners—new vision of teaching–learning links
	11	Methods of inquiry into adequacy and improvement of practice
III.	Activities constructed to promote the learning	
	1	Listening
	2	Watching (someone modelling, video demonstration)
	3	Being observed and receiving feedback
	4	Receiving student activities and materials, lesson plans
	5	Engaging with professional readings
	6	Discussing practice with more expert colleagues/facilitator
	7	Teachers take part in activities (positioned as students)
	8	Peers collaboratively plan to implement professional learning/development
	9	Comparing own theories with new theories
	10	Analysing student work (not outcomes)
	11	Examining student outcomes and understandings
	12	Analysing current practice and co-constructing new practice
	13	Discussing self-/mutually-identified issues: professional learning context
IV.	Learning processes	
	1	Cueing prior knowledge / retrieving and consolidating previous knowledge
	2	Awareness of new information and skills / assimilating new knowledge (add and/or adapt)
	3	Create cognitive dissonance with new information / cognitive reconstruction

V.	Responses of diverse teacher learners	
	1	Reject new theory and practice and continue with current practice
	2	Confirmed practice – no change
	3	Awareness changed but not sufficiently skilled
	4	Become aware of new theory/practice but unable to implement (skills)
	5	Believe enacting new practice but continues to resemble previous practice
	6	Select parts of new theory and practice and adapt to current practice
	7	Implement as required (compliance)
	8	Actively engage with, own, and apply new theory and practice and change practice substantively
	9	Enhanced regulation of own and others' learning (including processes of review)
VI.	Sustainability	
	1	Which aspects of the professional learning (e.g., certain behaviours, principles, theories) are expected to be sustained (if stated or implied)?
	2	At what level is the implementation (e.g., classroom/year level/school-wide) expected to be sustained?
	3	What kind of preconditions created for sustainability during the professional development?
	4	What kind of preconditions created for sustainability after the professional development?
	5	Any evidence of implementation sustainability?
	6	Will implementation sustainability have positive/negative impact on certain group of students?
VII.	Impact on diverse student learners	
	1	Size of impact
	2	Educational significance
VIII.	Methodological adequacy of documenting student learning processes and outcomes	
	1	Quantitative approach
	2	Qualitative approach

2.2.1 Procedure for mapping studies into categories

In order to develop a consistent and agreed understanding of the framework and what would count as evidence in each of the categories, three of the writers initially read and entered the same six studies independently. After reading each study and entering it onto the framework, the four members of the team met to compare and discuss the decisions made. The discussions at this stage focused mainly on clarifying the purpose of each category and subcategory in order to develop a mutual understanding of what was required and how to interpret the details of each study. During this process, additional subcategories were added to the framework and some descriptors reworded.

To establish inter-rater reliability, ten studies were randomly selected and two members of the team independently coded and entered their descriptions onto the framework. Then the whole team met and discussed the agreement/disagreement for each of the entries. By the second cycle, an inter-rater reliability of 90% or above was being met. For each category, the percentage of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The two team members then independently coded the remainder of the studies and entered their coding onto the framework. They continued to meet weekly to check the reliability of their coding. Any disagreements that remained unresolved were discussed by the whole team.

2.2.2 Formulae for computing effect sizes

When analysing the impact on student outcomes reported in the selected studies for this synthesis (Table A 2.2), we examined the nature and magnitude of the changes, if any, in student learning processes and outcomes that occurred during and after teachers' professional learning and development. We defined desirable student outcomes in terms of gains in academic achievement; enhancement of personal identity, self-esteem, self-concept, or attitudes towards learning; and improvement in interactions with, and acceptance by, peers and teachers, as well as attachment to school. Positive, negative, or null effects were determined by making comparisons with the intended outcomes of the new practice.

The educational significance of the impact was determined by the magnitude of the effect sizes of student outcomes reported in the studies, or calculated from other statistical data provided in the studies. If the statistical data provided in the studies did not allow for effect sizes to be calculated, or if the findings were described in narrative form, we made an interpretive judgment of the impact in terms of the educational significance for the targeted groups of students. In computing effect sizes, six transformation formulae were applied in accordance with the availability of the statistical data:

1. **Cohen's *d*[2]**

$$d = \frac{\overline{X_1} - \overline{X_2}}{S_{pooled}}$$

2. **Using the value of the *t*–test of the differences between the two groups[3]:**

a. $$d = t\sqrt{\frac{(n_1 + n_2)}{n_1 n_2}}$$

Where t is the t-value between the two groups
n_1 is the sample size of the first group
n_2 is the sample size of the second group

b. $$d = 2t / \sqrt{N}$$

Where t is the t-value between the two groups
$N = 2n = (n_1 + n_2) = (df + 2)$
If only the total N or df are available, assume equal n

3. **Using the F–value[4]:**

$$d = \sqrt{\frac{F(n_1 + n_2)}{n_1 n_2}}$$

Where F is the F-value between the two groups
n_1 is the sample size of the first group
n_2 is the sample size of the second group

4. **Using *r* coefficient[5]:**

$$d = \sqrt{\frac{2r}{\sqrt{1 - r^2}}}$$

Where r is the correlation coefficient

5. **Using success proportion[6]:**

If outcomes were of 'success' proportions in the treatment versus comparison group, an effect size was computed by calculating the difference between arcsine transformation of the treatment group success proportion (p_t) and the control group success proportion (p_c):

d = arcsine (p_1) – arcsine (p_2)
$d = \phi_1 - \phi_2$
ϕ = 2*arcsine ($\sqrt{p}$)

6. **Using Normal Curve Equivalents (NCEs)[7]:**

A Normal Curve Equivalent score is a normalised standard score matching the percentile distribution of 1, 50, and 99 with a mean of 50 and a standard deviation of 21.06.

$d = (NCE_1 - NCE_2) / 21.06$

Issues related to the interpretation of effect sizes are discussed in Chapter 5.

2.2.3 Procedure to establish inter-rater reliability for methodological adequacy

We developed an assessment rubric (Figure A 2.1) to establish the reliability of making judgments of the methodological adequacy of the selected studies in terms of documention of student outcomes. Calibration of the rubric was conducted by means of inter-rater reliability checks, whereby three members of the research team first individually assessed ten studies using the rubric and then worked together to discuss discrepancies and clarify or revise until high consistency (80–100% agreement) was reached. One of the three team members assessed the remainder of the studies independently, but random inter-rater reliability checks were applied during the regular meeting of the research team. Percentage of inter-rater agreement was calculated using this formula:

$$\frac{\text{Total number of ratings that agree}}{\text{Total number of ratings}} \times 100 = \%\ \text{agreement}$$

Figure A 2.1. Rubric for assessing methodological adequacy in documenting student outcomes

Criteria for assessing adequacy of methodology in documenting student outcomes

Rated as: (i) High, (ii) Medium, (iii) Low, and (iv) Not Known

A. Quantitative approaches to documenting student learning outcomes

1. Minimising sampling errors

- The sample taken from a population is both representative and of an adequate size (High)
- The sample taken from a population fairly meets the representative or size criteria (Medium)
- Failing to meet the representative and size criteria (Low)
- Insufficient information for judgment of adequacy (Not Known)

2. Controlling for extraneous variables (e.g., through the presence of control group(s), random assignment to conditions, matching treatment and comparison groups, or statistical control for extraneous variables)

- Appropriate controlling measures were carefully adopted and their rationale clearly reported (High)
- Controlling measures were used but their rationale not clearly reported (Medium)
- Controlling measures were not used at all (Low)
- Insufficient information for judgment of adequacy (Not Known)

3. Content validity of test instruments

- What is assessed is directly related to teaching/learning objective of the professional development, or a clear logical link can be made to the professional development (High)
- What is assessed is indirectly related to teaching/learning objectives of the professional development (Medium)
- What is assessed is not clearly reported / inadequately related to teaching/learning objective (Low)
- Insufficient information for judgment of adequacy (Not Known)

4. Reliability of assigning test scores

- The scoring scheme was unambiguous or the inter-rater reliability of a scoring scheme requiring professional judgment is 80% or above, or other adequate procedures for reliability established (High)
- The scoring scheme requires professional judgment and the inter-rater reliability is less than 80% (Medium)
- No provision of scoring scheme and/or no other independent rater was involved (Low)
- Insufficient information for judgment of adequacy (Not Known)

B. Qualitative approaches to documenting student learning and outcomes

1. Depth of data collection and analysis

- Sufficient to provide clear description, understanding, and explanation[8] of students' learning processes and/or outcomes (High)
- Barely sufficient to provide clear description, understanding, and explanation of students' learning processes and/or outcomes (Medium)
- Not sufficient to provide clear description, understanding, and explanation of students' learning processes and/or outcomes (Low)

2. **Content validity of assessment**

- What is assessed is directly related to teaching/learning objective of the professional development, or a clear logical link can be made to the professional development (High)
- What is assessed is indirectly related to teaching/learning objectives of the professional development (Medium)
- What is assessed is not clearly reported / inadequately related to teaching/learning objective (Low)
- Insufficient information for judgment of adequacy (Not Known)

3. **Reliability of assessment**

- The scoring scheme was unambiguous or the inter-rater reliability of a scoring scheme requiring professional judgment is 80% or above, or other adequate procedures for reliability established (High)
- The scoring scheme requires professional judgment and the inter-rater reliability is less than 80% (Medium)
- No provision of scoring scheme and/or no inter-rater reliability for scoring schemes requiring professional judgment is reported (Low)
- Insufficient information for judgment of adequacy (Not Known)

4. **Method of triangulation**[9]

- Findings for which there could be multiple interpretations are grounded in three or more difference types/sources of evidence (High)
- Findings for which there could be multiple interpretations are grounded in more than one type/source of evidence (Medium)
- Findings are grounded in only one type/source of evidence (Low)
- Insufficient information for judgment of adequacy (Not Known)

C. **The overall evaluation**

- Methodology rigorous in almost all respects (High)
- Methodology rigorous in some respects, but weak in others (Medium)
- A number of serious shortcomings in the methodology employed (Low)
- Insufficient information for judgment of adequacy (Not Known)

References

1 Shulman, L. S. (1996). Just in case: Reflection on learning from experience. In J.A. Colbert & P. Desberg & K. Trimble (Eds.), *The case for education: Contemporary approaches for using case methods* (pp. 197-217). Boston: Allyn & Bacon.

2 Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

3 Lipsey, M. W. & Wilson, D. B. (1996). *Toolkit for practical meta-analysis.* Cambridge, MA: Human Services Research Institute.

4 ibid.

5 ibid.

6 ibid.

7 Tallmadge, G. & Wood, C. (1981). *User's guide: ESEA Title I evaluation and reporting system*. Mountain View, CA: RMC Research.

8 For the discussion of the three tenets of the qualitative method, see Yin, R. (1989). *Case study research: Design and methods* (Revised ed.). Beverly Hills, CA: Sage Publishing.

9 For details, see (a) Denzin, N. K. (1970). *The research act in sociology.* Chicago: Aldine. (b) Denzin, N. K., & Lincoln, Y. S. (Eds.) (2000). *The handbook of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage Publications. (c) Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.

Appendix 3. URLs of citations

Adey, Philip
A model for the professional development of teachers of thinking
http://nzcer.org.nz/BES.php?id=BES117

Alton-Lee, Adrienne; Rietveld, Christine M.; Klenner, Lena; Dalton, Ngaio; Diggins, Cathy; Town, Shane
Inclusive practice within the lived cultures of school communities: Research case studies in teaching, learning and inclusion
http://nzcer.org.nz/BES.php?id=BES084

Ancess, Jacqueline
The reciprocal influence of teacher learning, teaching practice, school restructuring and student learning outcomes
http://nzcer.org.nz/BES.php?id=BES101

Appalachia Educational Laboratory
Collegial investigations: Shared inquiry through disciplined discussion and action research
http://nzcer.org.nz/BES.php?id=BES071

Appalachia Educational Laboratory
Questioning and Understanding to Improve Learning and Thinking (QUILT): The evaluation results. A proposal to the National Diffusion Network (NDN), documenting the effectiveness of the QUILT professional development program
http://nzcer.org.nz/BES.php?id=BES103

Bishop, R.; Berryman, M.; Tiakiwai, S; Richardson, C.; Powell, A.; Teddy, L.; Cavanagh, T.
Te Kotahitanga: Phase 1: The experiences of year 9 and 10 Maori students in mainstream classrooms; Phase 2: Towards a whole school approach; Phase 3: Establishing a culturally responsive pedagogy of relations in mainstream secondary school classrooms
http://nzcer.org.nz/BES.php?id=BES126

Coburn, Cynthia E.
Collective sensemaking about reading: How teachers mediate reading policy in their professional communities
http://nzcer.org.nz/BES.php?id=BES072

Fennema, Elizabeth; Franke, Megan L.; Carpenter, Thomas P.; Carey, Deborah A.
Using children's mathematical knowledge in instruction
http://nzcer.org.nz/BES.php?id=BES118

Gottfredson, Denise C.; Marciniak, Elisabeth; Birdseye, Ann T.; Gottfredson, Gary G.
Increasing teacher expectations for student achievement
http://nzcer.org.nz/BES.php?id=BES121

Kennedy, Mary
Form and substance in inservice teacher education
http://nzcer.org.nz/BES.php?id=BES082

Lipman, Pauline
Restructuring in context: A case study of teacher participation and the dynamics of ideology, race and power
http://nzcer.org.nz/BES.php?id=BES120

McNaughton, Stuart; Lai, Mei; MacDonald, Shelley; Farry, Sasha
Designing more effective teaching of comprehension in culturally and linguistically diverse classrooms in New Zealand
http://nzcer.org.nz/BES.php?id=BES124

Moxon, Judith
A study of the impact of the 'Restorative Thinking Programme' within the context of a large multi-cultural New Zealand secondary school
http://nzcer.org.nz/BES.php?id=BES128

Palincsar, Annemarie Sullivan
Working theory into and out of design experiments
http://nzcer.org.nz/BES.php?id=BES115

Palincsar, Annemarie Sullivan; Collins, Kathleen M.; Marano, Nancy L.; Magnusson, Shirley J.
Investigating the engagement and learning of students with learning disabilities in Guided Inquiry Science Teaching
http://nzcer.org.nz/BES.php?id=BES091

Palincsar, Annemarie Sullivan; Magnusson, Shirley J.; Collins, Kathleen M.; Cutter, Jane
Making science accessible to all: Results of a design experiment in inclusive classrooms
http://nzcer.org.nz/BES.php?id=BES102

Palincsar, Annemarie Sullivan; Magnusson, Shirley J.; Marano, Nancy L.; Ford, Danielle; Brown, Nancy
Designing a community of practice: Principles and practices of the GIsML community
http://nzcer.org.nz/BES.php?id=BES076

Phillips, Joy
Powerful learning: Creating learning communities in urban school reform
http://nzcer.org.nz/BES.php?id=BES122

Saxe, Geoffrey B.; Gearhart, Mary; Nasir, Na'ilah Suad
Enhancing students' understanding of mathematics: A study of three contrasting approaches to professional support
http://nzcer.org.nz/BES.php?id=BES083

Stevens, Robert J.; Slavin, Robert E.
The cooperative elementary school: Effects on students' achievement, attitudes, and social relations
http://nzcer.org.nz/BES.php?id=BES077

Tasker, Gillian Joy
Students' experience in an HIV/AIDS-sexuality education programme: What they learnt and the implications for teaching and learning in health education
http://nzcer.org.nz/BES.php?id=BES057

Timperley, Helen
Distributed leadership: Developing theory from practice
http://nzcer.org.nz/BES.php?id=BES123

Timperley, Helen; Bertanees, Cherry; Parr, Judy
A case study: Promoting teacher learning using a needs analysis approach
http://nzcer.org.nz/BES.php?id=BES127

Timperley, Helen; Parr, Judy
Theory competition and the process of change
http://nzcer.org.nz/BES.php?id=BES116

Appendix 4. Glossary

The page reference for the first and/or most important occurrence of the term is given in brackets. The abbreviation TPL&D BES is used to refer to the synthesis.

Assumptions (p. xvii). The theories, ideas, values, and beliefs that underlie people's actions and of which they are often unaware.

Best Evidence Synthesis Iteration (subtitle). A synthesis of the available international evidence about what does and does not work in improving diverse student outcomes. Its purpose is to create a shared body of professional knowledge to inform educators' practice. The term 'iteration' indicates that this BES will be updated as further information becomes available.

Co- and self-regulatory learning cycle (p. xliv). A process of cyclical inquiry developed by the writers that shows how teachers can collectively and individually identify important issues, acquire the knowledge they need to solve them, monitor the impact of new approaches, and adjust practice accordingly. (See pages xxviii–xxi.)

Co-construction (p. xliv). A process of collaborative learning in which two or more people collaborate to jointly construct new knowledge.

Coherence (p. 72). Coherence implies order, structure, harmony, and alignment within systems and among systems, with each part being subordinate to a central vision, principle, or purpose.

Coherent (p. xxix). Marked by an orderly, logical, and aesthetically consistent relation of parts. In a coherent theory, organisation, or system, it is possible to see how each part relates to the whole and works towards a common end.

Community of practice (p. xxvii). The complex network of relationships within which teachers participate, usually for the purpose of promoting professional learning. (See Chapter 10, Issue 4 for an extended discussion.)

Concept (p. viii). An abstract idea.

Conceptual framework (p. viii). A foundation of factual and conceptual knowledge that is organised in ways allowing the retrieval of prior understandings and the integration of new information. (See p. 12.)

Congruent information (p. 7). New information that is consistent with current understandings and values and so is readily understood.

Control group (p. xxviii). In an experiment, a group of test subjects that is matched with the experimental group on a range of factors except the factor under investigation. The group is left untreated or unexposed to the experimental procedure in order to compare the treated group against a norm.

Constructivist (p. 67). A theory of teaching and learning that holds that individuals construct new knowledge through their mental processes and social interactions.

Content knowledge (p. xv). Teachers' knowledge of the facts, concepts, theories, structures, practices, and beliefs associated with a particular learning area.

Core studies (p. xi). Studies or groups of studies that formed the basis of the TPL&D BES because they met the writers' methodological criteria and were associated with substantive student outcomes.

Cueing prior knowledge (p. 8). The process of bringing prior knowledge to the forefront of a learner's conscious mind. (See Process 1.)

Decile (p. 134). In New Zealand, a 1–10 system used by the Ministry of Education to indicate the socio-economic status of the communities from which schools draw their students; low-decile schools receive a higher level of government funding.

Demographics (p. 1). Demographics are the physical characteristics of a population, such as age, gender, ethnicity, family size, education, geographic location, and occupation.

Developmental progressions (p. xxxi). Sequential learning pathways within particular curriculum areas or areas of specific expertise.

Dialogical norms (p. xxx). The norms that govern the way people in a group behave and interact with each other. For example, the TPL&D BES writers found that effective professional learning communities are based around norms of collective responsibility for student learning rather than norms of individualism and teacher autonomy. Also referred to as prevailing discourse.

Disaggregated data (p. 87). To 'disaggregate' means to separate a whole into its parts. In education, this term means that test results are presented for individual students or groups of students. This allows parents and teachers to see more than just the average score for their child's school. Instead, they can see how each student and/or each group is performing.

Discourse (p. vii). In this context, this term refers to the norms, beliefs, and assumptions shared in a community of practice and reflected in the ways in which members talk to each other. For example, discourse in a school community is often influenced by teachers' beliefs about who can or cannot learn.

Dissonance (p. xv). The sense of disequilibrium that is created when a learner is confronted with dissonant information that challenges their existing ideas, theories, values, or beliefs. Research shows that learners are usually keen to resolve this situation, either by rejecting the new information or by making fundamental changes to their previous beliefs and understandings.

Dissonant information New information that challenges current understandings. Also called incongruent information.

Diversity (p. ix). The concept of diversity is closely related to that of identity. It refers to the differences between groups of people, as well as differences amongst the individuals who make up those groups. Dimensions of identity that are clearly visible and can be measured for statistical purposes include ethnicity, age, gender, and geographic location. Less visible yet equally important dimensions include beliefs, values, interests, and experiences. (See Chapter 3.)

Effect size (p. vi). Changes that are evident in measures used to assess particular outcomes. In the TPL&D BES, effect sizes are used to assess the magnitude of the outcomes for students. (See for an extended discussion.)

Empirical [evidence] (p. 228). Data that has been collected systematically for research purposes.

Engaging teachers' theories [of practice] (p. xxiii). The process of helping teachers to reflect on their existing theories of action and consider their adequacy so that they can then negotiate, with others, the meaning of new information. Also referred to as engagement with prior knowledge. (See Process 1.)

Explicit knowledge (p. 13). Knowledge, ideas, and beliefs that are clearly articulated.

Extended opportunities to learn (p. xii). Learning opportunities that occur over an extended period of time, involve frequent contact with a provider, and provide opportunities to learn through a variety of activities.

External expert (p. xxix). A provider of professional development who brings expertise from outside the participants' immediate environment.

Front-loading of new learning (p. xxxviii). An expression coined by the TPL&D BES writers to explain the relatively formal presentation of new ideas before participants in professional learning have opportunities to engage with it at a more individualised level.

Inquiry-based approach (p. xxx). An approach to learning that is based on constructivist and co-constructivist theories of learning. Constructivist theories are based on the belief that learners actively construct meaning for themselves and with others by questioning, thinking critically, and solving problems.

Iterative (p. xv). A process of learning and development that involves cyclical inquiry, enabling multiple opportunities for people to revisit ideas and critically reflect on their implications.

Knowledge base (p. ix). This term may refer to the complex set of facts, theories, concepts, and beliefs that an individual acquires over time through thinking about new information and using it to make decisions and solve problems. This term can also refer to the knowledge that is shared by members of a profession and grown and enhanced over time. The syntheses are intended as storehouses for such information from which all educators can draw and to which all can contribute.

Learning culture (p. xxxi). An organisational climate that nurtures learning through putting in place the infrastructure and conditions that people need to continually enhance their capabilities. Individuals in a learning culture work towards a shared vision – for themselves and for the community of practice in which they participate.

Literacy (p. xxiii). "The ability to understand, respond to, and use those forms of written language that are required by society and valued by individuals and communities." (*Effective Literacy Practice in Years 1 to 4*, 2003, p. 19)

Māori-medium schools (p. 2). Schools that are based on a Māori philosophy of learning and where the medium of instruction is te reo Māori; also called kura kaupapa Māori.

Mean (p. xi). The mean of a set of scores is the sum of the scores divided by the number of scores. The term average is sometimes used instead of mean. (*Mathematics in the New Zealand Curriculum*, 1999, p. 214)

Median (p. 57). The number that comes in the middle of a set of numbers when they are arranged in order.

Metacognitive (p. viii). Metacognitive knowledge, skills, and strategies are those that enable a person to think about and regulate their own thinking and learning. They include reflecting, self-monitoring, and planning.

Methodological approach (p. xxiii). A term used to describe the practice and procedures used in carrying out an inquiry. (See Chapters 4 and 5 and Appendix 2.)

Motivation (p. xxix). The internal process that energises and directs behaviour. The TPL&D BES writers say that while motivation is an important component of all learning, adult learners are less likely than students to engage with learning if they are not motivated by a perception that the learning is relevant to their professional lives.

Negotiating meaning (p. 169). The evidence shows that teachers need opportunities to make sense of new messages in terms of their existing theories of practice and the realities of their physical and social context. During the process of professional learning, providers and teachers need to engage with each other's theories about what constitutes desirable practice and about the beliefs on which that practice is based. They can then negotiate their way to improved theories, using improved student outcomes as the criteria for judging the success of the negotiated theory. This process is closely related to that of co-construction.

Novice (p. 11). Somebody who is in the process of acquiring the knowledge and skills necessary to participate in a particular field or activity but who has not yet developed a coherent framework from which to make decisions. They are on a developmental progression towards becoming an expert.

Numeracy (p. xxv). The ability and inclination to use mathematics effectively in a range of contexts.

Numeracy Development Project (NDP) (p. 34). The central part of the New Zealand Ministry of Education's Numeracy Strategy. The primary objective of the NDP is to raise student achievement in numeracy through lifting teachers' professional capability.

Open-ended tasks (p. 162). Tasks that require learners to engage in defining and formulating problems before trying to solve them and that have more than one acceptable solution.

Over-assimilation (p. xxxix). Over-assimilation happens when teachers believe that they are enacting new practices when, in reality, they have made only superficial changes. To avoid this, providers must engage teachers' theories of practice in ways that equip them to make principled comparisons between existing and new practice.

Pasifika students (p. xi). Students whose families have come from Sāmoa, Tonga, the Cook Islands, Niue, Tokelau, Tuvalu, and some other, smaller Pacific nations.

Pedagogical content knowledge (p. xv). Within each content area, the combination of knowledge that teachers need to have about curriculum content, how to teach it, and how to understand students' thinking about that branch of knowledge.

Pedagogical knowledge (p. xlv). Teachers' knowledge of the concepts, theories, and research about effective learning, learners, and the goals and processes of education.

Pedagogy (p. x). The processes and actions by which teachers engage students in learning.

Percentile (p. xxv). On a scale, a value indicating the percentage of a distribution that is equal to it or below it. In education, a percentile rank shows the percentage of students in a comparison group whose scores were equal to or lower than the score given. For example, a score at the 95th percentile is equal to or better than 95 percent of the scores.

Professional community of practice (p. xxvii). According to the TPL&D BES writers, a professional community of practice is one whose members are supported to process new understandings and their implications for teaching.

Professional development (p. vi). The dissemination of information to teachers in order to influence practice. Ideally, this involves professional learning.

Professional learning (p. vii). This is a broad term to describe an internal process by which individuals create professional knowledge. (Chapter 2 presents a framework for understanding teacher professional learning.)

Professional learning environment (p. xlv). The culture and infrastructure, within a school or other learning environment, that may or may not support professional learning and development. See 4.3.1.2.

Provider pedagogical content knowledge (p. xv). Term coined by the TPL&D BES writers to refer to the knowledge and skills that providers of teacher education need if they are to assist teachers to make a difference to students. This includes knowledge of the pedagogical changes teachers need to make in order to improve their practice, as well as knowledge of how to make the content meaningful to teachers and manageable within the context of teaching practice.

Rationale for engagement (p. xxix). An exposition of the fundamental principles or reasons for an opinion, action, hypothesis, or phenomenon. The writers found that teachers need a powerful reason to engage with new information in sufficient depth to change their practice. The rationale could come through the presentation of an alternative theory (e.g., about distributed leadership) and/or a problem of practice (e.g., problematic student data). (Also called rationale to participate or catalyst to engage).

Realist synthesis (p. 22). A strategy for synthesising research that is focused on explaining how and why certain mechanisms succeed (or fail) in different settings or contexts. This strategy recognises the impact of setting, context, processes, stakeholders, and outcomes on the implementation of interventions.

Responsiveness to diversity (p. xi). An approach to professional learning that is responsive to the increasing diversity of New Zealand's student population, as well as the complex dimensions that make up each individual's identity. (See 3.3.)

Scaffolding (p. 67). Temporary, structured support designed to move learners forward in their thinking.

Self-governing administrative structures (p. xxiii). New Zealand schools are governed by locally elected boards of trustees within a legislative framework that is set out under the Education Act 1989. The National Education Guidelines (NEGs) contain a statement of goals for education in New Zealand, as well as curriculum and administrative requirements.

Self-regulated learning (p. xxxv). The ability to use metacognitive strategies to plan and monitor one's own learning. The TPL&D BES writers say that self-regulated learners are able to answer three questions: 'Where am I going?', 'How am I going?', and 'Where to next?'

Social construction of students (p. xxx). This refers to the ways teachers think about their students. The TPL&D BES writers found that, at least in some circumstances, improved outcomes for students are associated with teachers thinking differently about the students they teach.

Sociocultural environment (p. 30). The social and cultural infrastructure of a society and its education system, which may or may not support professional learning and development in schools. (See 4.3.1.1.) Also called sociocultural context.

Socio-economic status (SES) (p. 187). Categorisation of individuals or communities based on income, family background, and qualifications.

Standard deviation (p. xx). A measure of how spread out a set of data is. It compares the data to the mean. If all the observations are close to their mean, then the standard deviation will be small.

Stanine (p. xxv). An interval that is used to divide test results into ninths. Like percentile ranks, stanines show how a student performed in relation to a group and can be used for inter-group comparisons.

Student demographics (p. 1). The physical characteristics of the student population. In New Zealand, this population is characterised by increased diversity.

Student outcomes (p. xi). The stated objectives for a sequence of teaching and learning. Valued student outcomes can include personal, social, and academic attributes. The writers emphasise the importance of measuring how effectively professional learning impacts on a range of student outcomes. (See Chapter 3.)

Substantive (p. xxii). The writers use 'substantive' to refer to both the strength and the magnitude of a change or impact.

Substantive learning (p. xxv). The TPL&D BES reveals that substantive improvements in student outcomes are usually associated with substantive learning: learning that challenges the beliefs, values, and/or understandings that underpin an educator's practice. In contrast, superficial learning involves acquiring relatively discrete pieces of knowledge and new skills that can be easily translated into practice.

Substantive student outcomes (p. xxiv). The TPL&D BES identifies elements in the professional learning context that are important for promoting professional learning in ways which impact positively and substantively on a range of student outcomes. (Note: The writers discuss their methods for evaluating the magnitude of change in Chapters 4 and 5.)

Supplementary studies (p. xi). Studies or groups of studies that the TPL&D BES writers used to complement the analysis of the core studies. These studies either met the methodological criteria but reported limited or no change in student outcomes or had substantive student outcomes but did not provide sufficient methodological details to allow judgments to be made about the links between professional learning and student outcomes.

Sustainability (p. xxix). The ability of a school community to sustain its improved student outcomes or continue to improve them after any external support has been withdrawn. Sustainability seems to depend on the school community's ability to engage in continuous learning through ongoing inquiry. (See Chapter 11.)

Tacit knowledge (p. ix). Knowledge, ideas, and beliefs that are built up over time through experience or personal training. It is internalised, routine, and difficult to communicate; in fact, the holder of the knowledge may not be aware of it. Tacit knowledge is an important part of an individual or community's knowledge base, but it can also be a barrier to change if it remains unidentified and unexamined.

Tail of underachievement (p. xi). An expression that refers to the wide spread of student achievement outcomes that leaves a disproportionate number of Māori and Pasifika students and students from low-skilled and non-employed families achieving well below the average.

Teacher outcomes (p. 7). The stated objectives for participation in professional learning. However, the writers emphasise that effective professional learning brings about changes in teachers' practice that impact positively on student outcomes. (See Chapter 3.)

'The black box' (p. xv). Black and Wiliam (1998) first introduced this term to educational research when they argued that policies aimed at raising British standards of learning had been unsuccessful because they didn't address the teaching and learning that goes on in classrooms. While there is now an enormous body of research about what takes place in the 'black box' between teaching practice and student learning, this synthesis addresses a second black box, situated between particular professional learning opportunities and their impact on teaching practice. (See section 2.1.)

Theoretical framework (p. viii). A structure of concepts and theories that provide a map to guide thinking, research, and action.

Theoretical principles (p. xxxvi). A set of principles that is used to explain the links between related concepts, facts, or phenomena, especially a set that has been repeatedly tested or is widely accepted.

Theories of practice (p. xviii). Theories of practice comprise a teacher's personal beliefs and values, the knowledge, skills, and practices that follow from them, and on which their classroom practice is based. (See Chapter 10 for an extended discussion.)

Theory (p. vi). A set of related concepts that have been structured to explain, interpret, and predict behaviour.

Treaty of Waitangi (p. xxiii). New Zealand's founding document, signed in 1840 in Waitangi in the Bay of Islands by representatives of the British Crown and about 520 Māori rangatira (chiefs). It establishes a set of principles that sit behind a partnership between Māori and Pākehā. (See NZ History Online: www.nzhistory.net.nz/category/tid/133)

Vision (p. xvi). A set of goals, targets, or opportunities about how teaching might impact on student outcomes. The writers found that effective school leaders are able to articulate a vision of how things might be different for the school's diverse student population, able to ensure that the collective effort is coherent with the vision, and able to motivate teachers to work towards achieving it.

Whānau (p. xviii). Extended family (Māori).

Abbreviations

Algebra I EOC	North Carolina End-of-Course Test for Algebra	p. 46
ANP	Advanced Numeracy Project	CASE 5
asTTle	Assessment Tools for Teaching and Learning	p. 2
ATOL	Assess to Learn project	CASE 4
BES	Best Evidence Synthesis	Title page
BSAP	Basic Skills Assessment Program	p. 47
BURT	Burt Word Reading Test	p. 40
CAP	California Assessment Program	p. 47
CAPE	Content Area Program Enhancement	p. 139
CASE	Cognitive Acceleration through Science Education	p. 100
C-BAM	Concerns-based Adoption Model	p. 13
CDI	Civic Development Inventory	p. 49
CGI	Cognitively Guided Instruction	p. 64
CITO	Dutch Central Institute for Test Development	p. 56
CLAS	California Learning Assessment System	p. 139
CPU	Constructing Physics Understanding	p. 101
CSEI	Coopersmith Self-esteem Inventory	p. 38
CSR	Comprehensive School Reform	p. xv
CTBS	California Test of Basic Skills	p. 46
ELL	English Language Learners	p. 50
ERIC	Educational Research Information Centre	p. 242
ES	Effect Size	p. 54
ESA	Essential Skills Assessment	p. 40
ESOL	English for Speakers of Other Languages	p. 215
ETP	Effective Teaching Profile	CASE 7
FAST	Foundational Approaches in Science Teaching	p. 101
FCAT	Florida Comprehensive Assessment Test	p. 47
GIsML	Guided Inquiry supporting Multiple Literacies	p. 101
HIV/AIDs	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome	p. 213
IEA	International Education Assessment	p. 2
IMA	Integrated Mathematics Assessment	p. 87
INSET	In-service Education for Teachers	p. 109
IQ	Intelligence Quotient	p. 45
ISTEP	Indiana Statewide Test for Educational Progress	p. 43
ITBS	Iowa Tests of Basic Skills	p. 43
LA	Los Angeles	p. 47
LEP	Limited English Proficient	p. 44
LISP	Learning in Science Projects	p. 103
MMAT	Missouri Mastery and Achievement Tests	p. 49
NCE	Normal Curve Equivalent	p. 48
NCEA	National Certificate of Educational Achievement	pp. 11, 68
NDP	Numeracy Development Project	CASE 5
NLS	National Literacy Strategy	p. 243
NNS	National Numeracy Strategy	p. 243
NWP	National Writing Project	p. 136
NZ	New Zealand	p. 40
OECD	Organisation for Economic Co-operation and Development	p. viii
ORS	Ongoing Resourcing Scheme	CASE 1
PD	professional development	p. 33
PIRLS	Progress in International Reading Literacy Study	p. 2
PISA	Program for International Student Assessment	p. 2
PL	professional learning	p. 33

QUILT	Questioning and Understanding to Improve Learning and Thinking	p. 213
RTLB	Resource Teachers: Learning and Behaviour	CASE 1
SABE	Spanish Assessment of Basic Education	p. 47
SAT-9	Stanford Achievement Test — 9th edition	p. 54
SAT scale	Stanford Achievement Test scale	p. 34
SOLO [taxonomy]	Structure of Observed Learning Outcomes	p. 44
Sp Ed	Special education	p. 52
SSI	Statewide Systemic Initiative	p. 48
STAR	Supplementary Test of Achievement in Reading	p. 26
TAAS	Texas Assessment of Academic Skills	p. 46
TESA	Teacher Expectations and Student Achievement	p. 167
TIMSS	Third International Mathematics and Science Study	p. 40
UK	United Kingdom	p. 43
US	United States	p. 43
VAMP	Values and Mathematics Project	p. 60

Index

The abbreviation PD stands for professional development and here covers the term professional learning, also used in the text.

A

activities 28–29, 84–87, 91–92, 114–118, 147–151
administrators/managers 3, 223, 254–255
assessment tools and skills 34, 183–192
  case study 246–249
  literacy 132, 137, 140, 143, 146–147, 154, 235–236, 242–249
  Māori-medium 137, 150
  mathematics 80–82, 87–88, 92
  science 113–114
Australia
  study used 273
autonomy (teachers') 205, 225

B

'balkanisation' 165, 208–210
beginning teachers 229–230

C

Canada
  studies used 273
classroom activities and materials 86, 110, 116–117, 122–123, 151
  see also resources
Cognitive Acceleration through Science Education (CASE) 99, 104–105, 107, 110, 112, 113, 116, 118
Cognitively Guided Instruction (CGI) 67, 80–81, 83, 93, 109, 221
collaborative planning 150, 173
collegial support 73–75, 106
  examples 68, 70, 88, 223
  see also learning communities
Columbia University 111
community involvement 255, 266–267
Complex Instruction 99, 110, 112, 114, 117, 162, 166, 172
computer-assisted learning 107–108
  see also technology
Constructing Physics Understanding (CPU) 101
constructivist approaches 67, 69, 89, 103, 112, 122, 229, 265–268
content knowledge *see* pedagogical content knowledge
content of PD opportunities 78–86, 108–114, 168–172
context of PD opportunities 71–77, 103–108, 122, 137–142, 154, 219
  organisational conditions 223–224
cooperative learning 19, 69, 71, 91, 162, 169–170, 172, 199
cross-curricular approaches *see* interdisciplinary approaches
curriculum knowledge 87, 147, 172, 191
  see also pedagogical content knowledge

D

disabilities, students with 161, 167, 221
  case study 238–241
discourses 26, 76, 108, 142, 167–168
dissonance 13, 85, 89–90, 121, 146, 152–153, 176–177
  in case studies 236, 240, 252, 256, 261–262, 266–267
diversity
  among students 20, 133, 221, 239, 242, 254; *see also* equity
  among teachers 6, 13–14, 77

E

early childhood education 18
Education, Ministry of *see* Ministry of Education
effect sizes 33–60
Effective Teaching Profile (ETP) 259–262
emotional practices 12
England *see* United Kingdom
equity (among students) 20, 114, 162, 188
Evaluation Associates 246
evidence-informed activities 196, 221–223, 225, 244–245, 247–248, 251
existing theories see teachers' theories and beliefs
external expertise 74–75, 106–107, 139–140, 166, 195, 203–204, 255, 260
  sustainability and 219–220
  see also providers; researchers

F

facilitators 235–237, 255, 260–261, 266–268
  see also providers; researchers
FAST (Foundational Approaches in Science Teaching) 101, 110, 113
feedback 84, 86, 117–118, 141, 149, 150, 198
  in case studies 236–237, 242, 248, 250, 255, 267
funding 194–195, 245, 246
  see also infrastructural support

G

gender stereotyping 161, 167
goals 15, 242, 246–247, 252, 254, 265
  addressing inequalities 168
  literacy PD 138, 140–141, 144, 236
  mathematics PD 77, 91
  science PD 108, 122
governance (in New Zealand) 1–2
group work 114, 172
Guided Inquiry supporting Multiple Literacies (GIsML) 102, 104, 116, 117, 119

H
HIV/AIDS-sexuality education 265–268
Hunter, Madeline 70–71, 77, 92, 219, 223

I
In-service Education for Teachers (INSET) 108
inclusive practices 238
infrastructural support 27, 72, 104–105, 122, 138, 142, 165
Integrated Mathematics Assessment (IMA) 68
interdisciplinary approaches 136, 165–166, 209–210
International Educational Assessment (IEA) 2
Israel 70, 71, 135
  studies used 273
iterative processes 8, 29, 30, 145, 149, 154, 188

K
kaupapa Māori 260

L
leaders 3, 142, 154, 175, 192–193, 195–196, 221–222, 225, 257
  addressing inequalities 166–167, 178
  cross-curricular projects 210
  literacy 136, 139–140, 236, 242–244, 246–248
  mathematics 75, 250, 252
  science 122
learning communities 120, 148, 154, 175, 195, 201–205
  examples 68, 88, 151, 236–237, 242–245, 247, 252, 257, 267–268
learning disabilities, students with 102
Learning in Science Projects (LISP) 103, 117, 118, 120, 122
learning processes (teachers') 7–8, 30, 89, 120–122, 247–248
literacy 130–154, 167–168, 174, 188, 189, 222
  case studies 235–237, 242–249
  effect sizes 60
Literacy Leadership Project 154
Literacy Professional Development Project 235
low-achieving students 132, 133, 144, 178, 242
low-income communities 68
  literacy projects 130, 133, 135–136, 137, 152, 188
  teachers' expectations 162, 168, 187

M
Māori-medium education 2, 6
  assessment tools and skills 137, 150
  studies 71, 230
Māori students 2, 20, 60, 171, 176, 250
  literacy gains 132, 133, 137, 246
  teachers' thinking on 162, 197, 259–262
  see also Te Kotahitanga
Massey Way, The 255, 257
mathematics 60, 65–93, 73, 186, 193, 250–253
mentoring 229–230, 256
Ministry of Education 25, 130, 132, 138, 235, 246, 251, 254, 269
modelling 85–86, 149
motivation 12, 29, 138–139, 170, 188, 218, 236, 248, 257

N
National Certificate of Educational Achievement (NCEA) 263
National Science Foundation (US) 102, 105
needs analysis approaches 134, 235–237, 268
Netherlands 71
  studies used 273
New Zealand
  policy context 1–3, 25–26
  studies used 270
Numeracy Development Project (NDP) 34, 68, 76, 80, 250–253

O
outcomes *see* student outcomes

P
Pasifika students 20, 133, 137, 230, 250, 263
pedagogical content knowledge 80, 83, 186
  literacy 143–145, 236, 242, 247
  mathematics 87, 92–93, 251–253
  science 110–111
  secondary and primary school teachers 208–209
pedagogy 112, 117
  generic approaches 78–79, 82, 91–92, 108
Picking up the Pace 133
policy and policy makers 3, 11–12, 25–26, 72–73, 105, 194
prescriptive approaches 82–83, 222, 223, 225
principals 166–167, 192, 210, 223, 235–236, 243, 254–255
professional communities see learning communities
professional development/learning 3
  conditions for success 11–12, 91–93, 122–123
  limitations 12–13
Program for International Student Assessment (PISA) 2
Progress in International Reading Literacy Study (PIRLS) 2
providers 3, 85–86, 142, 148, 149, 173, 248
  challenges for 153, 197
  effect of withdrawal 70–71
  examples 90, 116, 117, 120, 121, 191, 246–248, 250–252
  qualities of 228
  teacher-provider relationships 77, 140–141, 149, 150, 165, 266–267
  see also external expertise; facilitators; researchers

R
reading *see* literacy
Reading Literacy studies 2
Reading Recovery 132, 133, 222
readings (professional) 110, 118, 149, 236
relief teachers 142
research by teachers 242–245
researchers (as providers) 74, 200, 242–245
resources 251, 266
  see also classroom activities and materials
restorative justice 162, 168, 170, 173, 210, 254–258

S
scaffolding 67, 79
school organisation 26, 223–224
school-wide programmes see whole-school PD
science 60, 99–123, 193
secondary schools 171, 205–211
  case study 265–268
  departmental divisions 208–210
  interdisciplinary approaches 165–166
  literacy teaching 133, 136
  mathematics teaching 67
self-regulatory skills 15, 153, 177, 190, 196, 225
social constructions 160–179, 224, 238–241
social influences (on teachers) 11, 25, 224
special education 69, 132
streaming 70
student behaviour 71, 172, 173, 254–257
student outcomes 4, 12, 18–20, 174–175, 175
  assessment of 87–88
  literacy 140–141
  mathematics 72–75, 91
  professional communities and 201–204
  science 101–105
  studies of 33–60
  sustainability 218–225
students' understandings/responses 14–15
  literacy 235–236
  mathematics 78, 80, 89–90, 221, 252–253
  science 112–113, 122, 123
studies
  content: literacy 130–137; mathematics 65–71; science 99–103; student outcomes 35–56
  gaps in research 228
  use of studies: categorisation 31, 273–275; framework 24–30, 273–275; list (see relevant sections for detailed references) 270–273; locating 23, 269; methodology 22–23, 33–35, 56, 277–279
support 174, 195–196, 210, 248
  double-edged sword 203
  see also collegial support; infrastructural support; learning communities
suspensions 60, 162, 168, 170, 254–257, 259
sustainability 140, 196, 218–225, 242, 245, 256, 259

T
tacit knowledge 13
Te Kauhua 2
Te Kotahitanga 3, 161–162, 171, 174, 210, 257, 259–264
Te Poutama Tau 2
Teacher Expectations and Student Achievement (TESA) 163, 171, 178–179
teacher-student relationships 170–173, 255, 257, 259–262
teacher turnover 223, 243
teacher-tutors/trainers 106–107, 116, 196
teachers as learners 87, 118, 145, 204, 251, 267
teachers' expectations 138, 142, 162–168, 175, 178, 190, 251
  in low-income communities 187, 204
  of Māori students 2–3, 171, 176, 259
  see also social constructions
teachers' prior knowledge 7–10, 89, 152, 176, 236
teachers' theories and beliefs 106, 119–122, 145, 149, 153, 235–236, 248
  engagement of 194, 196–201, 230
  see also discourses; dissonance
teaching materials see classroom activities and materials; resources
technology 19, 136, 228
tests 34, 189, 218
theory and practice 232, 238–241
  addressing inequalities 169–170, 174
  case study 238–241
  literacy 236, 242–245
  mathematics 79, 85–86
  science 109–110
time (length and frequency of PD) 10, 72, 75, 107–108, 138, 139, 168, 177–178, 194
  in case studies 259, 265
Treaty of Waitangi 2, 255

U
United Kingdom
  assessment skills 186
  literacy and numeracy strategies 68, 132, 138, 222
  science teaching 105
  studies used 271
United States 34, 189, 198, 224
  literacy teaching 133, 135–137, 144, 145
  mathematics teaching 67–71
  policy context 25, 72, 105
  science teaching 105
  studies used 271–272
  TESA programme 163, 171, 178–179
university-based PD 103, 105, 106, 111, 228, 238–239

V
voluntary participation in PD 105, 147, 165–166, 259
  influence on outcomes 73, 91, 138

W

whole-school PD 73–74, 106, 142, 144, 254, 257
in secondary schools 208–210
workshops 9–10, 243–244, 246–247, 250–251, 255, 265–267
writing see literacy