Designing and Supporting Teacher Professional Development to Improve Valued Student Outcomes

Invited paper presented at the *Education of Teachers Symposium* at the General Assembly of the International Academy of Education, Limassol, Cyprus 26 September 2008

Adrienne Alton-Lee,
Ministry of Education, New Zealand & International Academy of Education

The New Zealand Ministry of Education has commissioned a best evidence synthesis iteration (BES) that identifies the characteristics of teacher professional development that make a positive difference for valued student outcomes. A forthcoming educational leadership best evidence synthesis iteration (BES) reveals that when school leaders promote and/or participate in effective teacher professional learning and development, this has more impact on student achievement than any other leadership activity. This presentation explores the implications of this evidence for policy and higher education. The focus is on the need to create the systemic infrastructure and conditions for effective and innovative teacher education underpinned by research and development.

There has been a silent revolution in education policy around the world in recent times. When many of us were at school, the education systems in our countries were charged with sorting students[1] by achievement level, into those who succeeded and those who failed. In some places, such sorting may have been a feature of schooling even at the points of access to primary and/or secondary education.

As knowledge itself is increasingly seen as an economic resource in a global community, societies are looking for school systems that help all students to learn, succeed and develop the capabilities needed to be lifelong learners in rapidly changing contexts. Increasingly diverse societies are also needing school systems to contribute to social cohesion. This silent revolution looks for school systems to perform at much higher levels, particularly for those who have traditionally been underserved by education.

That the task of our schools has undergone a fundamental change—from sorting, to supporting all learners to succeed—needs to be acknowledged in policy environments. Policy ideas for responding to this fundamental change are likely to be superficial if they do not attend to the implications for capability building. If the magnitude of the change required goes unrecognised, there is risk of policy discourses being almost magical in their assumptions about how change might be brought about. For example, it may be assumed that all that needs to happen is for teachers—working with large groups of students—to 'personalise' learning for each child. This paper calls for much greater attention to be paid to the role of research and development in informing effective teacher education and systemic capability building and for less faith to be placed in the magical or 'teachers must try harder' discourses that often pervade policy thinking.

In this paper I first make the case that there is an emerging and compelling evidence base for the role that effective teacher professional learning and development[2] has to play in resourcing and enabling transformation in education. The evidence provided is derived from syntheses of evidence about influences on change and valued outcomes for diverse learners in education— academic, social, well-being, self-regulatory and identity outcomes. The history of much educational research is that attention to the link between processes *and outcomes for students* (rather than the perspectives of providers or researchers) is rare. I consider briefly the evidence

---

[1] For the development of this point in relation to Plato's 'myth of the metals' see: Timperley, H., & Alton-Lee, A. (2008). Reframing teacher professional learning: An alternative policy approach to strengthening valued outcomes for diverse learners. *Review of Research in Education*, Vol. 32, No. 1, 328-369.

[2] The focus of my paper is on effective in-service teacher professional learning and development. This paper complements and builds upon rather than focusing on the emerging outcomes-linked findings for pre-service education considered in Cochrane-Smith, M., Feiman-Nemser, S., McIntyre D.J. & Demers, K. (2008). (Eds.). *Handbook of research on teacher education: Enduring questions in changing contexts.* New York & London: Routledge, Taylor & Francis Group and the Association of Teacher Educators.

of unintended harm in education. I go on to argue that research and development is not only a fruitful approach to be pursued but a moral imperative, in that it provides a means by which we can strengthen the valued outcomes that our communities seek for their children.

The second part of this paper counterpoints OECD findings of relatively low expenditure on educational research and development (R & D) with the value of collaborative, outcomes-focused R & D as a resource for policy and practice. The paper highlights a New Zealand example of innovative professional development that is countering a tradition of systemic underserving. The paper considers the policy challenge of scaling-up effective professional development across a school system and highlights the value of a collaborative R & D model for ensuring that systemic reform has depth and is sustainable.

A comparative, magnitude-of-impact analysis is used to identify two collaborative R & D programmes that have generated and sustained high-impact professional development interventions across a range of settings and countries. The illustrative examples offer practical solutions to the compelling educational policy problems that face our different nations. Given the potential of such R & D to generate the conditions for high-impact, adaptive and sustainable professional development, there is a case here for strategic investment—investment that will support the silent revolution expected of our schools.

Evidence from Educational Leadership Research

In considering the evidence for the importance of teacher professional development, I draw initially on the very small subset of research in the school leadership literature that focuses on student outcomes. The role of teacher professional learning has been highlighted in an analysis of the relationship between school leadership activities and student outcome gains prepared for the New Zealand Ministry of Education's forthcoming *Educational Leadership BES*[3].
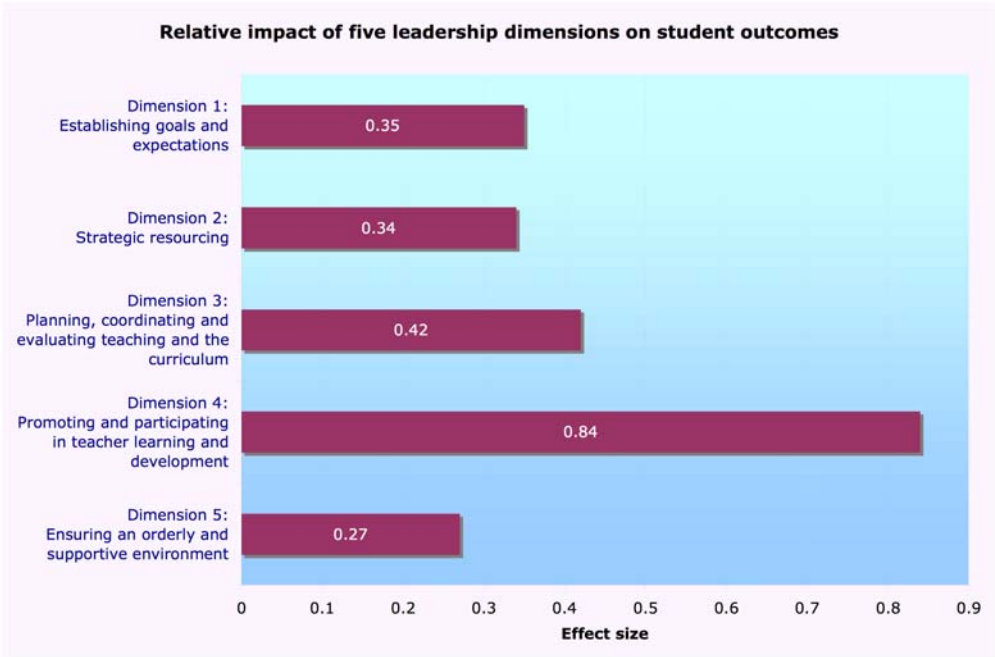

Figure 1. Relative impact of five leadership dimensions on student outcomes.

The number of effects and studies considered and the standard errors for these effects are given in Table 1 below. The source studies are cited in Robinson[4].

---

[3]   The analysis was prepared by Viviane Robinson with assistance on effect size determination from Professor John Hattie and Dr Ken Rowe of the Australian Council for Educational Research. This first analysis for the BES has been published by the Australian Council for Educational Leaders. Robinson, V. M. J. (2007). *School Leadership and Student Outcomes: Identifying What Works and Why. Monograph 41, Australian Council of Educational Leaders (Editor David Gurr).* http://www.educationcounts.govt.nz/goto/BES

[4]   Robinson, V. M. J. (2007). School Leadership and Student Outcomes: Identifying What Works and Why. Monograph 41, Australian Council of Educational Leaders (Editor David Gurr). http://www.educationcounts.govt.nz/goto/BES

2

Table 1. Leadership Dimensions Derived from Studies of Effects of Leadership on Student Outcomes

Leadership Dimension	Meaning of Dimension	
1. Establishing Goals and Expectations	Includes the setting, communicating and monitoring of learning goals, standards and expectations, and the involvement of staff and others in the process so that there is clarity and consensus about goals.	**Average ES = .35** *(SE = .08)* *49 effect sizes from 7 studies*
2. Strategic Resourcing	Involves aligning resource selection and allocation to priority teaching goals. Includes provision of appropriate expertise through staff recruitment.	**Average ES = .34** *(SE = .09)* *11 effect sizes from 7 studies*
3. Planning, Coordinating and Evaluating Teaching and the Curriculum	Direct involvement in the support and evaluation of teaching through regular classroom visits and provision of formative and summative feedback to teachers. Direct oversight of curriculum through school-wide coordination across classes and year levels and alignment to school goals.	**Average ES = .42** *(SE = .07)* *79 effect sizes from 7 studies*
4. Promoting and Participating in Teacher Learning and Development	Leadership that not only promotes but directly participates with teachers in formal or informal professional learning.	**Average ES = .84** *(SE = .14)* *17 effect sizes from 6 studies*
5. Ensuring an Orderly and Supportive Environment	Protecting time for teaching and learning by reducing external pressures and interruptions and establishing an orderly and supportive environment both inside and outside classrooms.	**Average ES = .27** *(SE = .09)* *42 effect sizes from 8 studies*

By far the highest effect size is associated with the role of school leaders in promoting and participating in teacher professional learning and development. Further analysis suggests that, by doing this, school leaders not only deepen their own pedagogical knowledge and understanding but they also develop the understandings necessary to create and sustain the conditions for improved practice in their schools.

Implications for School Leadership
The *Leadership* and *Teacher Professional Learning and Development BES* findings call for school leadership to play a central role in embedding a professional inquiry model into teaching practice. For example, the findings highlight how important it is for school leaders to actively develop shared commitment to goals that involve improving student outcomes and to actively promote and lead professional development. Effectiveness is linked to the role of leadership in creating and sustaining the conditions for ongoing, outcomes-focused professional inquiry and learning in schools. Such conditions include enabling teachers to process new learning with others and providing teachers with multiple opportunities to learn and apply their new understandings in practice.

Table 2. The Range and Mean Effect Size for 72 Professional Development Studies[5]

	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	Ns							
Elementary	172	0.61	0.07	0.28	0.34	0.90	-1.01	5.31
Junior High	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
Country	Ns							
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
other country	1	0.31	.		0.31	.	0.31	0.31
Number of Participants	Ns							
<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
Student Ability Level	Ns							

[5]   Timperley, H., Wilson, A., Barrar, H., & Fung. I. (2007). *Teacher professional learning and development: Best evidence synthesis iteration.* Wellington, New Zealand: Ministry of Education. http://educationcounts.govt.nz/goto/BES

Evidence from the Professional Development Research

The second body of evidence informing this paper is derived from a synthesis[6] (of findings from 72 individual or groups of studies) that analysed the links between professional development and its impact on valued student outcomes (see Table 2).

In giving guidance on interpreting effect sizes J. Cohen[7] suggested an effect of .20 can be considered small, an effect of .50 medium, and an effect of .80 large. When interpreting the table, it is important to realise that the size of the effect is not the only criterion by which to compare interventions; length is another: some of the shorter interventions had significant impact relative to their duration. In general, PD that continued in some form for one to two years —often after initial intensive teacher engagement, was found to have the greatest impact on student outcomes.

By analysing standardised asTTLe (Assessment Tools for Teaching and Learning) assessments, Hattie[8] has found that, in general, the effect size for a New Zealand teacher's contribution to student learning over a year is around .35:

> *In our own New Zealand studies, we have estimated the yearly effect in reading, mathematics, and writing from Years 4 to 13 (N = 83,751) is .35, although this is not linear: in some years and for some subjects there is more or less growth. The inference for the argument in this book is that teachers typically can attain between .20 to .40 growth per year, and that this is to be considered **average.** They should be seeking greater than .40 for their achievement gains to be considered above average, and greater than .60 to be considered excellent.*

As can be seen in Table 2, there was evidence of a wide range of impact on student outcomes for different kinds of professional development for both impact over baseline and impact in relation to a controlled comparison group. These include high effects and effects significantly larger than those for business-as-usual in controlled comparisons. In some cases, the gain was equivalent to three or more years' 'normal' achievement, with even greater gains made by students identified as having special needs, particularly when such students recorded little achievement in pre-tests. A detailed consideration of measurement issues in ascertaining the effect sizes, and each of the studies included is contained in the original BES[9].

There was evidence that professional learning communities designed to address inequities could actually be counterproductive. Lipman[10], for example, described how teachers who were given two hours of non-contact time per day to find answers to African-American underachievement interacted in ways that reinforced existing deficit thinking and structural inequalities. Those teachers who held alternative theories and could have served as a resource for the group's deliberations were marginalised.

Table 2 signals some challenges, particularly with respect to having an impact on social outcomes and on the crucial middle school/junior high school level. The table also highlights the meagre outcomes-linked evidence available for the effects of professional development on a curriculum area that is crucial to the development of social, participatory and citizenship

---

[6]   Timperley, H., Wilson, A., Barrar, H., & Fung. I. (2007). *Teacher professional learning and development: Best evidence synthesis iteration.* Wellington, New Zealand: Ministry of Education. http://educationcounts.govt.nz/goto/BES

   Timperley, H., & Alton-Lee, A. (2008). Reframing teacher professional learning: An alternative policy approach to strengthening valued outcomes for diverse learners. Review of Research in Education, Vol. 32, No. 1, 328-369.

[7]   Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

[8]   Hattie, J. (forthcoming). *Visible teaching - Visible learning: A synthesis of 800+ meta-analysis on achievement.* London: Routledge.

[9]   Timperley, H., Wilson, A., Barrar, H., & Fung. I. (2007). *Teacher professional learning and development: Best evidence synthesis iteration.* Wellington, New Zealand: Ministry of Education. http://educationcounts.govt.nz/goto/BES

   Timperley, H., & Alton-Lee, A. (2008). Reframing teacher professional learning: An alternative policy approach to strengthening valued outcomes for diverse learners. Review of Research in Education, Vol. 32, No. 1, 328-369.

[10]   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.

skills: social studies. This gap in the professional development literature is of concern not only because such outcomes are important to social cohesion, but also because there is compelling evidence from studies linking teacher goals, learning processes and student outcomes that it is possible for teachers—well-intentioned, caring and experienced—to unknowingly have impacts on students that are the reverse of what they intend[11]. Efforts to combat racism, for example, have often succeeded in exacerbating the problem[12]. Given this recurrent finding, there is a moral imperative to pay more attention to the design and effects of professional development in social studies and social sciences teaching[13].

Characteristics of Effective Professional Development

A summary[14] of the ten findings from the *Teacher Professional Learning and Development: Best Evidence Synthesis Iteration* is provided in Figure 2 on the next page. This summary highlights ten principles of effective professional development that are applicable at both system level and school level.

---

[11] Doyle, W. (1983). Academic work. Review of Educational Research, 53, 159-199.

Nuthall, G. (1999). Learning how to learn: The evolution of students' minds through the social processes and culture of the classroom. *International Journal of Educational Research,* 31 (3), 141-256.

Alton-Lee, A.G., & Nuthall, G.A., with Patrick, J. (1995). In G. Capella Noya, K. Geismar & G.

Nicoleau (Eds.). *Shifting histories: Transforming Education for Social Change.* Reframing classroom research: A lesson from the private world of children. Cambridge, MA: Harvard Educational Review. Reprint series No. 26.

Bossert, S. (1979). Tasks and social relationships in classrooms: A study of instructional organisation and its consequences. London: Cambridge University Press.

[12] Cole, M. (1998). Racism, reconstructed multiculturalism and antiracist education. *Cambridge Journal of Education*, 28 (1), 37-48).

Donn, M., & Schick, R. (1995). *Promoting positive race relations in New Zealand schools: Me mahi tahi tatou.* Wellington: Research Division, Ministry of Education.

Osler, A., & Starkey, H. (1999). Rights, identities and inclusion: European action programmes as political education. *Oxford Review of Education,* 25 (Nos. 1 & 2), 199-215.

Seixas, P. (2001). Review of research on social studies. In V. Richardson (Ed.). *Handbook of Research on Teaching (Fourth Edition).* Washington D.C: American Educational Research Association.

Shaver, J. (1999). Social Studies: Cognitive prejudice reduction. In G. Cawelti (Ed.). *Handbook of research on improving student achievement (Second Edition).* Virginia: Educational Research Service.

[13] Aitken, G. & Sinnema, S. (forthcoming). Effective pedagogy in social sciences Tikanga ā iwi: Best evidence synthesis iteration. Wellington: Ministry of Education. http://www.educationcounts.govt.nz/goto/BES

[14] Timperley, H. (forthcoming). Teacher professional learning and development. No. 18. Educational Practice Series. International Academy of Education.(to complete)

1. **Focus on valued student outcomes**

Professional learning experiences that focus on the links between particular teaching activities and valued student outcomes are associated with positive impacts on those outcomes.

2. **Worthwhile content**

The knowledge and skills developed are those that have been established as effective in achieving valued student outcomes.

3. **Integration of knowledge and skills**

The integration of essential teacher knowledge and skills promotes deep teacher learning and effective changes in practice.

4. **Assessment for professional inquiry**

Information about what students need to know and do is used to identify what teachers need to know and do.

5. **Multiple opportunities to learn and apply**

To make significant changes to their practice, teachers need multiple opportunities to learn new information and understand its implications for practice. Furthermore, they need to encounter these opportunities in environments where there are both trust and challenge.

6. **Approaches responsive to learning processes**

The promotion of professional learning requires different approaches depending on whether new ideas are, or are not, consistent with the assumptions that currently underpin practice.

7. **Opportunities to process new learning with others**

Collegial interaction that is focused on student outcomes can help teachers integrate new learning into existing practice.

8. **Knowledgeable expertise**

Expertise external to the group of participating teachers is necessary to challenge existing assumptions and develop the kinds of new knowledge and skills associated with positive outcomes for students.

9. **Active leadership**

Designated educational leaders have a key role in developing expectations for improved student outcomes and organising and promoting engagement in professional learning opportunities.

10. **Maintaining momentum**

Sustained improvement in student outcomes requires that teachers have sound theoretical knowledge, evidence-informed inquiry skills, and supportive organisational conditions.

Figure 2. Summary of the findings of the Teacher Professional Learning and Development BES Timperley, H. (forthcoming). *Teacher Professional Learning and Development.* **International Academy of Education**
Education Practice Series - 18

In her summary of the BES findings, Timperley provides this model of a teacher inquiry and knowledge-building cycles approach that promotes continuous improvement and teacher self-regulation of professional learning:
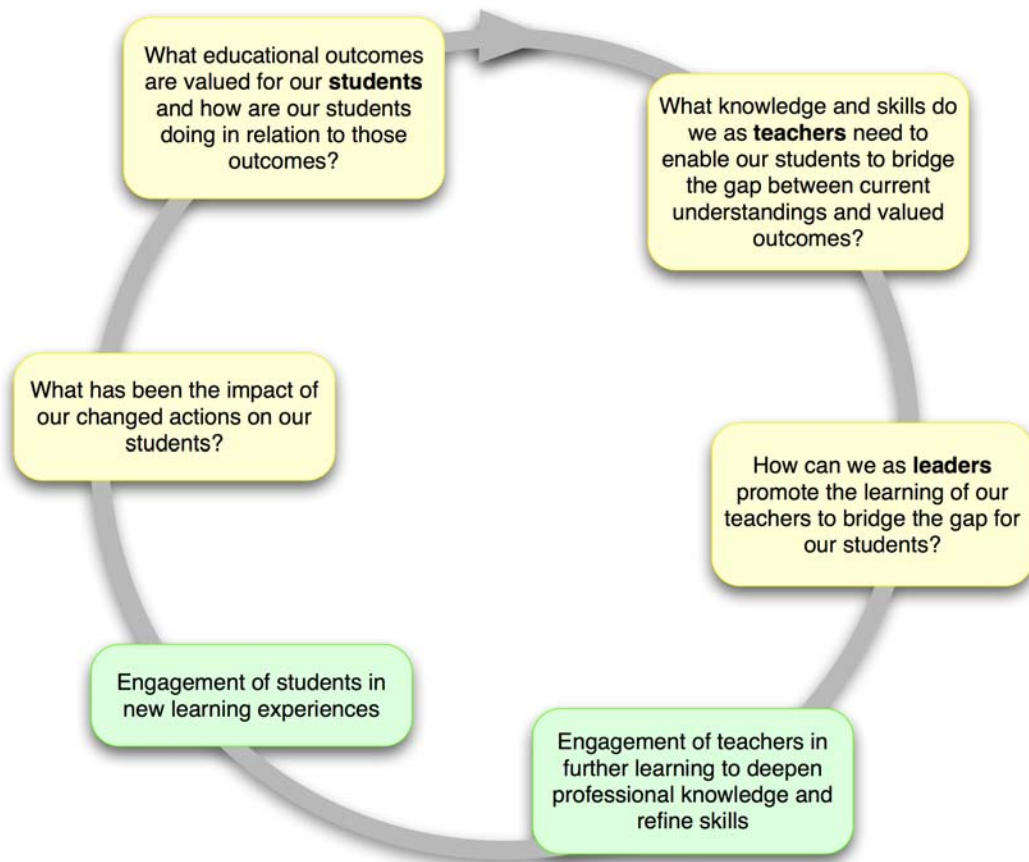
Figure 3. Teacher inquiry and knowledge-building cycles

I now explore further how research and development can offer teachers access to pedagogical knowledge, pedagogical content knowledge, and the expertise and capability required for systemic change.

The *Teacher Professional Learning and Development BES* has provided useful comparative information about the effectiveness of current professional development in New Zealand. Of particular significance is the case of Te Kotahitanga, a professional development programme designed by Maori research leaders[15] to reduce disparity in educational outcomes for Maori students. In New Zealand, Maori have a treaty relationship with the Crown that guarantees them the same educational opportunities as non-Maori. As the published BESs make clear, however, there are decades of evidence of inequitable teaching of Maori learners (fewer teacher interactions, less positive feedback, underassessment of capability, mispronounced names and so on)[16]. New Zealand also has a history of failed attempts to address through professional development this under-serving of Maori in English-medium education. This failure has been notably documented by Cazden[17].

---

[15]   Bishop, R., Berryman, M., Cavanagh, T, Teddy, L., & Clapham S. (2006). Te Kotahitanga Phase 3 *Whakawhanaungatanga: Establishing a culturally responsive pedagogy of relations in mainstream secondary school classrooms.* Report to the Ministry of Education. http://www.educationcounts.govt.nz/publications/series/9977/9454 See also *Timperley, H., Wilson, A., Barrar, H & Fung, I. (2007) Teacher professional learning and development (Schooling): Best evidence synthesis iteration.* Wellington: Ministry of Education. *http://www.educationcounts.govt.nz/goto/BES* (pp. 259-264).

[16]   Alton-Lee, A. (2003). *Quality Teaching for Diverse Students in Schooling: Best Evidence Synthesis.* Wellington: Ministry of Education.

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

Te Kotahitanga is designed to support teachers to strengthen their relationships with Maori students and has a cross-curricular focus across the first two years of secondary school. Teachers are supported to reflect critically on the assumptions they make about their relationships and interactions with Maori students and to interrogate their own roles in perpetuating low academic achievement, high rates of suspension and high absenteeism. Participating teachers engage in an interactive coaching strategy using an Effective Teaching Profile (ETP) tool in their classrooms. As Te Kotahitanga teachers have become more proficient in their use of the ETP, Maori students have improved in numeracy and literacy and on an assessment of essential skills.

Longitudinal follow-up has been the strongest evidence of this professional development succeeding in a way most critical for students. There were much improved results of participating students in the New Zealand Certificate of Educational Attainment (NCEA) a year after the two year intervention with their teachers. In 2005, just 32.1% of Maori students had gained NCEA level 1 but in 2006, almost half the Maori students in Te Kotahitanga schools did. Effectiveness varied across schools, with one raising the NCEA level 1 pass rate for Maori students from 19% to 64%. The gains were substantial not only when compared with previous records of student achievement but also when compared with a matched national cohort.

The research and professional development team was responsible for implementing the programme in participating schools. Some members of this team acted as regional coordinators, providing in-school support for facilitation teams, who then provided professional development for participating teachers.

In March 2005, following a two-week visit to the Te Kotahitanga project team and participating schools, Emeritus Professor Christine Sleeter, then Vice-President of the American Educational Research Association's Division K (Teaching and Teacher Education), said:

> I see more potential to make significant and sustained improvements in schools for students from historically underserved communities in this project than in any other project that I have had contact with.[18]

This project has exemplified a cyclical research and development approach, in which the lessons learned from each of four implementation phases successively informed improvements in the model. For example, strengthened practice in the facilitation and leadership of change processes within the schools. Through successive phases, Te Kotahitanga has now been made available to 33 schools. The challenge for New Zealand is to extend the reach of this programme to meet the need across many more schools.

Coburn's[19] *Rethinking scale: Moving beyond numbers to deep and lasting change* provides a useful caution. In the light of the failure of so many reforms to lead to lasting improvements in classroom practice, Coburn identifies four dimensions of scaling up that need attention: depth, sustainability, spread, and shifting reform ownership to the schools. Cordingley and Bell[20] have extended Coburn's framework to remind policy makers that, whenever scaling up a professional development reform, it is important to keep goals and purposes to the fore. Perhaps where we most need knowledge is in the area of how to provide ready access to effective professional development in ways that will energize and support teachers to strengthen practice.

In New Zealand, as elsewhere, we have been monitoring achievement in literacy, mathematics and science at the national level. For over a decade, we have seen marked disparities persist

---

[18] Personal communication with Professor Russell Bishop, Project Director, March 28, 2005.

[19] Coburn, C. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, 32(6), 3-12.

[20] Cordingley, P., & Bell, M. (2007). Transferring learning and taking innovation to scale. Centre for the Use of Research Evidence in Education. Thinkpiece prepared for The Innovation Unit. www.innovation-unit.co.uk

for Maori and Pasifika students in reading literacy, an area in which there has been a range of professional development available to schools and examples of relatively high impact reported, but no national provision of effective professional development.

There were significant decreases in disparities for middle primary students in the 1998/2002 TIMSS data in mathematics and science when measured against the 1994 data, which had revealed New Zealand's national performance to be below the international mean. The indices for disparity between Pakeha (those of European heritage) and Maori have decreased from −.66 and −.57 to -.26 across the three TIMSS studies and the indices for disparity between Pakeha and Pasifika have decreased from −.81 and −.86 to −.41)[21].

We do not have the evaluative data to explain these reductions in disparity. However, it is important to interrogate the relationship between policy and system improvement. One hypothesis is that the policy shift arose as a result of the implementation of the advice of the Mathematics and Science Taskforce, which in 1997 was responsible for increasing the investment in professional development. The professional development was targeted at year 4 mathematics and at science education (building on a body of research and development generated by one of New Zealand's most significant R & D projects in education: the Learning in Science Project).

Since 2000 there has been a progressive national professional development programme in numeracy in New Zealand informed by ongoing research and development in both English and Maori medium. The PD has involved over 690,000 students and 27,000 teachers from years 1 to 10. The Numeracy Development Project provides an infrastructure of facilitators and lead teachers within schools who support teachers to assess student knowledge using a Number Framework and a diagnostic interview and also model effective mathematics teaching in classrooms. A strategic approach has been taken to developing a national learning community across schools, policy, research, pre-service and in-service teacher education sectors, and a government publishing organisation to support sustainable development (see Figure 4).

The research and development that originally informed the programme was carried out in Australia for years 1–3 (K–2). From these beginnings, New Zealand has followed a strategy of involving the research and teacher education communities in a process of continuous R & D and has extended the initiative through to year 10. Teachers record student progress on a national, closed website. To date there have been 17 evaluation and research reports and three compendia made available to schools. The 2007 year 9 data gave overall effect sizes for the multiplicative domain of .52 with a decile-related range from .38 to .56. Where principals have participated in the professional learning, student achievement has been higher.

---

[21]   Ref needed

Improving the Quality of Mathematics Teaching: Issues of Depth in a National Professional Development Initiative

Ro Parsons (Ministry of Education) and Joanna Higgins (Victoria University of Wellington) - Poster presentation, AERA 2008 Annual Meeting, New York City. Communications: joanna.higgins@vuw.ac.nz
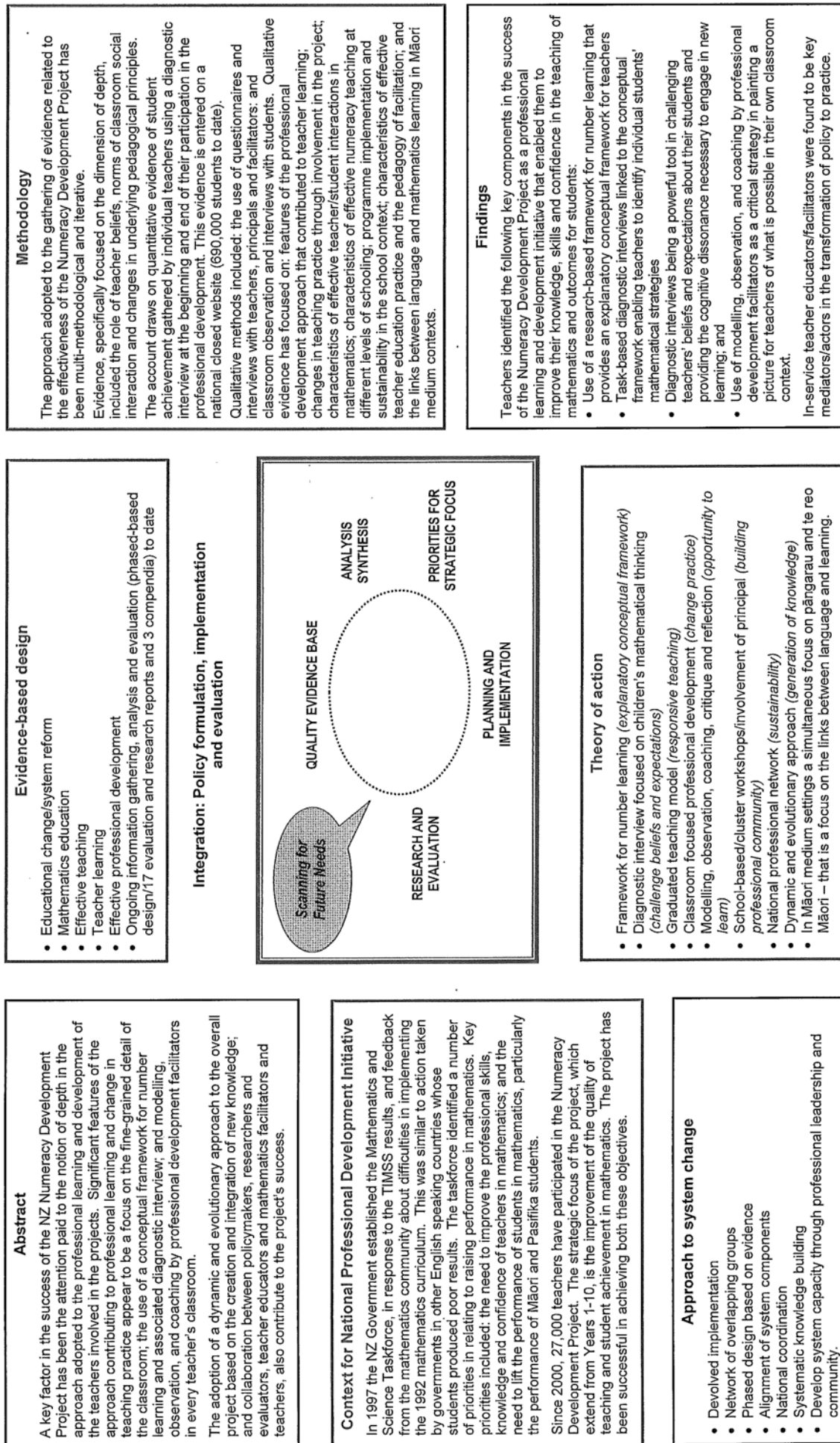
Abstract

A key factor in the success of the NZ Numeracy Development Project has been the attention paid to the notion of depth in the approach adopted to the professional learning and development of the teachers involved in the projects. Significant features of the approach contributing to professional learning and change in teaching practice appear to be a focus on the fine-grained detail of the classroom; the use of a conceptual framework for number learning and associated diagnostic interview; and modelling, observation, and coaching by professional development facilitators in every teacher's classroom.

The adoption of a dynamic and evolutionary approach to the overall project based on the creation and integration of new knowledge; and collaboration between policymakers, researchers and evaluators, teacher educators and mathematics facilitators and teachers, also contribute to the project's success.

Context for National Professional Development Initiative

In 1997 the NZ Government established the Mathematics and Science Taskforce, in response to the TIMSS results, and feedback from the mathematics community about difficulties in implementing the 1992 mathematics curriculum. This was similar to action taken by governments in other English speaking countries whose students produced poor results. The taskforce identified a number of priorities in relating to raising performance in mathematics. Key priorities included: the need to improve the professional skills, knowledge and confidence of teachers in mathematics; and the need to lift the performance of students in mathematics, particularly the performance of Māori and Pasifika students.

Since 2000, 27,000 teachers have participated in the Numeracy Development Project. The strategic focus of the project, which extend from Years 1-10, is the improvement of the quality of teaching and student achievement in mathematics. The project has been successful in achieving both these objectives.

Approach to system change

- Devolved implementation
- Network of overlapping groups
- Phased design based on evidence
- Alignment of system components
- National coordination
- Systematic knowledge building
- Develop system capacity through professional leadership and community.

Evidence-based design

- Educational change/system reform
- Mathematics education
- Effective teaching
- Teacher learning
- Effective professional development
- Ongoing information gathering, analysis and evaluation (phased-based design/17 evaluation and research reports and 3 compendia) to date

Integration: Policy formulation, implementation and evaluation

QUALITY EVIDENCE BASE

Scanning for Future Needs

ANALYSIS SYNTHESIS

PRIORITIES FOR STRATEGIC FOCUS

PLANNING AND IMPLEMENTATION

RESEARCH AND EVALUATION

Theory of action

- Framework for number learning (*explanatory conceptual framework*)
- Diagnostic interview focused on children's mathematical thinking (*challenge beliefs and expectations*)
- Graduated teaching model (*responsive teaching*)
- Classroom focused professional development (*change practice*)
- Modelling, observation, coaching, critique and reflection (*opportunity to learn*)
- School-based/cluster workshops/involvement of principal (*building professional community*)
- National professional network (*sustainability*)
- Dynamic and evolutionary approach (*generation of knowledge*)
- In Māori medium settings a simultaneous focus on pāngarau and te reo Māori – that is a focus on the links between language and learning.

Methodology

The approach adopted to the gathering of evidence related to the effectiveness of the Numeracy Development Project has been multi-methodological and iterative.

Evidence, specifically focused on the dimension of depth, included the role of teacher beliefs, norms of classroom social interaction and changes in underlying pedagogical principles.

The account draws on quantitative evidence of student achievement gathered by individual teachers using a diagnostic interview at the beginning and end of their participation in the professional development. This evidence is entered on a national closed website (690,000 students to date).

Qualitative methods included: the use of questionnaires and interviews with teachers, principals and facilitators; and classroom observation and interviews with students. Qualitative evidence has focused on: features of the professional development approach that contributed to teacher learning; changes in teaching practice through involvement in the project; characteristics of effective teacher/student interactions in mathematics; characteristics of effective numeracy teaching at different levels of schooling; programme implementation and sustainability in the school context; characteristics of effective teacher education practice and the pedagogy of facilitation; and the links between language and mathematics learning in Māori medium contexts.

Findings

Teachers identified the following key components in the success of the Numeracy Development Project as a professional learning and development initiative that enabled them to improve their knowledge, skills and confidence in the teaching of mathematics and outcomes for students:

- Use of a research-based framework for number learning that provides an explanatory conceptual framework for teachers
- Task-based diagnostic interviews linked to the conceptual framework enabling teachers to identify individual students' mathematical strategies
- Diagnostic interviews being a powerful tool in challenging teachers' beliefs and expectations about their students and providing the cognitive dissonance necessary to engage in new learning; and
- Use of modelling, observation, and coaching by professional development facilitators as a critical strategy in painting a picture for teachers of what is possible in their own classroom context.

In-service teacher educators/facilitators were found to be key mediators/actors in the transformation of policy to practice.

Figure 4. Improving the Quality of Mathematics Teaching: Issues of Depth in a National Professional Development Initiative

In the English context, the growing evidence[22] for the importance of effective teacher professional learning has led to a policy commitment to fund a school-based Masters of Teaching and Learning with piloting in late 2009. This is seen as a supported pathway to continued professional learning. Given the evidence about the impact that effective, student-outcomes-focused professional development can have, systemic reform of this magnitude has the potential to grow the capabilities necessary for transforming schools in the ways that are required. In the section that follows, I highlight the importance for policy of showing how professional development, when informed by continuing cycles of collaborative research and development, can bring about innovative, productive, sustainable systemic transformation in education.

Strategic Research and Development: a Resource for Policy
This section focuses on two professional development programmes for which there is evidence of very high impacts on student learning, achieved within relatively short time timeframes. Both these programmes provided and developed external expertise to support professional development that is consistent with all ten findings of the *Teacher Professional Learning and development BES.* Both were underpinned by decades of R & D. Both involved a cyclical model of R & D in which researchers, teacher educators, curriculum developers and practitioners collaborated across sites. But before considering the nature of these exemplary approaches, I highlight the problematic status of R & D in education.

One of the premises of the Iterative Best Evidence Synthesis Programme is that R & D, when focused on strengthening valued student outcomes, is a critical resource for supporting transformation of practice on the scale needed. The BESs themselves provide overviews of effective R & D, but in the absence of an evolving R & D function to support the conditions for effective teacher professional learning, such knowledge is unable to act as a catalyst for deep change. Some countries have strategically funded educational R & D; others have taken other paths to improving education. A 2003 OECD report[23] identified the relatively low proportion of funding afforded educational R & D—and the challenges this raises for knowledge societies:

> *A rough estimate of the level of educational R & D as a percentage of total expenditure on education is on average less than 0.3% in six countries for which data are available. This is a very small figure when education is compared with other knowledge sectors, for example, the health sector where between 5–10% of the total health expenditure in public and private sectors is directed to R & D (p. 11).*

In 2007, the Director of OECD's Centre for Educational Research and Innovation reported[24]:

> *The issues of effective relationships between research and policy makers, capacity building within those domains, and the importance of allocating scarce resources in the most efficacious manner remain as important as they were ten years ago* (p. 3).

The issue of scarce resources is pertinent here because some of the activities that fall under OECD definitions of R & D will be too expensive for some jurisdictions. Also, much R & D will not deliver benefits in terms of student outcomes. Accordingly, I put the case for policy to fund strategic R & D that will contribute to effective, sustainable teacher professional learning and promote valued outcomes and/or address compelling policy issues.

The two examples of professional R & D that I now bring to your attention have both been used and evaluated in a variety of countries and have both provided evidence of sustainability in classroom practice. I have chosen these examples because they can also help meet several of the policy needs and answer some of the problems of practice that currently exercise us in

---

[22]   See www.curee.co.uk for the series of systematic reviews on Continuing Professional Development (CPD) by the Centre for the Use of Research Evidence in Education, Coventry.
[23]   OECD (2003). Knowledge management: New challenges for educational research. Paris: OECD.
[24]   OECD (2007). Knowledge management: Evidence in education linking research and policy. Paris: CERI, OECD. www.sourceoecd.org/education/9789264033665

New Zealand and, I know, elsewhere. Such challenges can occasion superficial policy responses. These R & D programmes have between them provided a range of evidence concerning interventions that:

1. strengthen multiple valued outcomes for all students including conceptual knowledge, higher-order thinking, problem solving, creative thinking, active use of language, symbols and text and self-management competencies;
2. use developmentally appropriate pedagogy to engage, retain and motivate rather than disaffect diverse students at middle school level;
3. support classroom management and teaching practices that produce collaborative and respectful engagement and social cohesion rather than exacerbating exclusive, racist, bullying and alienating peer cultures;
4. address the importance of the value of ecological sustainability.

Project FAST (Foundational Approaches to Science Teaching)

The writers of the *Teacher Professional Learning and Development BES* found a 2.85 effect size gain in students' achievement a year after their teachers had received professional development in Project FAST (Foundational Approaches to Science Teaching)[25]. For decades, evaluations of this professional development project have shown that the outcomes—scientific knowledge, thinking skills, higher-order thinking, and creativity—of students of participating teachers are significantly greater than those of students from comparison groups. The project has repeatedly been accorded exemplary status in US reviews.

Project Fast is an inquiry-based, interdisciplinary approach to science education, embracing physical science, ecology, and relational study (for example, resource management, technology, air pollution, water resource management, world food production, and humans in the environment). The approach is specifically designed to address the developmental needs of middle school students (12- to 15-year-olds) and to produce equitable learning opportunities. Teachers are required to develop their students' capacity to learn collaboratively and cooperatively.

The programme and associated curriculum materials have been informed by R & D carried out by the Curriculum, Research and Development Group at the University of Hawai'i since 1966. Yamamoto[26] has provided an account of the collaborative processes of research, development, trial and evaluation used by the Project Fast developers as they have worked alongside teachers in a laboratory school setting over the four decades. The magnitude of the impact of the Project Fast professional development reflects the value of the repeated cycles of R & D that have produced 'smart tools' and learning processes that are able to sustain an ongoing inquiry approach. The term 'smart tools' used here is informed by an analysis by Professor Viviane Robinson (lead author of the forthcoming *Leadership BES*[27]) that explains how educational leadership can be exercised through the development of 'smart tools; that are 'fit for purpose' and informed by sound evidence and theories.

Teachers involved in Project Fast are not given access to curriculum materials until they have participated in an intensive professional development experience with continuing on-site coaching designed to integrate new learning and classroom practice: a 'participate to purchase' principle that builds teacher capability. The instructional materials include teacher and student guides that help scaffold the FAST inquiry approach and reference resources.

---

[25] A range of FAST studies is considered in Timperley, H., Wilson, A., Barrar, H & Fung, I. (2007) *Teacher professional learning and development (Schooling): Best evidence synthesis iteration.* Wellington: Ministry of Education. http://www.educationcounts.govt.nz/goto/BES For a range of source publications go to Curriculum Research and Development Group, University of Hawai'i. http://www.hawaii.edu/crdg/ For a quick overview see University of Hawaii (2002). Foundational approaches in science teaching (FAST). What works in the middle: Results-based staff development. J. Killion, National Staff Development Council. http://www.nsdc.org/connect/projects/resultsbased.cfm: 114-117.

[26] Yamamoto, K. (2007, March). *Against all odds: Tales of survival of the Foundational Approaches in Science Teaching (FAST) Project.* Paper presented at the Annual Meeting of the American Educational Research Association. Chicago, IL.

[27] Robinson, V., Hohepa, M., & Lloyd, C. (forthcoming), *Educational leadership: Best evidence synthesis iteration.* Wellington: Ministry of Education. http://www.educationcounts.govt.nz/goto/BES

By 2001, the professional development programme had been used in 11 countries, in a range of languages including Braille, and across 36 states in the US. This cumulative R & D provides a valuable foundation for education systems elsewhere—not to simply copy, but to adapt, trial, and further develop in ways that are responsive to the local context.

Complex Instruction: Working for Equity in Heterogeneous Classrooms

The writers of the *Teacher Professional Learning and Development BES* found a 1.06 effect for students' achievement four months after their teachers had received professional development in Complex Instruction (CI)[28].

CI is a R & D programme that was initiated by Elizabeth Cohen with Rachel Lotan at Stanford University in 1979. Cohen drew on sociological and organisational theory to develop a strategy for equitable instruction that would foster higher-order thinking in high and low achievers. Teachers are supported to use the theory to foster small-group approaches. Students are trained to value the contributions of each group member, to be accountable, and to manage cognitive dissonance constructively. Students learn to use each other as learning resources, thereby multiplying the supports available to each. Teachers are trained to use specific strategies that enhance the role of low-status students, to the benefit of both high and low achievers.

A longstanding literature affirms the effectiveness of well-designed and managed co-operative groups. CI complements an engineering approach to groupwork with well-designed curricular materials that focus on big ideas and a problem-solving approach. CI strengthens teacher pedagogical content knowledge through the use of multiple-ability curricular resources consisting of carefully designed and evaluated group tasks. The collaborative R & D process draws on a wide range of subject matter, research expertise, and community funds of knowledge to develop effective tasks.

Bilingual instructions support the engagement of students whose first languages are English or Spanish while also creating a learning environment that is supportive of students who speak other first languages. Neves[29] found that, in CI, increased proficiency in English was associated with more frequent use by students of their first language, Spanish

Early studies showed positive correlations between increased rates of student talking and working together and student gains on standardised tests of mathematics, as well as on social studies tests[30]. Cohen et al.[31] published evidence gathered over a 12-year period that the students of CI-trained teachers achieved more highly on standardised tests and unit tests in social studies, science, and mathematics at both elementary and middle school levels.

Filby[32] attributed the sustained use of CI by teachers in Arizona not only to improved achievement outcomes but to such other outcomes such as improved motivation and reduced problems with discipline and truancy.

The cycles of R & D used in CI have informed the quality and effectiveness of the approach at both the classroom and professional development levels. Like Project Fast, CI has generated

[28] A range of Complex Instruction studies **is** considered in Timperley, H., Wilson, A., Barrar, H & Fung, I. (2007) Teacher professional learning and development (Schooling): Best evidence synthesis iteration. *Wellington: Ministry of Education.* http://www.educationcounts.govt.nz/goto/BES For a range of source publication**s** go to www.**stanford**.edu/group/pci/

[29] Neves, ,H. A. (2007). The relationship of talk and status to second language acquisition of young children. E. Cohen & R. Lotan (Eds.). *Working for equity in heterogeneous classrooms: Sociological theory in practice.* New York & London: Teachers College Press.

[30] Cohen, E., Lotan, R., & Hothuis, N. (1997). Organising the classroom for learning. In E. Cohen & R. Lotan (Eds.). *Working for equity in heterogeneous classrooms: Sociological theory in practice.* New York & London: Teachers College Press.

[31] Cohen, E., Bianchini, J., Cossey, R., Holthuis, N., Morphew, C., & Whitcomb, J. What did students learn? 1982-1994. In E. Cohen & R. Lotan (Eds.). *Working for equity in heterogeneous classrooms: Sociological theory in practice.* New York & London: Teachers College Press.

[32] Filby, N. (1997). A viewpoint on dissemination. In E. Cohen & R. Lotan (Eds.). *Working for equity in heterogeneous classrooms: Sociological theory in practice.* New York & London: Teachers College Press.

an array of 'smart tools' to support its effective use. CI has been used in the US, Canada, Europe and Israel.

Research and Development Underpinning Effective Professional Learning

The evidence and examples given in this paper highlight the contribution that R & D can make to creating and supporting effective, sustainable teacher professional development.

Too often, the cycles of R & D that create the conditions for effective PD are invisible because, in their publishing, researchers focus on the classroom and teacher learning, not the conditions for reform that their contributions create. My analysis in this paper has only been indicative: a systematic study of effective R & D programmes, judged by their impact on student outcomes and the extent to which they inform scaling-up, would be a valuable policy resource.

This paper makes the case for cyclical R & D as a context for designing and supporting effective professional development that can enable us to meet new educational challenges. While the educational leaders in our schools and teacher educators can accomplish much, ongoing R & D is needed if we are to generate the conditions that will sustain and support efforts to embed a productive inquiry approach to educational development. Further, such R & D is critical for informing effective pre-service teacher education.

In policy jurisdictions where market models, political exigencies, financial constraints, reward hierarchies in tertiary institutions[33], and an enduring belief that teaching is a craft practice are powerful influences on decision making, the case for investment in educational R & D is not self-evident.

The question I am most often asked by policy workers is 'What is your definition of R & D?' In a 1995 OECD report[34] that addressed itself to this question, the authors helpfully explained: 'The problems of inclusion and exclusion encountered in defining R & D derive from the same problems that beset the effort to define education' (p. 37).

Current definitions of R & D have typically failed to signal its cyclical inquiry nature, leading to the suggestion that the term RDD & U[35] (research and development, dissemination and utilization) be used instead. In this paper, I highlight the value of integrating R & D and teacher professional development.

To strengthen the policy case for investment in effective professional development underpinned by R & D, rather than provide a general definition, it may be more helpful to develop a set of criteria for use when making policy and funding decisions. The list of criteria provided in Appendix A is indicative and calls for more systematic attention to the nature, characteristics and potential value of strategic R & D in education.

In concluding this paper, I suggest that, in the interests of our children and our future, we build upon and fund the kind of educational R & D that generates and supports effective professional development. There is good evidence that strategic R & D can make a significant contribution to effectively addressing educational policy problems.

Such R & D can be a transformative resource in creating schooling systems that enable teachers to better support diverse students to develop the capabilities to be lifelong learners who flourish in rapidly changing contexts.

---

[33]   Alton-Lee, A. *Improving education policy and practice through an Iterative Best Evidence Synthesis Programme.* Invited address to OECD-US Seminar, Evidenced-Based Policy Research, Washington DC, April 19-20, 2004 http://educationcounts.edcentre.govt.nz/goto/BES Also at www.excelgov.org/usermedia/images/uploads/PDFs/OECD-Alton.pdf

[34]   *OECD (1995). Educational research and development: Trends issues and challenges. Paris: OECD.*

35 Filby, N. (1997). A viewpoint on dissemination. In E. Cohen & R. Lotan (Eds.). *Working for equity in heterogeneous classrooms: Sociological theory in practice.* New York & London: Teachers College Press.

Appendix A

Strategic Research and Development (R & D)
Creating the Conditions for the Effective Design and Support of
Professional Development in Education

Indicative criteria

1. Strengthens valued outcomes for diverse learners (including low and high achievers).
2. Is driven by a clearly articulated moral purpose.
3. Builds upon and informs bodies of evidence about what works in pedagogical practice.
4. Seeks to have a bigger positive impact for investment of time and resources.
5. Uses cumulative cycles of R & D and 'smart tools' to strengthen practice.
6. Embeds a collaborative, high-trust approach across policy, research, practice, teacher education, curriculum and resource development, and community funds of knowledge.
7. Creates a knowledgeable learning community and models a professional inquiry approach.
8. Ensures effective professional development is integral to dissemination and use.
9. Develops synergies at multiple levels of the system, including initial teacher education.
10. Continues to evolve in innovative ways that are responsive to new challenges and valued by teachers.