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STEPPING FORWARD IN PRIMARY MATHEMATICS WITH PRIME™

EVALUATING **SCHOLASTIC PRIME MATHEMATICS** IN NEW ZEALAND SCHOOLS ON FIVE COUNTS

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LESTER FLOCKTON, PHD

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EVALUATING

SCHOLASTIC

PRIME™

Mathematics

IN NEW ZEALAND SCHOOLS ON FIVE COUNTS

Learning & Progress

Teacher Capability

Curricular Content & Standards

Programme Design

Classroom Manageability

Stepping Forward in Primary Mathematics with PRIME: Evaluating PRIME Mathematics in New Zealand Schools

By Lester Flockton

This evaluation follows two earlier New Zealand reviews of PRIME Mathematics. The first involved an analysis of the linkages between the PRIME programme and the New Zealand Curriculum *(PRIME Mathematics in the New Zealand Context: Analysis of Linkages).* The second review, *(The PRIME Mathematics Experience: A Review of New Zealand Schools' Early Response to Scholastic PRIME Mathematics*, published May 2015) examined the suitability and effectiveness of the programme from the perspective of practising teachers. Both of these reviews gave reason for considerable confidence across a number of key indicators. They showed that PRIME could prove to be an attractive and dependable alternative to the Numeracy Project. This is particularly true when PRIME is used as the base programme rather than as supplementary to another programme such as the Numeracy Project.

This third independent review has been carried out as part of Scholastic Publisher's commitment to obtaining insightful feedback from those who have chosen to step forward in improving their mathematics programmes in ways that lead to better outcomes for students and more satisfying teaching for teachers. All mathematics programmes, whether new and innovative, such as PRIME, or those that have been around for a while, should be independently evaluated from time to time so that any strengths and weaknesses can be properly and publicly recognised and responded to. Moreover, all such reviews should give particular weight to feedback from a cross section of practising teachers. Scholastic actively and eagerly seeks such feedback, and is proving particularly responsive to any matters raised by teachers.

The PRIME Mathematics Programme

PRIME was developed in Singapore for the Primary grades. Unlike the traditional textbook and the kind of teaching typically associated with textbooks, PRIME is better described as a 'text-based' or 'book-based' programme. This is quite different from the typical textbook approach. It is designed to combine best practice pedagogy with recognition of how learning actually happens among diverse learners. In the Singaporean classroom, for example, group work, working in pairs, and the use of concrete materials are common to the PRIME approach.

The PRIME programme supports students to progressively develop concepts and master skills through systematic spiraling of content with constant rewinding and reinforcement of previous learning. Teachers are able to use a variety of contexts that are meaningful and relevant to their students without the need to constantly search out and build up teaching resources. Significantly, when following the PRIME programme, teachers own mathematical understandings, knowledge and teaching strategies are strengthened and developed in ways that build professional confidence and capability.

Why an alternative mathematics programme for New Zealand schools, students and teachers

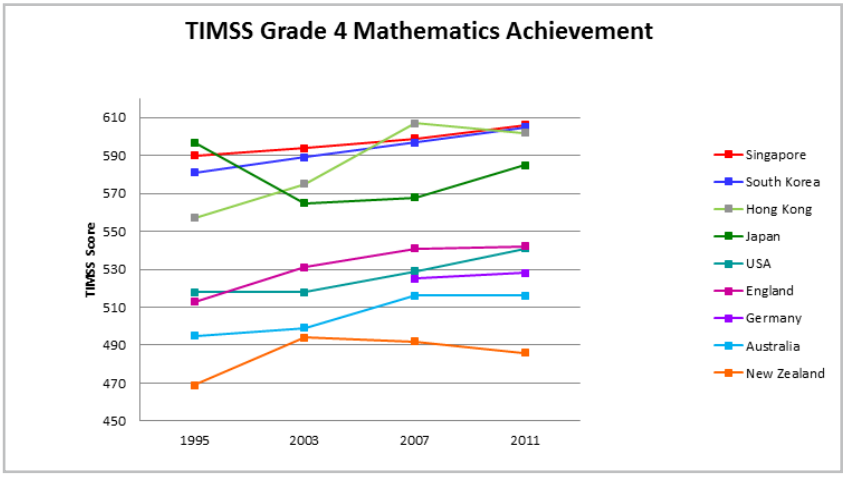
Over the past decade or so, New Zealand schools have used the Numeracy Project as their mathematics programme. Most have incorrectly assumed that this particular programme, developed and promoted by the Ministry of Education and its consultants, is mandatory, but clearly it is not. Over the years of the Numeracy Project, the absence of an attractive alternative programme has undoubtedly contributed to this misunderstanding. That situation has now changed.

Understandably, the Ministry's Numeracy Project has had some appeal because its resources have been largely cost-free in terms. Increasingly, however, many schools are recognizing other essential criteria that should determine the choice of their mathematics programme, including how well it results in growth of student achievement, and how effectively and consistently it can be taught and managed by all teachers regardless of their mathematical aptitude or experience. They view cost as having many dimensions, such as time required to find, download, print, and organize resources, time to work out day-to-day programmes, and time to attend courses. Clearly, cost is much more than dollars and cents.

Then there is the cost to students' learning and progress. If a programme is not producing expected results, then this is a negative cost at the expense of student achievement. As one school principal has observed, the Year 4 results from the TIMSS international survey between 1995 and 2011 show that while the results of top performing countries have been going up, New Zealand's results have declined. Significantly, that decline coincides with the introduction and implementation of the Numeracy Project. Likewise,

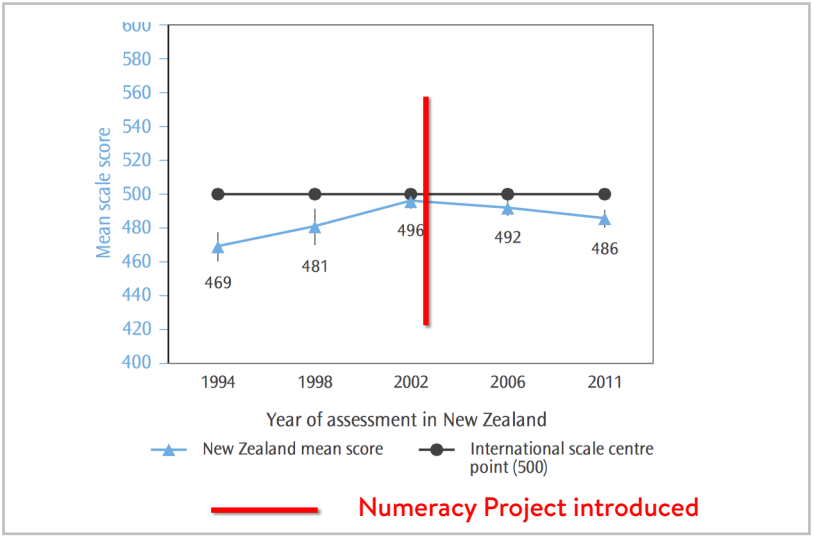
repeated assessments by the National Education Monitoring Project, which specifically included Numeracy Project tasks, have shown little if any improvement over successive cycles.

Figure 1: TIMSS Grade 4 Mathematics Achievement



Scholastic Australia. (2016). Retrieved from http://au.scholastic.com/en/scholastic-prime-mathematics/prime-maths-proven-best-practices

Figure 2: Trends in New Zealand Year 5 mathematics achievement, 1994/95–2010/11



Chamberlain, M., & Caygill, R. (2013). *Key findings from New Zealand's participation in the Progress in International Reading Literacy Study (PIRLS) and Trends in International Mathematics and Science Study (TIMSS) in 2010/2011.* Wellington, New Zealand: *Comparative Education Research Unit, Research Division, Ministry of Education.*

Serious concerns with the outcomes of the Ministry of Education Numeracy Project have been widely aired in the media. For example:

"A $70 million dollar maths-teaching programme is holding New Zealand children back from developing their mathematical skills, according to a new report.

The New Zealand Initiative found the Numeracy Project, which changed the way maths was taught across most primary schools 15 years ago, led to deteriorating performance in young pupils."

One News, 4 June 2015

Commenting on an OECD report showing New Zealand's decline from 12th to 23rd in maths from 2001 to 2012, Chris Hipkins (Labour Education Spokesman) said:

"The fact that is it such a significant decline is something that we should really wake up and pay attention to."

NZ Herald, 3 December 2013

Mathematics experts have also admitted that the Numeracy Project is contributing to poor mathematics achievement among too many New Zealand children.

"Associate Professor Vince Wright, who ran a national project to reform maths teaching for 10 years, admitted that the poor performance of New Zealand students in national and international testing over the last decade had caused 'a lot of soul searching' in maths education circles.

Critics – including many private maths tutors and the country's foremost mathematician, Sir Vaughan Jones – have blamed new teaching methods that encourage children to use a range of strategies instead of traditional calculations to solve real-life problems."

NZ Herald, 16 March 2013

Some have simplified the issue of poor performance by attributing it to lack of mathematics knowledge among many primary teachers. Paradoxically, a core focus of the Numeracy Project was to address this very concern, yet the evidence suggests that, on its own, it has not resolved the problem.

"The focus of the Numeracy Project is to improve student performance in mathematics through improving the professional capability of teachers".

Ministry of Education, 2004. The Number Framework: Teachers' material

Robust evaluation recognises that there are multiple reasons underlying unsatisfactory outcomes from the Numeracy Project. These reasons need to be properly identified, analysed and understood according to balanced criteria. Moreover, such criteria should apply to evaluations of all mathematics programmes, regardless of what they are or where they come from, including PRIME Mathematics.

The 5 Counts for judging the suitability and worth of primary mathematics programmes

The following five criteria provide the basis for this evaluation of PRIME Mathematics. These essential criteria that have strong validity for examining the performance and worthiness of all mathematics programmes, regardless of the approaches they use, their source, or their authorisation.

- Student learning & progress
- Teacher capability
- Curricular content & standards
- Programme design
- Classroom manageability

1. Student learning & progress

All students learn, but it is what they learn, how they learn, and the pace of their learning that is of concern to educators. Not all children need to learn all of the same content at the same time, and not all children will learn at the same pace. Some children can come to understandings of relatively complex concepts with comparative ease.

Others will struggle despite excellent teaching and resources. What does matter, is that learning is retained. For most, permanence or retention requires regular revisiting of previous learning along with plenty of practice and meaningful application. An over-crowded or poorly designed programme can seriously negate this basic principle of learning.

It is well known that for optimal learning, children's attitudes and strength of engagement are paramount. Both the programme and the teacher are critical factors in this regard. If content is too difficult, many children will be demotivated. The same can occur if it doesn't have a suitable element of challenge. The teacher has a vital role in ensuring the right balance. Likewise, children's engagement in learning will be enhanced when they see the relevance of what they are learning, and experience regular success from their efforts.

The terms of achievement and progress are commonly used to summate learning outcomes and consequently judge all of the associated inputs (programme, teaching, resources, etc.). They invariably denote measurement. However, we need to exercise caution in giving too much credence to single measures of the kind that some tests provide. They never tell the full story. There is no substitute for highly skilled overall professional judgment based on multiple observations and measures.

2. Teacher capability

New Zealand primary teachers are diverse in their talents, aptitudes and curricular skills. By definition they are generalist teachers even though some are specially qualified in particular areas such as mathematics, the arts, English, science or physical education. It would be unrealistic and inappropriate to expect all primary teachers to have special aptitude in mathematics, yet almost without exception all primary teachers teach mathematics – along with the 7 other major areas of the New Zealand Curriculum. Likewise, it would be simplistic to suggest that good mathematics teaching is assured when teachers have passed competency tests in mathematics, and that the result would be improved student achievement. It's not as easy as that.

Teacher professional learning and development, however, is as important to mathematics as it is to every other curriculum area. This requires an intelligent conception and approach to professional development that ensures

ensures every teacher is participating in opportunities to build and strengthen their curricular practice. One-off courses and occasional programmes have a place, but they also have distinct limitations in ensuring sustainable, ongoing learning for every teacher. An effective PLD programme will be sustainable, ongoing, affordable and accessible to every primary teacher. Moreover, it will be strongly context-based (with regards to needs of the teacher and fit with the school's programme) and economical in the time it consumes.

Consideration must also be given to effective and sustainable processes of inducting new teachers into the school's chosen mathematics programme, including those who have come to teach in New Zealand from other systems. Pre-service teacher training can only ever provide introductory preparation for classroom teaching. Teachers with no working knowledge of a particular mathematics programme need to be able to begin teaching the programme without waiting for an opportunity to attend a course. To overcome this important issue, teacher induction and ongoing development that gives confidence and capability to work with a particular programme needs to be largely built into the programme itself, rather than being separate from it. That is, teachers' professional learning grows as they work with such a programme because of the way its design and presentation intentionally guides their teaching.

3. Curricular content and standards

Mathematics is a universal language, so strong curricular commonalities from country to country are to be expected. All citizens, wherever they are, benefit from having confidence and skill in performing basic arithmetical processes, the part of mathematics referred to as numeracy. The fact that many of these processes can be performed on electronic devices is no good reason for every individual not to learn how to calculate, approximate, and transact with number. Numeracy has high utility for everyday living.

The New Zealand system, like many others, gives a certain priority to number in the primary years, while at the same time requiring that students be introduced to the wider scope of mathematics. So all students, from their earliest years, should also be developing concepts and understandings in algebra, geometry, measurement, and statistics. Some refer to this as 'strand' math.

It is the proper place of a curriculum to set out what should be learned at successive stages or levels of learning. In effect, these prescriptions are the standards, and students' progress through them according to their individual learning responses.

Curricular standards need to be realistically achievable and properly graduated from one level to the next. They should use commonly understood and widely accepted terminology and conventions rather than manufactured jargon.

It is the school's responsibility to decide how best to help students attain curricular standards. It is not the function of the curriculum to decree this. For example, a curriculum standard requiring a student to be able to calculate to reach a correct answer is just that. How they reach that answer is a matter of process, and good teaching will ensure that every student has an efficient and assured method for performing that process. Some students who are capable of cognitive agility and resourcefulness may be able to use multiple methods, but many others are better served by developing fluency and confidence with a single efficient method. At the primary stage, it is not defensible good practice to expect all students to learn and demonstrate multiple methods for reaching an answer or solving a problem. Indeed, such an expectation has been shown to seriously disrupt progress for many students.

4. Programme design

The national curriculum sets down expected content coverage. It does not provide a plan in terms of what classroom teachers should attempt to cover in their day-to-day programmes or how they should structure their lessons day-to-day, week-to-week. Yet the design of the classroom programme is vital to quality teaching and learning. It needs to step and balance learning content and coverage for the longer term (the school year). Short term planning (day to day, week to week) should be systematically connected to the longer term goals, with learning experiences constantly building on and reinforcing previous learning throughout the programme. A well-sequenced and connected plan is critical to progression of learning.

To expect individual teachers to construct and design programmes and plans within broadly stated frameworks and ensure strong learning connections within and across curricular content over the course of a year is unrealistic.

It risks uneven quality of programmes and teaching within a school, and at worst can become somewhat ad hoc. To avoid this, teachers need to be able to draw upon a programme that provides a good structure for teaching and learning for both the long and short term.

A well-designed mathematics programme will be suitably aligned to the curriculum and appropriately matched to the stages, needs and capabilities of different groups of children. It will recognise the importance of linking topics, the careful sequencing of content, and regular revisiting and practice of previous learning in association with new learning.

Above all, effective programme design will take full account of what we know about learning and how learning happens. We know that primary students typically progress their learning through concrete experience then pictorial representations before reaching a level of abstraction. We also know that not all children move through these stages at the same pace. Some need repeated small steps whereas others can progress with less repetition. Moreover, when children can connect what they are learning to their everyday lives, their learning is likely to make greater sense. Good programme design, therefore, allows for flexible choice of contexts within the topics that are being taught.

5. Classroom Manageability

Manageability includes the time required of teachers to plan and prepare their day-to-day maths programme. Planning and preparation are part and parcel of a teacher's work, but the amount of time taken for this is not necessarily directly linked to programme or teaching quality. Furthermore, the amount of time consumed in planning and preparing mathematics needs to be balanced against time that should be available for other areas if a meaningfully balanced curriculum is to be provided. It would be entirely inappropriate for maths planning and preparation to require an exorbitant amount of teacher time.

The resources that teachers require for delivering their maths programme should be generally accessible and not require constant internet searching, selecting, copying, printing worksheets, assembling, etc. Searching can be hit or miss, and the selected activities may not always tie in well with the essence of what is being learned and the focused practice it requires. Activities for the sake of activities are counter to good programme design

and delivery, and may do little to advance children's learning and progress towards important goals.

Good practice in New Zealand schools recognises the importance of differentiation in the delivery of programmes. Children are typically grouped according to capability, and provided with learning activities in which they can succeed and progress. Flexible grouping means that they are not necessarily locked into a particular group because of static organisation. Rather, they are grouped according to their response to particular topics. A good mathematics programme will be designed so that this can happen.

The five criteria explained above are consistent with those used in the previous PRIME review. What has changed, though, is that the schools involved in initial trialling of the programme have reached a more extensive working knowledge of its structure, content and approach. This is resulting in confidence to commit to adopting PRIME as their preferred programme, along with an increasing number of other schools.

Teachers' evaluation of PRIME Mathematics according to the 5 counts for judging the suitability and worth of a primary mathematics programme

This evaluation is drawn from comprehensive interviews with groups of teachers who are using PRIME as their sole mathematics programme.

Twenty-six teachers from eight schools took part in the inquiry. The majority of these teachers have been using PRIME for at least one year, and in some cases longer than that. Most had previously used the Numeracy Project programme for several years.

On a self-rating survey, 27 percent said they were highly confident in their mathematics knowledge and ability, while 73 per cent rated themselves as moderately confident. The year levels they taught spanned the full range from Year 2 to Year 8, with most teaching within the Year 2 to Year 6 range (the PRIME programme begins at Year 2). Years of teaching experience ranged from 2 to 30, and averaged at 12 years of experience.

The schools involved in this inquiry were in Auckland, Wellington, Hamilton, Taranaki, and Manawatu. Each of the Ministry of Education socio-economic decile bands (low, medium, high) was represented in the cross-section of participating schools, and roll sizes ranged from medium to high.

1. Student Learning

Attitudes, Engagement

When teachers were asked about students' attitudes towards PRIME and their engagement in learning through PRIME, without exception the feedback was positive and reassuring. The practice books have strong appeal for a number of reasons. They give students a sense of ownership over their learning and provide a constant source of feedback. The amount of written work compared to their previous maths programme is more focused and less demanding of recording skills, which means that more of maths time is relevant to actual learning and reinforcement of previous learning. Positive responses among students and high levels of engagement are common, which reflects growing confidence resulting from well-stepped learning progressions that are giving students feelings of success and achievement.

The practice books have wide appeal to students. Many are eager to show their parents what they are learning and how they are progressing, and the practice books hold all of that information together in a way that is uncomplicated, easy to follow and readily accessible.

A survey of student attitudes, engagement and efficacy in PRIME trial schools shows positive results. The survey was conducted at the end of a full year on PRIME.

	Agree	Do not agree
I usually do well in maths	100% (81% quite a lot or heaps)	0%
I am good at maths	99% (69% quite a lot or heaps)	1%
I think maths is interesting	90% (72% quite a lot or heaps)	10%
I like doing maths at school	93% (75% quite a lot or heaps)	7%
I learn useful things in maths	99% (86% quite a lot or heaps)	1%
We have class or group discussion about maths problems	92% (67% quite a lot or heaps)	8%
I can explain my way of solving maths problems	96% (62% quite a lot or heaps)	4%
I think about and do interesting maths problems	91% (73% quite a lot or heaps)	9%

The following examples of teachers' evaluative feedback are representative:

"All of my kids enjoy PRIME. They really like showing parents their PRIME books and their parents like this too. They can see what they are learning and how they are progressing."

"They ask if they can take their books home to show their parents. They are so proud of their achievements with PRIME."

"PRIME is very well suited to kids who don't find maths easy. It's visual and they don't have to labour with lot of recording, which means more time for more purposeful learning activity."

"They are eager to work in their practice books after teaching activities. They show that they are having a real sense of achievement, and they always want to show their parents the work they do in their workbooks. The work they are doing in their practice books is constantly giving evidence of what they can do."

"My kids love the practice books. The course books are colourful and clear."

"Initially the children were overjoyed, then they settled into a more serious and sober approach. Those who had not been very confident in maths started to show increasing confidence as they became familiar with the work they were doing and the approach being used, and with this their motivation also grew – they were wanting to learning more."

"My Year 2 children struggled with the course book, so instead of giving them that book, I present the material in ways that are easy for them to follow. But they do like using the practice books."

"Confidence has increased with PRIME. For example, they now see that they can solve harder problems than they thought they could do."

"They are fully engaged particularly since they are doing work according to what they can handle and they succeed with it. Student Voice (Five Talk Moves) has definitely increased."

"The thing is, with PRIME children are working with content that is within their capability – not too hard, not too easy. The balance is right."

Progress & Achievement

Teachers were asked about how they track student progress and the suitability of PRIME assessments for making National Standards judgments. Most are following good practice by constantly tracking students' learning through observation and checking their responses as they proceed through each chapter. As part of their day-to-day instructional practice they are building clear profiles of where each student is succeeding, where they might need further learning, how they are responding to feedback, and the pace at which they are able to learn and master new concepts and skills. This formative assessment is an inseparable part of how they are delivering the PRIME programme. The performance of students in PRIME's chapter reviews is also considered particularly helpful in summing up their learning at regular intervals. They show what students can do and what they understand as well as revealing any gaps in learning that need to be given further attention.

In each PRIME school, multiple sources of information are used for making summative judgments on progress and achievement. Additional to the assessments that are part of PRIME teaching, other checks variously include Individual Knowledge Assessment of Number (IKAN), Junior Assessment of Mathematics (JAM), Global Strategy Stage (GloSS), Progressive Achievement Tests (PAT), and e-asTTle. A number of teachers commented that IKAN, JAM, and GloSS are carry-overs from Numeracy Project assessments and that their continued relevance and use would need to be reviewed.

PRIME is providing a very good alternative analysis of student achievement and progress relevant to the New Zealand curriculum, and has the added attraction of greater manageability and efficiency of the assessment process. Regardless, all teachers see the value of having more than one source of assessment information as checkpoints for making their overall judgments. To this end, PRIME has developed sets of summative assessments directly aligned to the programme as well as The New Zealand Curriculum. Placement tests have also been made available to help teachers identify the appropriate text level for those students who are introduced to the programme partway through their primary years. Both of these developments are direct responses to recommendations made in the previous review of PRIME.

As part of this evaluation, an analysis of student achievement as variously measured and tracked using IKAN, GloSS, PAT, and e-asTTle showed that they had indeed made confident gains in their learning over the period of one year. With time, it will become possible to further gauge the strength and magnitude of progress by those students whose learning continues and consolidates with the PRIME programme through their primary years.

Teachers commented:

"The course work is assessed all the time – every day. We use PAT etc. to see if different sources of information are giving reasonably consistent results. If they are not, then we need to investigate why."

"The review section at the end of each chapter is valuable for monitoring progress over the range of content covered. They also spiral back so that checks can be made on retention of learning from previous chapters. This is really good."

"The chapter reviews are a very good diagnostic. They provide further information to our day-to-day teaching observations of any gaps in their learning."

"I've found that I've got more useful knowledge about what the kids have learned and where they need more attention through the chapter reviews and my teaching than from some of the tests we have to do. It's easier to do. You get a good sense of which children are confident, which kids are wobbly, what they can do, and what they might need more work on."

"We've found that already we are getting really good results using PRIME from our year 5 and 6 kids who have been using it just for a year."

National Standards

Making and reporting judgments on student achievement according to National Standards is a compulsory system requirement. Accordingly, there needs to be assurance that PRIME assessments provide a valid base of information for overall teacher judgments. Earlier PRIME reviews have already established that the content of PRIME is suitably aligned to the standards, so it stands to reason that a thorough programme of assessment (formative and summative) based around PRIME will be appropriate to the requirements of national standards judgments and reporting.

Teachers commented on their confidence in using PRIME assessments for this purpose, and the relative ease of making judgments.

"We don't have any issues or problems doing our National Standards judgments with PRIME. If anything, it is becoming easier because of the way we are now building up our knowledge of what our students can and cannot do."

"Using PRIME in conjunction with other measures makes it straightforward for making National Standards assessments. It's not difficult to do."

2. Teacher Capability

Some claim that teacher capability in respect of mathematical knowledge and skills is the single most important determinant of student achievement. Yet despite New Zealand's very considerable outlay in teacher professional training and development over the past several years, returns as measured by improved student progress and achievement in mathematics have been elusive. In this evaluation teacher capability it is regarded as *one among others* of the important determinants of student achievement, and therefore deserves recognition.

It is too early in the implementation stage of PRIME in New Zealand to gauge whether or not its approach to professional learning is superior, yet it is clearly showing promise. Why? Because the programme is designed so that teachers learn with their students as part of their day-by-day teaching. It is built into the programme as an integral part of the PRIME approach and the resources it provides.

PRIME provides well-pitched and paced guidance and support to teachers on the actual substance of what they are to teach and what students are expected to learn – concepts, processes, and skills. During this evaluation, teachers commented that as they work through the programme with their students, their own knowledge and confidence is strengthened or confirmed because of the way the material is structured and presented. There is no ambiguity. The pathway is clear and the structure is coherent.

"Maths processes are all very clearly explained and easy to follow. If I am not sure about something, I know I will be able to sort it out."

"The teachers' books are a great resource for those who might need to sharpen up on the maths they are teaching to kids. It's all there and it all fits together with what is being taught."

"PRIME gives you professional learning about maths processes, including effective problem solving strategies, algorithms, and especially how to get children to learn and understand place value. As a teacher, if you need support with these things, all of the support is there."

3. Curricular content & standards

Teachers are understandably concerned that the content of an alternative to their established maths programme is suitably aligned to The New Zealand Curriculum and meets requirements of National Standards. In the case of PRIME, that assurance has already been established. There is also a wish to ascertain the nature and extent of any significant pluses or minuses in PRIME compared to other programmes such as the Numeracy Project. After all, to switch from an established programme to another, the advantages need to outweigh any disadvantages across multiple considerations (the '5 Counts'), including those of curricular content and standards. Importantly, teachers will want to be satisfied that content is properly pitched to children's stages of learning, and that they are able to develop skill and confidence in performing math processes by following clearly understood methods and well practised strategies.

In terms of curricular content, feedback from classroom teachers using PRIME identified place value as a particular emphasis, with number values being explored and applied across all curricular areas (strands). It is widely recognised that understandings about the meaning of number and how number works in a variety of contexts is critical in developing confidence and facility with numeracy. Some mentioned that in working with PRIME they found that they needed to lift their expectations of what senior students could and should learn in areas such as fractions. Moreover, the students showed they were capable of responding to heightened expectations, much to the credit of how the learning is presented. Teachers also found the PRIME programme clearer and easier to follow than their previous programme because of the way it introduced and sequenced curricular goals.

"The emphasis on place value is consistent all the way through in PRIME, and furthermore it is woven into subsequent strand work, like showing number values in measurement."

"Place value is learned in a very logical way – so much better than how we previously went about it, and children really relate to it and understand it."

"Link between strands and number is a real plus in PRIME. We didn't get this with our previous programme."

"There is a lot of emphasis on learning and knowing basic facts."

"PRIME supports students to learn fractions especially well. There are specific and excellent ideas that are easy to follow for both teacher and student."

"The approach to problem solving is very effective. Students create and work through their own problems in PRIME. When it came to completing GloSS word problems, they were much more confident than previously."

"NP pushes children to thinking and computing numbers in their head; they are pushed towards imaging pretty early and a lot of our kids begin to slip and struggle from this point on. PRIME doesn't make this mistake. It is more realistic in understanding how to get kids to genuinely move forward and develop their numeracy skills."

4. Programme Design

Programme design is about how curriculum objectives and standards are 'packaged' for teaching and learning over the course of time. It needs to faithfully represent the curriculum, but it must also provide a structure that effectively supports teaching and learning.

The implications are considerable. For example, does the design ensure coverage of the curriculum in a way that leads to deep learning, and learning that has permanence? Does it step the learning, so that students can make smooth and confident progress from what they can already do, to what they cannot yet do? Does it make provision for ensuring that learning contexts are meaningful to students? Does it support both teacher and student to give and receive feedback? And, importantly, does it guide and support the teacher with his/her teaching? How effectively PRIME is proving to address design considerations such as these is central to a balanced evaluation of the programme.

This evaluation has shown that one of the distinctive virtues of PRIME is the careful choice and arrangement of content so that it introduces new learning by systematically building on previous learning. The coverage of content is patterned so that prerequisite to new learning is the reintroduction and reinforcement of content that students had previously encountered. Thus the design avoids the common pitfall of making assumptions that knowledge previously covered by students is still intact, and that new learning can proceed from where they left off. New knowledge, therefore, is introduced by revisiting what was previously learned, then proceeding from there. Teachers report that this inbuilt revision not only gives students confidence to progress to their next steps of learning; it also means that new learning is more readily understood.

Teachers noted that not only is PRIME well structured in its design, that it takes children forward in manageable steps, and that it gives ample opportunities for using contexts that are meaningful and relevant to particular groups of children, but it also facilitates good instructional feedback by the teacher, as well as providing the students self-generated feedback. This is supported because of the clarity with which the learning is presented, the models that are provided, and the practice items that allow reference back to those models.

Some children are capable of responding to approaches that allow them to be inventive or flexible in how they perform various numeric operations. While PRIME does not preclude this approach from being used by students who are capable of it, priority is given to ensuring that all students are proficient in performing a consistent method that will give them the confidence to successfully perform the operation with accuracy across a range of applications. Competence with functional numeracy is an important responsibility of maths teaching, and PRIME's approach recognises this.

Another of the significant features of PRIME's design identified in this evaluation is the consideration it gives to supporting teachers with their teaching. Teachers, regardless of their personal maths expertise or aptitude, can confidently enter and follow the programme content without dependence on external induction and training workshops. They say that this is because it is presented and structured in a way that allows them to acquire good understandings of the instructional goals, the instructional content and the steps for working towards the goals. This gives teachers confidence in their teaching and assurance that what they are teaching it, and the way they are teaching, is pedagogically sound in leading to expected student outcomes.

"Learning progressions are very clear in PRIME. You get a very good understanding of the steps that students are advancing through and how each step builds on and reinforces previous steps. Everything 'fits together'. "

"The coverage and integration of strand maths is much better than it was with our previous programme. I love that integration of number into the strands. It has context, and children can see the integration for themselves. It makes such good sense."

"Regrouping and number bonds are done really well."

"There are lots of problem solving, and plenty of opportunities for creating problems. The children get to use what they have been learning in a variety of problem-solving examples. When they did GloSS they showed that they were much more confident with problems and their achievement was better."

"With PRIME there is no risk of children missing sections of their learning of maths processes that could easily happen with our previous programme because of the way it is designed. There are no gaps. And there are lots of opportunities for children to support others."

"I love the idea of the course book. The entire programme fits together and holds together rather than being an assortment of stuff. This must be great for beginning teachers."

"I love the way it gets students to thoroughly learn one strategy. It's a real strength. Too many kids get confused when they have to try to do multiple strategies, and their progress suffers."

"I've found that we can do real life practical activities that fit easily within the PRIME approach. Measurement in PRIME, for example, gave me the opportunity to be very hands on – and having followed the guide initially, I now find that I can teach this confidently without having to go back to the book again for guidance. So it's not just kids learning – it's teachers too."

"With PRIME, children are becoming more comfortable with place value, algorithms, etc. We're not seeing so many gaps that get in the way of moving forward."

"The books are very pictorial. They're a great resource for the children, because they can look back to what they have previously learned if they want help to recall."

"The consistency or connectedness in the books is a particular strength."

"We don't need to think of number knowledge and strategy separately. They work together."

"The 'think about' examples give students the power to be the teacher. In PRIME, reading, writing and maths blend together."

"Although we are very early into the PRIME Programme, we have noticed that the students' maths language has improved. In the Senior School during our GloSS assessments we have observed that the students' place value knowledge (or retaining of it) made it easier for them to explain their strategies."

"There is a lot of support in the books – for teacher and student. It's amazing how the programme enables children to support other children."

"I would sum up the things that are more effective with PRIME than our previous programme as: maths language, retaining what they are learning, clearer understanding of strategies (e.g. for problem solving), the smooth integration of the maths strands with number, and its inclusiveness of student voice – the involvement, engagement and participation of students. They show 'can do' confidence rather than a 'can't do' attitude."

"We are finding that PRIME builds a really solid understanding of place value, giving students a broad base for strand work. We have students who are surprising themselves and saying things like, 'I didn't know I could do that without a calculator'. I think we are building mathematicians who will be able to hold their own in the years ahead."

5. Classroom Manageability

Teachers in this evaluation were clearly concerned that the content of PRIME and its approach should ensure best possible learning experiences and outcomes for their students. They were knowledgeable about the content of primary maths and clear in their expectations about the centrality of student achievement and the need to be able demonstrate that their students are making optimal progress. It was also clear from their feedback that these expectations and their teaching could be frustrated if a programme's design was not sufficiently appreciative of the importance of its classroom manageability. The programme itself needs to quite deliberately enable and support manageability.

By manageability, teachers were referring to such matters as organising the programme in ways that flexibly differentiate according to children's individual and varying learning needs and abilities. They were also particularly concerned that programme planning should ensure properly staged lessons in ways that eliminate possible risk to children's learning. Risks stemming from unskillsed planning include such factors as lack of clarity, irregular content coverage, insufficient rehearsal of previous learning, and ill-considered timing and pacing of coverage. To avoid such risks they were of the view that the programme itself should provide major teacher support for the structure and sequencing of content of successive lessons. They shared the view that this should not be left entirely to the teacher. The programme itself should be providing a clear structure for classroom planning.

The teachers also contended that planning should not be, to any degree, a 'hit and miss' affair because of the way a programme is designed, and not unduly arduous or disproportionately time hungry. The same applied to the time required for preparation of materials and resources for lessons. Moreover, they emphasised the value of students' records of their day-to-day work being easily managed and held together in a way that usefully contributes to tracking and making assessments of their progress, as well as supporting students' own reflections on their learning.

Teachers were asked to rate the amount of time they took to prepare for their maths lessons with PRIME on a 10 point scale, with 1 being a little and 10 being a lot. Almost all of the ratings were in the range of 2 to 4. When asked how this compared with the preparation time needed for their previous programme (Numeracy Project), all responded that it was considerably less. One teacher said that her planning time had been cut by about three-quarters. In deciding her rating, another teacher said, "All I have to think about is how I am going to teach, not what I am going to teach. And even then, the teaching and learning processes are so very clearly set out, consistent, and easy to follow. It's very teacher friendly." "My joy in teaching math is coming back," commented another.

"PRIME sets out the sequence and content for lessons, and any resources that are needed. It's all there. Clear, easy to follow and uncomplicated. This makes classroom planning so much more straightforward and it gives you confidence that your programme is on a sure footing and following along a well thought through path."

"With PRIME I no longer have to spend all of that time on the internet, downloading stuff, then going to the photocopying room, printing stuff off and putting it all together. This has really reduced that kind of workload, which means my time is better spent on what matters more in preparing for maths lessons."

"I like the way everything the students are learning and doing can be seen in their practice books, and it's all in sequence. It's great not have to manage all of those bits and pieces of paper into folders, etc. It gives me more confidence that we have good evidence of what they are learning and how they are doing."

"With PRIME, there is no issue with teaching materials and resources. Everything we need is already available."

"What you need for your planning is all in one place and you are not having to hunt around. The content of PRIME's programme has similarities to the Numeracy Project programme, but the learning steps seem smaller with lot more practice. It's so nice having it all in one spot. So much easier to plan, prepare and teach to."

"The PRIME books are not as wordy as some of the other material we have used, and the books are not as 'busy' as the Numeracy Project stuff, so you have real advantages of clarity and ease of following the programme, which is a major plus."

"The children like having their own book.They can write reflections in it and the teacher can comment too. What they are doing and learning is all in one place and children certainly enjoy talking about what they are doing and looking back in their books to see what they have already learned."

"In our planning we don't have to think about how to deal with how we go about number knowledge and strategies – in PRIME it's all there, and it does number very well."

"PRIME is a consistent programme with a flow to it. Themes and strategies are cyclically repeated, and the children can see this. I think it adds to their confidence and positive attitudes toward maths."

"With PRIME, it's all at your fingertips."

Conclusion

The teachers who contributed to this evaluation were both thorough and insightful in their feedback. Most were well qualified by knowledge and experience to make valid judgments about PRIME Mathematics. Understandably, those judgments drew on their experiences with the math programme they had previously used (commonly called the Numeracy Project). For many, that programme was the only one they had known, so their change to PRIME allowed them to think afresh. Moreover, it gave them the opportunity to critically evaluate the pros and cons of the respective programmes and to come to a point of preference. To help ensure a suitably objective and balanced critique, their evaluation was framed within the '5 Counts' used in this inquiry. An overall summation of their responses is that, while they acknowledged the undoubted worth of some features of their previously taught programme, PRIME more roundly satisfied expectations in regard to student learning and progress, curricular content and standards, teacher support, programme design, and classroom manageability. They were certainly encouraged by PRIME's responsiveness to their suggestions, such as the development of PRIME summative assessments and a resource that provides an initial induction into working with and organising PRIME in the classroom.

A recent OECD report, drawing on a wide pool of evidence, has given advice on the conditions that are associated with improvement of mathematics learning. One of their key statements is that schools should be given more freedom to decide what to teach and how they assess student progress. This, of course, requires responsible and well-informed decision-making by schools. They need to be assured not only that the programmes and approaches they choose to follow will lead to good practice and desired outcomes; they also need to be able to assure others of this. This evaluation shows that PRIME Mathematics gives such assurances.

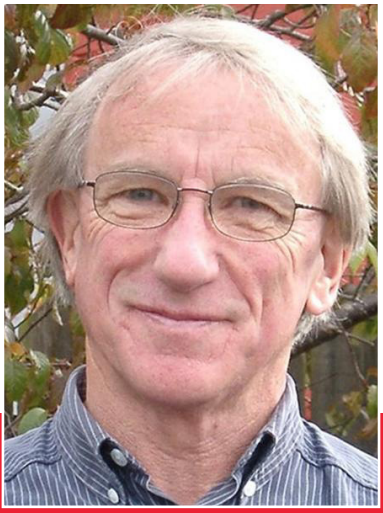
Acknowledgement

The willingness and professionalism of principals and teachers who made time to participate in this evaluation warrant both appreciation and commendation. Without exception, their motives and reflections clearly centred around the desire to provide their students with a highly credible maths programme in terms of the '5 Counts' used in this evaluation. In short, they impress as principals and teachers who want the best for their children, and the best possible approach to achieving that.

Terminology

The use of the word **programme** in this evaluation refers to the externally designed and presented programme that a school chooses to follow in its mathematics teaching. For example, the Numeracy Project is one programme; PRIME is another programme.

The words ***children, students*** and ***learners*** are often used interchangeably, yet there are important distinctions that have implications for understandings about learning and educational practice. ***Children*** are very young people with highly individualised and developing personalities. They are not necessarily rational, objective, logical or independent in their thinking and behaviour. ***Students*** are people of all ages who, by definition, are receiving education in formal settings or institutions according to their set programmes or curriculum. Institutional curricula often assume linearity, rationality, and objectivity. ***Learners*** are all human beings on the planet. Their learning begins at birth, continues on into old age, and takes many forms. It is not institution dependent.



ABOUT THE AUTHOR

Dr Lester Flockton is a graduate of Dunedin Teachers' College and the University of Otago. He has extensive experience in New Zealand's school system as teacher, principal, inspector of schools, Ministry of Education official, researcher, university teacher, educational thinker and leader. Throughout his career in education he has worked on many national curriculum and assessment committees and projects, including major roles in the development and writing of The New Zealand Curriculum (2007). He has led numerous professional development and learning programmes, made dozens of conference presentations here and overseas, and held office in various professional organizations.

Lester was one of the founding directors of the Educational Assessment Research Unit at the University of Otago, and one of the prime developers and co-directors of New Zealand's highly regarded National Education Monitoring Project. Lester's field of expertise combines teaching and learning, curriculum and assessment, and the leadership, governance and management of schools. He has received a number of honours in recognition of his service to education in New Zealand.

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