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Pressure to Perform: Reviewing the Use of Data through Professional Learning Conversations

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With increased accountability attached to students' results on national testing in Australia, teachers feel under pressure to prepare students for the tests. However, this can lead to shallow teaching of a narrowed curriculum. An alternative approach involves using data to identify common errors and misconceptions, discussing strategies aimed at building understanding of important mathematical ideas as well as students' confidence in answering context-based mathematics questions. This study explored the use of a learning model based on professional conversations about national testing results as well as school-based assessment data with junior secondary mathematics teachers in one school. The teachers identified the learning needs of students and chose to implement mental computation and estimation approaches as well as a strategy to address the literacy demands of numeracy test items to support student learning before and after the NAPLAN test. An analysis of the professional learning model identified approaches to enhance both student learning and teaching practice.

Background

In Australia, the debate surrounding mathematics and numeracy achievement has been similar to that experienced elsewhere. There is a growing recognition of the need for greater numeracy proficiency and that early intervention provides the best chance of success for children at risk of failure. The concern about numeracy by Australian governments was first highlighted in the National Literacy and Numeracy Plan (DETYA, 2000), which provided a framework for improving the literacy and numeracy outcomes of all students. This plan embraced the development of the national benchmarks for students in Years 3, 5 and 7, as well as the need for assessment and reporting against these benchmarks. Until recently, each state and territory in Australia collected student achievement data for the Federal Government. Concern about the proportion of students not meeting the minimum national benchmark standards (Curriculum Corporation, 2000) has continued with large investments by governments to address the needs of students at risk.

To better standardise the monitoring of student achievement the National Assessment Program in Literacy and Numeracy (NAPLAN) was introduced in 2008 (DETYA, 2000). The same tests in literacy and numeracy are now administered nationally to all students in Years 3, 5, 7 and 9. Testing early in the school year potentially provides diagnostic information to teachers about their students' performance in mathematics topics common to all states and territories (Curriculum Corporation, 2006).

Whether we approve of a national testing regime or not, this level of accountability is in place for the foreseeable future with pressure on school principals and teachers to improve results. While the information may be useful after the results are released, teachers of Years 3, 5, 7 and 9 are experiencing increased pressure early in the school year to prepare students for the test. Principals, school systems personnel and parents are scrutinising the results to determine whether schools and their teachers are 'measuring up'. Public comparisons between 'statistically similar' schools are now possible with the Federal Government sponsored My School website which presents statistical and contextual information about schools.

The results from the NAPLAN assessments are reported in individual student reports to parents, as well as school and aggregate reports with substantial information including results for each item and for each student. The school reports enable teachers to analyse the results for each year group to determine which items appear to be understood and which are problematic. In addition, school data can be compared to the Australian student data. The information is useful to address common errors and misconceptions as well as to aid planning and programming of future learning (Perso, 2009). Rather than abandon good pedagogical practices and have students individually practise test items, NAPLAN items can be used to address key issues in students' understanding and develop appropriate quality-teaching approaches (Anderson, 2009).

The purpose of the project reported here was to engage teachers in professional learning conversations about using evidence from their own NAPLAN results to identify their students' needs and collaboratively develop pedagogical practices which research has shown to be beneficial in building understanding. In particular, this paper describes and analyses the outcomes of a professional learning program conducted in one school by addressing the following research questions.

1. What strategies did teachers choose to use to support student preparation for NAPLAN and how was this different to previous practice?
2. Did the professional learning support have an impact on student learning and on teaching practice (including attitudes)?

Literature Review

Teaching to the Test!

High-stakes testing has been criticised for encouraging teachers to limit the curriculum to what is assessed (Abrams, Pedulla & Madaus, 2003) and resulting in the "corruption of indicators and educators" (Nichols & Berliner, 2005, p. 1). While the types of testing being conducted in some states in the United States of America in recent years could be considered higher stakes than the NAPLAN testing in Australia, systems, principals and teachers feel under pressure to prepare students for the tests and achieve good results, particularly given the publishing of data on the *My School* website. The pressure to raise scores has the potential to distort teaching and learning but there are ways teachers can support students' preparation for high-stakes tests without detracting from real learning

(Gulek, 2003). Miyasaka (2000) identified five types of test preparation practices that support student learning and improve achievement – teaching the mathematics content, using a variety of assessment approaches, teaching time management skills with practise in test-taking, reviewing and assessing content throughout the year, as well as fostering student motivation and reducing test anxiety. In addition, Marzano, Kendall and Gaddy (1999) found knowledge of test vocabulary and terminology improves student performance.

Compulsory testing of students in Years 3, 5, 7 and 9 in Australia has the potential to focus teachers' efforts on preparing students for the test by using past papers for practise and limiting learning to technical support such as how to fill in answers (Nisbet, 2004). However, balancing this narrow approach is the potential benefit of identifying students' strengths and weaknesses with data informing planning and teaching. In a survey of 56 primary schools, Nisbet (2004) reported two thirds of the schools in his study used data to identify topics causing difficulties but only 40% of teachers used the results to identify individual students who were having difficulty. Further, only 22% used the results to plan their teaching. The low proportion of primary school teachers using the data to inform teaching and learning represents a missed opportunity and there is little evidence that secondary mathematics teachers are analysing NAPLAN data in meaningful ways.

An Alternative Approach – Engaging Teachers in Professional Conversations about Data

There is an alternative approach to 'teaching to the test' but the evidence above suggests teachers require support to analyse and interpret the data and consider alternative practices, to address common student misconceptions and difficulties (Anderson, 2009). Gulek (2003, p. 42) refers to the need for "school practitioners to become assessment literate in order to make the maximum use of test results" and Thomson and Buckley (2009) describe the potential of test item analysis to inform pedagogy. It should be noted the test preparation practices that we are advocating are aimed at improving students' knowledge, skills and understanding of numeracy and mathematics and not at artificially increasing students' test scores. Unlike Dimarco (2009) who criticises giving any attention to such tests, we believe teachers' professional standing does not need to be compromised by considering how NAPLAN items can be used to improve student learning.

Planning professional learning opportunities for teachers in relation to new assessment regimes, or new approaches to teaching and learning, requires consideration of several factors which impact on teachers' practice in classrooms such as teachers' knowledge, beliefs and attitudes (Wilson & Cooney, 2002). Rather than change in beliefs and attitudes preceding change in practice, Guskey's (2002) model of teacher change proposes professional learning precedes the implementation of new ideas in classrooms, which when implemented could lead to a positive change in student learning outcomes, and subsequently, a change in teachers' beliefs and attitudes. This model suggests that teachers need to try new ideas and witness positive student outcomes before they fully embrace such approaches.

Following Earl and Timperley's (2009) research into the use of evidence to inform practice and building on Guskey's (2002) model of teacher change, the professional learning model developed for this project aimed to engage secondary mathematics teachers' in rich conversations about data including NAPLAN and whether NAPLAN items provide opportunities for learning and teaching. As noted by Earl and Timperley these conversations required more than just looking at their students' results.

> … conversations that are grounded in evidence and focused on learning from that evidence have considerable potential to influence what happens in schools and ultimately enhance the quality and the efficiency of student learning. We have also come to the conclusion that having conversations based on data in educational contexts is very hard to do. It is hard because productive use of evidence requires more than just adding data to the conversation; it involves a way of thinking and challenging ideas towards new knowledge. (p. 2)

The research design was based on a model of "productive evidence-based conversations" (Earl & Timperley, 2009, p. 3), which has particular qualities (see Figure 1). The conversations involve having an "inquiry habit of mind", with discussions about a range of relevant evidence where relationships are respectful but allowing for challenge. The approach taken in this study involved a group of teachers from the same school discussing the evidence from the previous NAPLAN Numeracy test for their students, asking questions about the data informed by classroom-based knowledge of their students, identifying topic areas requiring further investigation, and developing strategies to address the particular learning needs of their students.

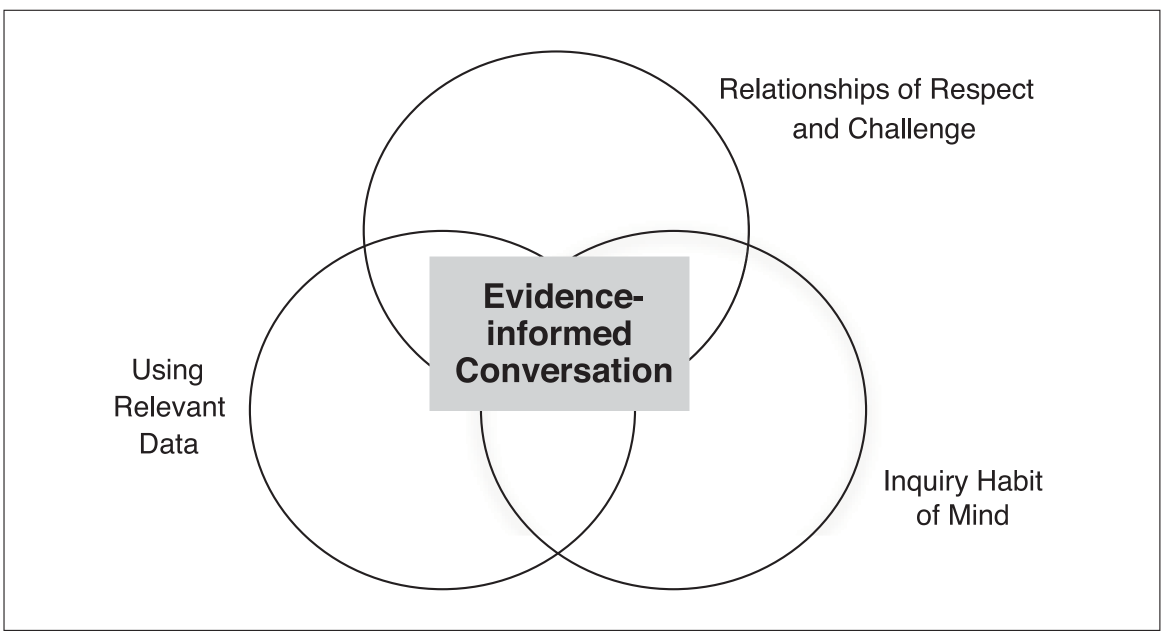

Figure 1. Processes for evidence-informed conversations (Earl & Timperley, 2009, p. 3)

Pedagogical Approaches to Improve Students' Engagement with Context-based Mathematics Questions

National testing agendas can provide an opportunity if we use test items to assist students who have difficulty reading and interpreting mathematical text, to further develop students' thinking skills, and to analyse common errors and misconceptions, frequently presented as alternative solutions in multiple-choice items. One practical approach to 'teaching to the test' while maintaining sound pedagogical practices is to use NAPLAN items as discussion starters so that students develop number sense, adopt new problem-solving strategies, and build confidence and resilience. Hence, teachers' professionalism need not be compromised by national testing agendas as long as they adopt teaching strategies, which use the data in meaningful ways to inform their planning and teaching.

Research has advocated several teaching practices that have the potential to target particular aspects of students' difficulties in mathematics and numeracy. While many strategies could be considered, in this project, the following strategies were chosen based on sources of students' errors; mental computation, estimation and number sense; and the literacy demands of context-based mathematics questions.

Common student misconceptions have been identified as a major source of errors. For example, Ryan and Williams (2007, p. 23) use the term "intelligent overgeneralization" to refer to students' predisposition to create inappropriate rules based on experiences. Some common generalisations include: multiplication makes bigger; division makes smaller; division is necessarily of a bigger number by a smaller number; and longer numbers are always greater in value. Figure 2 presents a NAPLAN Numeracy item where this type of over-generalisation occurs with few students selecting the correct answer of 22.

What is the answer to 6.6 ÷ 0.3?

A) 0.022 B) 0.22 C) 2.2D) 22

Figure 2. An item from the 2008 Year 7 non-calculator allowed numeracy NAPLAN test

A common fraction misconception occurs when area is not the feature students identify in regional models of fractions (Gould, Outhred & Mitchelmore, 2006). The "number of pieces" interpretation is a common response. This research explains the responses to the 2008 Year 7 NAPLAN item shown in Figure 3 where only 28% correctly selected the last option. The fact that three parts (though unequal) were shaded obviously prompted most students to see it representing three quarters. The most popular response was option c.

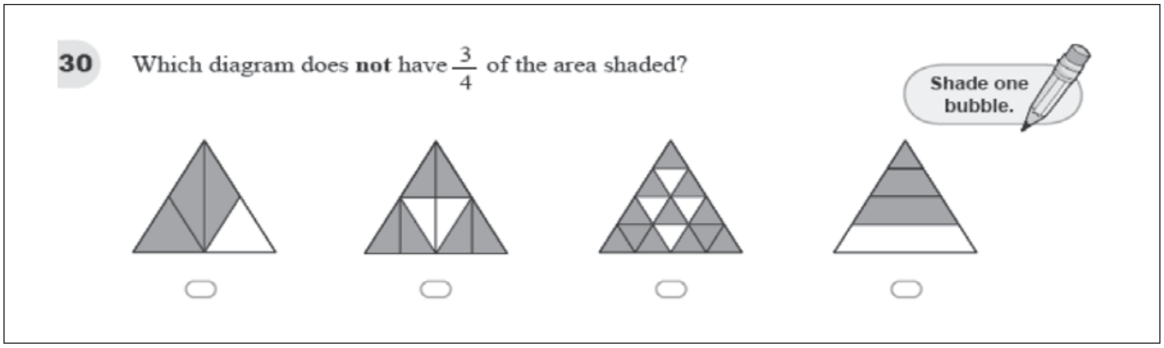

Figure 3. A fraction item from the 2008 Year 7 non-calculator numeracy NAPLAN test.

1. *Mental Computation, Estimation and Number Sense*

In dealing with misconceptions like these, Anderson (2009) points out that encouraging students to apply reasoning about numbers to evaluate answers can be a challenge. She argues that one way to support the development of students' thinking strategies is to use test items that focus on mental computation, estimation and number sense (McIntosh, Reys & Reys, 1997). While students are frequently reluctant to estimate, this is an important first step. Options in multiple-choice items may often be eliminated after considering whether the solutions are reasonable. Anderson proposes that after students have estimated the answer teachers can pose questions such as the following.

1. What strategies could you use to check the solution?
2. What would the question need to be to obtain each of the alternative answers?
3. What happens when you multiply a whole number by a number less than one?

An estimation focus allows test items to provide a source of meaningful mathematical discussion.

2. *Literacy Demands of Context-based Mathematics Questions*

The contextual nature of many NAPLAN items and the associated language implications often lead to claims that these tests are more comprehension than mathematics. However, interpreting mathematical situations in context is what numeracy is all about. Hence, we claim the contextual nature of the items is at the heart of numeracy and deserving of special attention. Further, it seems pointless to pursue repetitive symbolic manipulation exercises to address poor responses to contextual items.

Newman (1983) developed an error analysis protocol to analyse student responses to contextual items. She identified five levels of difficulty (Table 1). Most errors occurred in the second and third levels of 'comprehending' and 'transforming' the text into an appropriate mathematical strategy, not applying the symbolic procedure. By translating each of the levels from Table 1 into a question for students, teachers are able to determine their first level of difficulty (White, 2005).

Table 1
Levels in Newman's Error Analysis

Reading the question	Reading
Comprehending what is read	Comprehending
Transforming the words into an appropriate mathematical strategy	Transforming
Applying the mathematical process skills	Processing
Encoding the answer into an acceptable form	Encoding

Methodology

One school with a high NESB enrolment and a history of NAPLAN results below state and national average volunteered to participate in the project. Ten teachers of Years 7 and 9 (12 classes in total) were involved. The Professional Learning Model had five stages.

Stage 1 involved teachers collecting data about their own students' ability in NAPLAN style items. In May each year, Years 7 and 9 students complete two 32-item test papers for Numeracy, one with and one without the use of a calculator. With the teachers, the authors used the 2008 NAPLAN numeracy test results for the school to identify specific areas of the curriculum requiring review and consolidation. Items from the 2008 NAPLAN papers in these areas were used to compile a short pre-test for diagnostic purposes for each of Years 7 and 9 consisting of 5 non-calculator and 5 calculator items. Though the results from 2008 were those of the current Year 8 and 10, not the cohorts involved in the project, they were still considered reflective of teaching approaches in the school because the teachers were the same. Furthermore, the value of the selected items would be gauged by how the students responded to them.

Teachers administered the tests in early March, slightly more than two months before the NAPLAN tests in May 2009. Each teacher corrected their class responses to reveal the number of students selecting each option in multiple-choice items or the common solutions to the free-response items. In the six Year 7 classes, only one class had more than 50% of total responses correct in the calculator and non-calculator pre-tests (same class). In the six Year 9 classes, two had more than 50% of total responses correct in the non-calculator pre-test and no class had more than 50% of total responses correct in the calculator pre-test. These data support the items chosen as being areas of difficulty for the students.

Stage 2 involved a one-day meeting (two months before the NAPLAN tests) between the teachers and the authors. The day consisted of professional learning conversations to review the students' pre-test responses, consider the key mathematical ideas and misconceptions in the tasks, compare this to data collected using school-based assessment procedures, and explore a range of possible research-based teaching approaches identified by the authors. Teachers were encouraged to pose questions about the data. They also contributed suggestions about the mathematical issues they saw as relevant and strategies they believed could be used to address the identified student difficulties. From these conversations, a list of possible strategies was jointly constructed. Each teacher then nominated one or more to implement in their general teaching as well as specifically with targeted NAPLAN items.

Stage 3 where teachers implemented their chosen strategies occurred over the next two months prior to the NAPLAN tests and continued beyond the tests. In this stage, lesson observations by a trained research assistant who is a qualified mathematics teacher were conducted.

Stages 4 and 5 involved further professional learning conversations about the effectiveness and learning from the project in October 2009 and September 2010. Data collected in Stage 4 involved teacher questionnaires and interviews from the original 10 teachers and in Stage 5, eight teachers provided data about their use of their nominated strategies and reactions to the professional learning. An interview with the principal also occurred in Stage 5. In addition, student learning was analysed by comparing NAPLAN results for the Year 7 and 9 students in 2009 with their Year 5 and Year 7 results respectively in 2007 aligned with the corresponding New South Wales data.

Results and Discussion

The results are reported in two sections. The first looks at the preferred teaching strategies identified and used by the teachers. These data confirm pedagogical practices and identify opportunities for teacher change supported by the professional learning model. The second section reports on student learning. Given there was only two months of teacher implementation between the professional conversations and the NAPLAN test, these data are seen as some indicator of the professional learning model's success, but not in any way conclusive on its own.

Teaching Strategies

Teaching strategies data were collected in Stages 2, 3, 4 and 5. Stage 4 questionnaire and interview data are reported before Stage 3 lesson observation data. This order allows for a better comparison of the observations against the teachers' reporting.

Stage 2

During the professional learning discussions, the teachers reported giving their students practise on NAPLAN type items before the tests. However, there was no use of actual school data to inform their planning and practice to support student learning, or approaches to build desired understanding in their general teaching. When each pre-test item was discussed, teachers were asked to estimate the proportion of the school cohort correctly answering each item. They tended to overestimate and were frequently surprised by the low proportion of correct responses.

From looking at the mathematics involved in the identified areas and the incorrect answers chosen by students, the teachers and authors chose eight strategies as potentially useful for improving students' mathematics and numeracy proficiency. These strategies contained a mix of general teaching strategies and some which are appropriate when conducting class discussions based around NAPLAN style items. The teachers indicated during the professional learning discussions in Stage 2 that they intended to focus on the areas of concern and use strategies to address these from the professional learning day not only in their general teaching, but also to use NAPLAN items as stimuli for constructive class discussion.

Stage 4

After implementation, teachers completed a short questionnaire where they ranked the strategies in their preferred order of usefulness. Table 2 shows the results from the eight teachers who responded to the questionnaire. Scores were calculated by assigning 1 to the first choice, 2 to the second choice and so on, hence the lowest score indicates the most preferred strategy and the highest score indicates the least preferred (scores could range from 8 to 64).

Their ranking must be interpreted realising they may not have tried some at all and only chose from the specific strategies they did implement. None the less, the attractiveness of the ones they did choose to try is a factor in determining effective strategies, which promote good pedagogy and are seen as comfortable for use by teachers.

Table 2
Preferred strategies as selected by the teachers to address students' numeracy learning needs

	Strategy	**Score**
1.	Promoting interpretation of context-based mathematics questions using Newman's error analysis questions	20
2.	Developing efficient mental computation strategies	29
3.	Using estimation strategies with all questions	36
4.	Eliminating possibilities in multiple choice questions	41
5.	Checking reasonableness of answers	43
6.	Developing visualisation strategies in geometry (2D to 3D and 3D to 2D representations)	47
7.	Identifying irrelevant information in mathematics questions and problems	52
8.	Developing strategies for answering open-ended questions	58

Newman's questions and mental computation emerged as the most popular choices with 7 teachers ranking Newman's in the top 3. The final teacher ranked it last – so among 7 of the teachers, the preference was strong. Teachers' comments revealed some believed they were already using such strategies. For example:

> The majority of the strategies I already used prior to the PD except for the Newman's Method.

Others found the opportunity to consider new approaches was beneficial to both their teaching and student learning as shown by the comments below from three different teachers.

> Identified their need for mental computation and to read all the question.
>
> I found the Newman's questions are very useful. I went through that with all my classes.
>
> Newman's strategies – worked – ensuring read all of the question.

Three teachers' comments suggest their knowledge and understanding of the potential of NAPLAN items and data have improved:

> It gives me an idea of which kind of questions students found hard so I would focus more on those areas.
>
> Next year I intend to show students a variety of strategies for approaching the numeracy tests. I will also target some specific areas of knowledge that students in the past have had difficulties with.
>
> The pre-test identified common areas of weakness in my class. Common misconceptions were easily identified by the alternate choices students made when choosing the answer.

Professional dialogue between teachers and the researchers enabled the identification of a range of strategies for implementation in classrooms, an approach acknowledged as successful by the following three teachers' comments:

> It was good to gather with colleagues and to discuss alternate teaching strategies.
>
> It was especially good to get the chance to do practical maths questions and be the "student" ourselves.
>
> Focusing on mental computation, visualisation, Newman's as part of each unit, from beginning of the year – encouraging this as a normal part of doing Maths.

Even though teachers indicated they already used some of the teaching strategies in regular lessons, their awareness of the strategies and ability to identify when they were using them increased. Further, they had not used them as a focus for supporting NAPLAN preparation nor in taking items and through these strategies making them a source of constructive class discussion rather than right/wrong drill and practice. The data here show they were still using some of the learning from the professional conversations three months after the NAPLAN tests.

Stage 3

Table 3 shows the strategies identified in the professional learning conversation, which were planned for and actually used by the teachers in the eight observed lesson. Some teachers used more than one strategy.

The data set here is not large but still allows for some inference about the classroom practices of the participating teachers. The top two strategies (Newman's analysis and mental computation) figured prominently but a specific focus on estimation did not. All three teachers who used Newman's analysis actually went through the steps with the class. Visualisation, though not an original popular choice, was used as the basis for three of the lessons. The specific test strategy of eliminating possibilities in multiple choice questions was planned but not widely used indicting lessons became more involved with the mathematics and appropriate procedures rather than test based strategies. As one teacher said to her class:

Does the answer actually fit the question? Have confidence in your ability.

Table 3
Teachers' planned and observed aimed at addressing students' numeracy learning needs

	Strategy	Planned	Observed
1.	Promoting interpretation of context-based mathematics questions using Newman's error analysis questions	3	3
2.	Developing efficient mental computation strategies	2	2
3.	Using estimation strategies with all questions	0	0
4.	Eliminating possibilities in multiple choice questions	3	1
5.	Checking reasonableness of answers	1	2
6.	Developing visualisation strategies in geometry (2D to 3D and 3D to 2D representations)	3	3
7.	Identifying irrelevant information in mathematics questions and problems	1	0
8.	Developing strategies for answering open-ended questions	0	0

Four of the lessons involved NAPLAN items as a source of class discussion and group work. In all these lessons, teaching went beyond right/wrong answers and looked at procedures. Three involved group work while one was more teacher centred. The visualisation lessons were three of the four, which did not use NAPLAN items. The teachers chose other activities to involve groups of students building objects given specific properties (for example, can you build the shape which looks like this from the front and has the most or least number of cubes). In one visualisation lesson, one group was noted as definitely not being engaged. The level of student engagement was commented on positively in six of the other seven lessons.

In summary, the teachers in all eight lessons planned for one of the identified strategies and in seven of the lessons implemented one or more. In all lessons, the focus was on procedures and strategies, not just right answers. Newman's analysis appears to have provided a new lens for dealing with mathematics in a context. The focus on mental computation supported student thinking rather than memory based approaches.

Stage 5

The data from stage 5 gave some mixed messages. Table 4 shows the eight teachers responses about effects of involvement in the project in September 2010.

These results suggest the project had some effect on the teachers over a year after participation but the effect does not seem emphatic. Further, when asked what they did differently now as a result of participation, five of the eight said 'nothing really'. The three who nominated some change identified 'targeted review of questions students found difficult in previous years'; 'problem solving including Newman'; 'start with 5 questions (Naplan style)'. Except for Newman, these changes do not reflect the intended focus on strategies and the mathematics involved.

Table 4
Teachers' responses about effects of involvement in September 2010

Statement	Agree	Disagree
My involvement in the NAPLAN project has impacted on the strategies I use in my general mathematics teaching	6	2
Because of the project, I felt more confident in preparing my classes for NAPLAN this year	6	2
Since the NAPLAN project, the classroom environment in mathematics lessons promotes students' willingness to engage more with word problems	5	3
Because of the project, I am more aware of the types of errors and misconceptions students have in learning mathematics	5	3

However, when asked about the strategies, which had been identified in Stage 4, the eight teachers indicated sustained substantial use as shown in Table 5.

Table 5
Frequency of use of identified strategies aimed at addressing students' numeracy learning needs

	Strategy	Regularly (weekly)	Sometimes (monthly)	Never
1.	Promoting interpretation of context-based mathematics questions using Newman's error analysis questions	3	5	0
2.	Developing efficient mental computation strategies	7	1	0
3.	Using estimation strategies with all questions	7	1	0
4.	Eliminating possibilities in multiple choice questions	2	6	0
5.	Checking reasonableness of answers	6	1	1
6.	Developing visualisation strategies in geometry (2D to 3D and 3D to 2D representations)	2	6	0
7.	Identifying irrelevant information in mathematics questions and problems	1	5	0
8.	Developing strategies for answering open-ended questions	5	3	0

The frequency of use is consistent with both the nominated preference of strategy in Stage 4 and observed strategies in Stage 3. Estimation here matches Stage 4 nominations and suggests the Stage 3 non-observation of estimation was just a chance occurrence. Newman figured less regularly which can be explained by the strategy being very specific to contextualised questions which may not be a focus in class much of the time. Checking reasonableness, providing irrelevant information and open-ended questions are more prominent than in the earlier stages. The high level reported for mental computation and estimation shows a positive shift to engaging with working mathematically rather than with rote routine procedures.

The identification of specific strategies suggests more had been taken from involvement in the professional learning conversations than was indicated by the questionnaire. Interviews with the eight teachers confirm the stronger influence of the professional learning model. One teacher commented that 'PD offered was an intense time' – this included visits for lesson observation as well. Reflecting on changes to their own practices brought comments like:

> Personally use Newman's method as it works well

> Too much and too little information encourages students to think

> Hands on resources used including centicubes
>
> Newman's all the time in all subject areas (including RE)
>
> Logic questions such as are all squares parallelograms? Are all parallelograms squares?

Other comments also indicated that the teachers were making more use of data and trends in the data. For example, all the teachers identified for themselves that tables and graphs as an area needing attention.

The interview with the principal indicated she was very pleased with the whole professional model saying there was evidence of a positive change in classroom practice. She cited an intensive intervention to work on school programs as one example, but more importantly their own awareness of strategies to use and a heightened consciousness and control of their use of these strategies. In addition, she acknowledged teachers increased understanding of ways to use data to inform decision-making. She stated:

> The project has energized them and got the discussion going. There is more energy and discussion around teaching and learning. The teachers now seem to have the language to talk about these things. Staff members were ignoring NAPLAN but now they are starting to engage with it. We need to have strategies and practices based on, and informed by, data.

While mixed, the Stage 5 data suggest teachers are more aware of ways to implement different pedagogical practices in their classroom even though they may be of the opinion that they were doing so all along. In particular, the language they use to describe their practice would seem to indicate that they have in fact moved to a higher level of awareness about their own practice and the potential of evidence to inform their planning and programming.

Student learning

Student data from 2007 and 2009 at the sample school for each student were compared to the total New South Wales data. The New South Wales data set was readily available with the schools data and was seen as an appropriate standard to use for comparison. The group of students used in the comparisons was exactly the same group in both 2007 and 2009. The mean gain for each group was calculated by averaging the entire individual gains. The data need to be interpreted realising that an expected mean improvement from Years 5 to 7 is 50 points and Years 7 to 9 is 40 points and that the professional learning model intervention only occurred for two months prior to NAPLAN in 2009. The impacts of other unknown factors cannot be ignored.

To address the impact of other factors, Cohen's coefficient for effect size has been calculated for each group. Effect size for statistically significant findings attempts to "quantify the importance or substantive influence of the mean differences observed" (Kline, 2004, p. 132). Tables 6 and 7 show the results of comparing the mean gains using a one tailed t-test along with the associated Cohen's coefficient.

Table 6
Year 7 mean gains for the school compared to the NSW means from 2007 to 2009

2007 – 2009	Yr 5-7 N=123	*t* value	*p* value 1 tail	*Cohen's d*
Sample School Mean Gain	66.08	2.508	0.008	0.23
NSW Mean Gain	55.2			

The results in Table 6 show that the gains by the sample school compared to the state are significant at the 1% level for Year 7. The results in Table 7 show that the gains by the sample school compared to the state are significant at the 2% level for Year 9.

Table 7
Year 9 mean gains for the school compared to the NSW means from 2007 to 2009

2007 – 2009	Yr 5-7 N=126	*t* value	*p* value 1 tail	*Cohen's d*
Sample School Mean Gain	45.5	2.138	0.017	0.19
NSW Mean Gain	38.1			

Cohen's coefficient for effect size (0.23 for Year 7 and 0.19 for year 9) supports that the intervention alone is not likely to be responsible for the statistically significant differences in mean achievements. The sample values of 0.19 and 0.23 for Cohen's d Effect Size suggest that the mean differences are of a small rather than a large substantive difference accounting for a small proportion of the variation. A Cohen's d of "0.2 or greater corresponds to a small-sized mean difference" (Kline, 2004, p. 132). A coefficient of 0.5 represents a medium effect size. This proportion of the variation between the means, however, is statistically very unlikely to have occurred by chance alone (Kline, 2004).

The analyses of the mean differences reported in the NAPLAN comparative data do support a positive impact of the professional learning model on student learning but the professional learning can only be viewed as one factor impacting on the gains. Analysis of the model needs to be much wider than just statistical measures of student improvement.

Another source related to student learning is the teacher comments about the students' approach to solving problems and their overall attitude to engaging with mathematics. The eight teachers who responded to questions about what strategies worked and how these impacted on student attitudes indicated the chosen teaching approaches encouraged students to be more confident. Three different teacher comments from the eight are:

> Using a variety of strategies empowers students with ways to better respond to set questions in class tests and exams.
>
> Students gain confidence when they feel that they have been well prepared for tests and they perceive that it is important they try their best. They need to get used to the language used and the style of questions as well as improving their numeracy knowledge.
>
> Students seem a bit more confident and are more inclined to have a go now.

Both the quantitative and qualitative data support an improvement in learning though this improvement cannot be directly linked to involvement in the project alone. Importantly, students' experiences were positive and they gained confidence in tackling NAPLAN-style questions.

Conclusions

There is evidence that engagement in the professional learning model by teachers coincided with some positive student learning outcomes. The school thus saw the project as successful. The mix of using clearly identified strategies in general class teaching with NAPLAN items as a stimulus for discussion, appears to be an effective pedagogical combination. The results here are consistent with Martin's (2003) observation that showing students test items and discussing strategies for thinking about questions and responses promotes student confidence and resilience, and enables a greater sense of student control over their learning. In addition, the professional learning model aimed to improve the assessment literacy (Gulek, 2003) of teachers, and develop their attitudes and beliefs about the potential of using NAPLAN data for planning and teaching. Using data to inform teaching certainly became apparent as part of teaching practice where no indication of doing so previously was evident. However, there is no conclusive evidence about the way the data were used and the degree to which such use impacted on teaching practice and student learning.

Overall, teachers' comments (especially ones immediately after the implementation) supported the efficacy of the professional learning model. Interestingly, teachers' general comments in interviews one year on indicated they felt involvement had no real impact on their teaching practice and confidence but principal comments and their identification of their teaching strategies suggest there were long term changes to their practice. We conclude that a professional learning model like this does have a positive impact on mathematics learning and teaching but that unless conversations are revisited regularly, can mean awareness of the impact is lost in the day-to-day hustle and bustle of school life and teacher involvement in a range of initiatives.

The problem which can arise with high stakes testing where comparative results are in the public domain is that the tests become the curriculum and teaching strategies become restricted to improving test performance regardless of whether any actual learning takes place. Such a position being taken by teachers is understandable, but, as shown in this paper, not the only approach available to improving test performance. National testing programs provide challenges and opportunities for mathematics teachers. One challenge is to focus on the diverse learning needs of students while preparing them for national testing early in the school year.

In the project reported here, a professional learning model was implemented with a fair degree of success with two teams of teachers (those teaching Year 7 and those teaching Year 9), which aimed to turn NAPLAN into a teaching resource and a means of taking control of the testing agenda.

Ideally, the opportunity to form collaborative professional learning teams is desirable where some expertise about research into teaching mathematics can be accessed. However, the professional learning model described above need not be dependent on such external input and can be engaged with individually or in small groups within a school. As noted by Perso (2009, p. 11), "teacher reflection on student results becomes a powerful tool to guide the teaching of mathematics for numeracy by students". In fact, the results indicate more teacher input rather than less is desirable.

The model presented here is not advocating 'teaching to the test', rather it supports the notion that there is much to learn from using data available from a school's NAPLAN results and items to develop discipline knowledge as well as pedagogical content knowledge about important mathematics concepts. Nor does the approach presented here advocate national testing as the most desirable approach to assessing students' knowledge, skills and understanding. Teachers best carry out assessment as they talk to and observe their students (AAMT, 2008). However, given the reality we face and the fact that many teachers do feel pressure to actively prepare their students for the tests, the model presented here offers some ideas for a constructive way to do so. Future development of the model is therefore indicated and, in particular, the results suggest looking for ways to increase long-term positive beliefs, awareness of the impact of the model and ownership by teachers.

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