

# The Role of the Diagnostic Interview in the Numeracy Development Projects

Joanna Higgins  
Victoria University of Wellington  
<[joanna.higgins@vuw.ac.nz](mailto:joanna.higgins@vuw.ac.nz)>

Linda Bonne  
Victoria University of Wellington  
<[linda.bonne@vuw.ac.nz](mailto:linda.bonne@vuw.ac.nz)>

Formative assessment practices in two case study schools are described in this paper. The two high-decile, urban primary schools that participated in this exploratory study were at different stages of embedding the Numeracy Development Projects (NDP). Teachers, numeracy lead teachers, and members of the senior management teams completed surveys and then a cross-section of staff was interviewed. Students' numeracy achievement data, field notes from one school's staff meeting that focused on the diagnostic interview, and other school documentation completed the data sets. The findings describe how a school's use of the diagnostic interview to generate formative assessment data can contribute to the development of school-based conditions for the sustainability of a professional development project. In particular, for the NDP, consistent, school-wide use of the diagnostic interview and its resultant achievement data appeared to strengthen a school's emphasis on improving students' achievement.

## Background

Professional development that gets to the core of educational practice is important in projects aimed at system-wide change, such as the Numeracy Development Projects (NDP). Elmore (1996) defines the core of practice as "how teachers understand the nature of knowledge and the student's role in learning, and how these ideas about knowledge and learning are manifested in teaching and classwork" (p. 2). This paper examines the role of the diagnostic interview in getting to the core of practice so that both individual teachers and the school as a collective experience powerful professional learning. Such a tool provides teachers and schools with a means of establishing core ideas of quality instruction and enables teachers to develop more complex practice rather than merely making superficial changes (Higgins & Parsons, in press).

The diagnostic interview<sup>1</sup> is one of three pedagogical tools of the NDP that ensure powerful professional learning in a school setting, the others being the Number Framework and the strategy teaching model (Higgins & Parsons, forthcoming). Higgins and Parsons have identified the following three embedded design elements of the diagnostic interview for teacher professional learning:

Firstly, it is designed as a model for the types of questions that teachers might use in teaching students strategies; secondly, teachers deepen their understanding through the items in the diagnostic interview illustrating the different stages of the Number Framework; and thirdly, the information gained through the interview enables teachers to develop more specific expectations of student learning. The strategy and knowledge components of the interview build teachers' knowledge of the interconnectedness of mathematical ideas. (Higgins & Parsons, forthcoming)

Such design elements suggest that the diagnostic interview has some of the characteristics of what Robinson and Timperley (2007) term, a "smart tool". They reserve the term "smart tool" for tools that meet the criterion of "following two characteristics: (a) they incorporate a valid theory of the task for which they were designed and (b) the tools themselves are well designed" (p. 256). Specifically, Robinson and Timperley argue for the importance of a smart tool having embedded theories about quality instruction and acting as a mechanism for collecting evidence of the quality of teacher performance and related student outcomes. The diagnostic interview, like the literacy "wedge

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<sup>1</sup> For the purposes of this discussion, the term "diagnostic interview" refers to the following formative assessment tools for numeracy: the diagnostic interview (NumPA) (Ministry of Education, 2008), IKAN (Individual Knowledge Assessment for Numeracy), and GloSS (Global Strategy Stage assessment) (all available online at [www.nzmaths.co.nz](http://www.nzmaths.co.nz)).

graph” used in Robinson and Timperley’s example of a smart tool (p. 256), is a well-designed tool that incorporates a theory of teacher professional learning, the task for which it was designed. The diagnostic interview provides teachers with a model of types of strategy questions, illustrations of Number Framework stages, specific expectations, and a means of gathering evidence of student learning at different levels. The importance of teachers understanding the interconnectedness of mathematical ideas is illustrated through the strategy and knowledge sections of the diagnostic interview.

## Methodology

This exploratory case study<sup>2</sup> aimed to define questions and conjectures for a subsequent study. The focus on formative assessment was one component of a study<sup>3</sup> that also sought to elicit teachers’ and school leaders’ thinking around the themes of instructional leadership, networks of practice, and embedding the NDP.

The following two research questions were investigated in this case study:

- In what ways are students’ numeracy achievement information collected?
- In what ways does the data contribute to embedding the NDP in a school?

### *Participants*

The two participating schools in the Wellington region had originally completed numeracy professional development in the NDP’s early years of implementation and, more recently, had undertaken a renewed, two-year focus on numeracy. The schools continued to call on outside facilitators to support the continued improvement of numeracy instruction. Both of these urban, full primary schools were selected because they reported recent improvements in their students’ achievement; for example, data from one school showed that the achievement of a target year group had improved. Also, both schools were geographically convenient to the researchers.

School A was a medium-sized, high-decile, state primary school. The school had one numeracy lead teacher – a classroom teacher and syndicate leader – who had been in the lead teacher role for approximately eight years and who currently worked with two colleagues towards consolidating the NDP in their school setting.

School B was a large, high-decile, state primary school. The lead teacher responsibilities at this school were shared; one classroom-based lead teacher had been a numeracy lead teacher at her previous school and had had three years in her current role at this school. The second lead teacher was a “walking” member of senior management who had taken up the second lead teacher role when a colleague had left the school the year before. She had also worked in the role several years previously.

The two schools can be thought of as being at different stages of implementation: school A was still undergoing the organisational redesign needed to support full implementation of the NDP; school B was embedding the structural changes it had already put in place.

### *Procedures*

All teachers, numeracy leader teachers, and senior management (including principals) were invited to participate in this study. Initially, all teachers and senior management members were asked to complete a survey (see Appendix J, pp. 195–197) at each school’s numeracy-focused staff meeting,

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<sup>2</sup> See Yin (2003) for a discussion of case-study methodology.

<sup>3</sup> See other papers by Higgins & Bonne, in this volume.

at which the researchers made field notes. Several teachers at both schools took up the option of completing the survey after the meeting for later collection. Survey questions were generated using Cobb and Smith's (2008) frame of leadership priorities and were designed to elicit responses about leadership, networks of practice, formative assessment, and the roles these play in sustaining the NDP in their school<sup>4</sup>. At both schools, almost 90% of staff returned completed surveys.

Audio-taped interviews were subsequently carried out with lead teachers of numeracy, all members of senior management, and a representative sampling of teachers at both schools. At school A, a total of six interviews were held with: the numeracy lead teacher (who also taught year 3–4 students), the principal, the deputy principal (who also taught new entrants), the assistant principal (who also taught year 5–6 students), and two other teachers who were part of the NDP team (one taught year 7–8 students; the other taught year 5–6 students). Responses to other questions around the themes of leadership, networks of practice, and embedding the NDP also elicited comments relating to the diagnostic interview and the use of students' numeracy achievement data.

At school B, nine interviews were held with: numeracy lead teacher 1 (who also taught new entrants), numeracy lead teacher 2 (who was also the deputy principal), the principal, the assistant principal, a teacher with special responsibility for curriculum, and one classroom teacher from each of the following year groups: years 3–4, years 5–6, and years 7–8. An additional teacher of year 5–6 students, who had undergone NDP development elsewhere and who was identified as having a particular strength in teaching numeracy, was interviewed at the principal's recommendation. All school and numeracy leaders were interviewed with the questions shown in Appendix J. Teachers' interview questions are also shown in Appendix J. In the case of dual roles, leadership roles took precedence over teaching roles; for example, the numeracy lead teacher at school A, who also taught year 3–4 students, was interviewed using the questions for school leaders.

Lead teachers were also asked to provide copies of school documentation that supported the development of high-quality numeracy instruction and student achievement data for the current and previous year. In summary, the schools' data sets comprised surveys, interview transcripts, school documentation, and student achievement data.

### *Analysis*

It is important to lay the foundations for the development of school-based conditions for the sustainability of a professional development project (Coburn & Russell, 2008; Higgins with Bonne & Fraser, 2004; Timperley, Wilson, Barrar, & Fung, 2007). Drawing on the school-level foundational conditions identified by Timperley et al. (2007) and the leadership dimensions described by Robinson, Hohepa, and Lloyd (in press), the data was analysed using the following seven dimensions:

- consistency of interpretation of the NDP at the school level;
- setting direction and school targets for student achievement;
- consistency in grouping students for instruction;
- evaluation of the impact of an initiative at the school level;
- the formation of focused school-wide networks of practice;
- evidence-based and school-wide consistency in reporting to parents;
- information for school-based instructional leaders on individual teachers and groups of teachers.

The formative assessment tools of the NDP were analysed against these seven dimensions.

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<sup>4</sup> See other papers by Higgins & Bonne in this volume.

## Findings

The evidence that follows demonstrates how two schools at different stages of establishing numeracy practices used achievement data to consolidate the changes in their school. While school B had quite well-established structures and practices in place for numeracy assessment, school A was still in the process of making decisions about the combination of assessment tools that best met the needs of their students, teachers, and community. Their numeracy lead teacher explained:

We were doing the whole [diagnostic interview], but then that was getting too much, so then we were doing GloSS<sup>5</sup> because ... when you compared it to the national norms, we were up and above, so we then went back to just doing GloSS ... (Lead teacher, school A, interview)

The full diagnostic interview was still used occasionally with students:

... new to the school, coming into the school, we do a full thing when they come in if we can, if we have time. And any children that we've got concerns with, we might do one ... (Lead teacher, school A, interview)

Teachers at school A were no longer using the diagnostic interview school-wide:

This year, we're trialling doing a full one for the year fours and the year sevens. (Lead teacher, school A, interview)

They had explored using the revised PAT: Mathematics<sup>6</sup> but were unsure that it was a good fit with their other mathematics assessments. Also:

We have made a decision not to go down the asTTle<sup>7</sup> track, we're just waiting and seeing how that all pans out, so we are still playing around with stuff ... (Senior management member, school A, interview)

In the meantime, we have term monitoring for students and on to that term monitoring would go your basic facts and your GloSS levels ... (Lead teacher, school A, interview)

At school B, the lead teachers had established appropriate school structures and resources for the administration of the diagnostic interview and supported their colleagues to become confident in using the interview. This was reported by teachers as "taking staff meetings, i.e., ... Numeracy Diagnostic" (year 0–1 teacher, school B, survey) and working with teachers on a one-to-one basis: "Tomorrow I am going to work with [a lead teacher] – administering a diagnostic test to a pupil" (year 3–4 teacher, school B, survey). Another comment was "The school expectations for interviewing every student were supported by good systems – diagnostic tests" (year 7–8 teacher, school B, survey).

### *Consistency of Interpretation of the Diagnostic Interview*

Although school A was a smaller school than school B, the staff were also aware of the need for consistency in administration of the diagnostic interview. Their strategy for addressing this was to have one teacher do all the interviews for their two targeted year groups:

What we've decided is that in year 4 and year 7, we are going to actually do at the end of each year a full number survey and release people like [teacher's name] to do that testing. Then we can actually be sure that our GloSSing is up to scratch as well as getting consistency across. (Senior management member, school A, interview)

School B was a large school, and the lead teachers and senior management strove for a degree of consistency of teachers' practices. As the end-of-year, school-wide diagnostic interviewing drew near,

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<sup>5</sup> GloSS: Global Strategy Stage, an assessment tool that can be used to determine which global strategy a student uses, available online at [www.nzmaths.co.nz](http://www.nzmaths.co.nz)

<sup>6</sup> PAT: *Progressive Achievement Test: Mathematics*, New Zealand Council for Educational Research

<sup>7</sup> Assessment Tools for Teaching and Learning (asTTle) is an educational resource for assessing literacy and numeracy developed for the Ministry of Education by The University of Auckland.

the two lead teachers at school B led a staff meeting that emphasised the importance of consistency of administration as they worked to establish norms around how the interview was used:

This is the way we do [the diagnostic interview] at [school] ... It's important we're consistent here at [school], otherwise we won't get good data. (Lead teacher 1, school B, speaking at staff meeting)

Teachers were aware of the importance of "making sure that I am doing it right and that I understand exactly where their level should be" (year 5–6 teacher, school B, interview), and were supported by the lead teachers to administer the diagnostic interview in a consistent manner, as is evidenced by this survey response:

New staff have a diagnostic test modelled for them, and then they have an opportunity to observe them in return, offering feedback and further support. (Year 7–8 teacher, school B, survey)

The facilitator with whom the staff had worked had also stressed the importance of consistent practice when training the lead teachers in the use of the diagnostic interview:

When we started, he trained [a former lead teacher] and I to do the numeracy diagnostic test and then we trained the other teachers until he was satisfied with the way we were doing it. (Lead teacher 2, school B, interview)

Opportunities were provided by the numeracy lead teachers for teachers to revisit this:

There are times when they'll say "Look, we're having this meeting, and we're going to show you all a video about how to do the diagnostic." [A lead teacher] says "I'm going to do some, come into my room and watch me do a diagnostic ..." (Year 3–4 teacher, school B, interview)

### *Setting Direction and School Targets for Student Achievement*

School-wide data at school A was used to identify groups of students whose learning needs might demand special programmes:

We're looking for pockets of excellence where we say "Mmm, where are we going to take these kids?" And we're looking for pockets of "Here's a group of kids who we need to support." (Senior management member, school A, interview)

The degree to which their students' numeracy data was aligned with students around New Zealand was also a focus:

For mathematics, we want to know that our number testing is aligning with the national picture, in the same proportion. (Senior management member, school A, interview)

School B had a very clear school-wide focus on improving students' numeracy achievement, and this was supported by a focus on data. In their implementation plan, it was stated:

The diagnostic interview results undertaken in term 4 will inform the subsequent year's focus for goal setting and development of programmes to determine student learning. (School B's Implementation Plan)

The school's implementation plan also includes a copy of the end-of-year curriculum level expectations for students' numeracy stages, taken from [www.nzmaths.co.nz](http://www.nzmaths.co.nz), which provides this and other NDP information for teachers and schools. School B's 2007 end-of-year data for year 1 students had shown that 86% of students had been assessed as operating at stages 2–4 of the Number Framework, with the remaining 14% below the curriculum level expectation for this year group. Although this compares favourably with around 16% being below the expectation<sup>8</sup>, it caused concern:

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<sup>8</sup> See [www.nzmaths.co.nz](http://www.nzmaths.co.nz)

In a school of this decile, we were shocked at [this result] because kids come in with good maths knowledge ... (Lead teacher 2, school B, interview)

This data had been analysed and shared with staff at the start of 2008 as this cohort of students moved into year 2:

When we got the numeracy diagnostic results, we were a bit shocked to find where our year 2 children were, and I think it sort of galvanised [the other lead teacher] and I into wanting to sustain the project in the school. (Lead teacher 2, school B, interview)

As a result of the diagnostic interviews last year, our year 2s are quite low ... well below as far as looking at the national benchmarks ... so we highlighted the need to work with teachers of year 2 children. (Lead teacher 1, school B, interview)

The senior management team drew on this data to set this strategic goal for the 2008 school year: "70% of the target group of children at [the school] will be moving into stage 5 by the beginning of year 3" (school B's annual plan, 2008). It was the lead teachers' responsibility to set up a withdrawal programme in order to achieve this goal. This was informed by a presentation at a lead teacher development day:

We went over to the very first lead teacher meeting, and there was a woman speaking about the programme she'd put into place ... And so we came back here all fired up ready to do something similar and so we ... worked with teacher aides ... (Lead teacher 1, school B, interview)

The 2008 end-of-year data showed that "46% of the targeted year 2 children are working at stage 5" and "43% of the targeted year 2 children are working in stage 4 in readiness to transition into stage 5" (school B's annual plan, 2008).

### *Consistency in Grouping Students for Instruction*

At school A, the "I can"<sup>9</sup> assessment sheets were used for ongoing monitoring:

The "I can" sheets are also part of what syndicate leaders might look at [at] different times too across the syndicate to see if there are any areas of weaknesses or strengths that they might need to note for individual children, in particular gifted and talented kids ... (Senior management member, school A, interview)

At school B:

Student data is initially used by a classroom teacher as part of formative assessment and the where to next. Very important. (Senior management member, school B, interview)

There was emphasis on administering the diagnostic interview in a consistent manner across the school because they used their data to inform key decisions about numeracy. At the start of the school year, end-of-year data from the previous year was used to determine groupings for instruction, based on students' strategy stages:

Diagnostic testing is used for the following year by the new teacher for groupings, and following on from that are the "I can" sheets done on a regular basis to see what stage they are at and confirm that stage before they move on to the next stage. (Senior management member, school B, interview)

This teacher talked about the accuracy of the information received about the strategy stages of their students, who were drawn from several of the previous year's class groups:

I went on last year's [diagnostic interview data]. I did "I can" sheets at the start of the year, and it pretty much confirmed everything that was in those things, so I just took it, that was the benchmark that I went from ... (Year 3-4 teacher, school B, interview)

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<sup>9</sup> "I can" assessment sheets can be found at [www.nzmaths.co.nz/node/1491](http://www.nzmaths.co.nz/node/1491)

### *Evaluation of the Impact of the Diagnostic Interview*

At school B, students' achievement results were treated as a key indicator of the impact of the NDP, as this member of the senior management team reported:

It's school-wide data to inform how we are doing as a school, moving student achievement up to the target areas ... (Senior management member, school B, interview)

Numeracy data was discussed as a whole staff:

Now and again, we'll do testing and they'll throw it up on a big screen and just say "Look at this, we've got a real trend here where we're dropping in this, we need to get onto this." And everyone's more than keen. I mean we're looking after our kids, so we do want to hear it. (Year 3–4 teacher, school B, interview)

The lead teachers evaluated progress towards each year's strategic goal for numeracy. Most recently, the improvement in achievement of the year 2 students, described earlier, had been seen as a positive result of the programme established by the lead teachers working closely with the teachers in that part of the school, as well as with a team of teacher aides. One of the lead teachers talked about anecdotal evidence of positive change related to the diagnostic interviewing process:

So then we see much more confident teachers, and we see children achieving at a much better rate, and I haven't got all the diagnostics, they are still doing their diagnostics, but the talk at the moment is "Wow, my kids have done so well in fractions, not so good in ad-sub." I thought they might have done better, but their fractions are fantastic, so that's all really exciting. (Lead teacher 2, school B, interview)

### *The Formation of Focused School-wide Networks of Practice*

During the study, the researchers attended a staff meeting at school B where the focus was on the diagnostic interview. This official network was used to set norms around how teachers were to administer the interview, with the group discussing questions about what counts as a correct response from a student and how many attempts they should be allowed for each question. There was some debate over whether or not teachers should ask a student to explain their strategy when they gave an incorrect answer.

Other well-established within-school networks that provided opportunities for teachers to discuss the diagnostic interview and its data included buddy teachers, a large group of provisionally registered teachers and their tutor teachers, and neighbouring teachers. Syndicate groupings were another important network for discussing and reflecting on practice. One teacher talked about how the focus on numeracy was included by a syndicate leader, who:

always makes sure there's part of our meetings ... that are just open to any, like she always says "Is everyone ok, how are you going with this, what do you need?" (Year 3–4 teacher, school B, interview)

The same teacher alluded to the opportunities afforded by the school's virtual network:

I find it confusing how big stage 5 is. There are some kids who are just on it who aren't that good at maths and there are some who are fantastic, but they get the same grade, and so we had a huge discussion. There was an email that went right around the school straight after it, you know, it was real fast and, you know, good effective communication. (Year 3–4 teacher, school B, interview)

A related study<sup>10</sup> describes how within-school networks appeared to have greater influence on numeracy instruction in both schools than networks that reach beyond the school. At school B, the provision of release time enabled numeracy lead teachers to support teachers – individually, in groups,

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<sup>10</sup> See Higgins & Bonne, Networks of support and influence in the Numeracy Development Projects: A case study of two schools, in this volume.

and as a whole staff – in order to develop consistent practices around the use of the diagnostic interview and the resultant data, with the ultimate goal of improving students' numeracy achievement.

### *Evidence-based and School-wide Consistency in Reporting to Parents*

At school A, a teacher described the value of the diagnostic interview data for reporting to parents of 5-year-olds:

We have a six-week conference with children where we share our number data with parents ... and talk about where their kids are at and where we're going to take them. (Senior management member, school A, interview)

The same teacher reported that information from the diagnostic interview completed with students on school entry meant that:

... my teaching of number knowledge is sharper – the NumPA testing gives me a clear picture of what I need to target, e.g., counting forwards and backwards, teen numbers, and I use teaching techniques and resources that I know work ... (Senior management member, school A, survey)

The diagnostic interview was not being used across the whole school. Instead, GloSS data was informing reporting to parents. At school B:

School-wide data is analysed by the team for reporting to parents as a whole, and then assessment for each classroom, as far as each classroom teacher is concerned, is used for reporting to parents. (Senior management member, school B, interview)

Descriptors of students' strategy stages, in particular, seemed to raise questions for teachers when reporting to parents. With reference to the broad range of understandings encompassed by a single strategy stage, one teacher asked:

How do we communicate that through to the parents? And we're just talking about what we can put in the reports. You know, just to tell the parents "Look, they've made great progress but are still within this, they are close to transition, but it's not quite there." (Year 3–4 teacher, school B, interview)

### *Information for School-based Instructional leaders on Individual Teachers and Groups of Teachers*

The focus on students' achievement data at school B included using it as a means of identifying possible development needs for teachers:

I guess it can identify for the numeracy leaders who might be having some issues, like the teacher, and therefore maybe just through that we can then put the support in that we actually need. So it's used in a constructive supportive manner, it's not saying they haven't done well. (Senior management member, school B, interview)

A colleague commented:

It also shows areas for PD [professional development] that we need to focus in on ... Obviously, for the numeracy leaders, it helps them to work out maybe teachers that they, or classes in particular, that they feel need extra support with either teacher knowledge or following the programme itself. (Senior management member, school B, interview)

So not only might it be possible to diagnose a need for development across the whole staff, but the data might also give an indication of support needed by individual teachers. Supposedly, it also has the potential to identify areas of strength of individuals and of the whole staff, although this was not reported in these two schools.

### Limitations

This exploratory study focused on two urban, high-decile schools. Only a small number of survey and interview questions specifically focused on formative assessment in numeracy, although responses to a number of other questions included references to assessment. Further research will be needed to determine whether other types of schools that are working to embed the NDP share any characteristics of practice relating to formative assessment.

## Discussion and Conclusion

The schools demonstrated the laying of all seven dimensions<sup>11</sup> of the foundations of school-based conditions helpful in sustaining the NDP. Tracking the laying of these conditions through the use of the diagnostic interview in the school enabled a view of how both schools got to the core of practice, enhancing the likelihood of deep-level changes both to individual teachers as well as to school-wide collective practices. This viewpoint also demonstrates the power of the diagnostic interview as a pedagogical tool for professional development. The evidence demonstrates that the diagnostic interview, as well as the data generated from its use, contributed to embedding the NDP in the schools studied.

The study suggests that professional development designers and implementers should pay attention to the power of well-designed assessment tools that embody underlying theories of professional development initiatives.

### For Further Research

- Can the NDP be embedded in a school using forms of assessment other than the diagnostic interview?
- What is the relative importance of the actual choice of assessment tool and having systems in place to ensure its consistent, school-wide use?

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<sup>11</sup> See description under Analysis.

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