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Author

Nisbet, Steven

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Teachers' Views on the Effect of Compulsory Statewide Numeracy Testing on the Teaching of Mathematics in the Primary School

Steven Nisbet
Griffith University

This paper reports on teachers' views on the effects of compulsory numeracy testing in Years 3, 5, and 7 in Queensland primary schools. In a pilot study, teachers in city and country schools were surveyed to determine their opinions about the appropriateness and validity of the tests, the influence that such testing has had on their teaching and assessing of mathematics, and how they are using the results of the tests. Even in a relatively small sample, there is great diversity of opinion about the tests, and it appears that of the test results are not being used to any great extent.

Introduction

Since the mid 1990s, there has been an increased emphasis on numeracy skills in Queensland primary schools as a result of many factors – some originating at the state level and others at a national level. At the state level, a report of a review of the Queensland school curriculum entitled "Shaping the Future" (Wiltshire, McMenniman, & Tolhurst, 1994) acknowledged the importance of numeracy in the school curriculum and recommended (i) that numeracy advisers be appointed to schools, (ii) that a diagnostic test be introduced in the lower primary school to identify students with difficulties, (iii) that a state-wide test be introduced in Year 6 to monitor pupils' progress in numeracy, and (iv) that resources be allocated to cater for pupils identified with learning difficulties. Consequently, from 1995, the Year 2 Diagnostic Net and Year 6 Test were introduced in Queensland government schools (Queensland Schools Curriculum Council, 1996). Although the Year 6 Test was discontinued in 1997, the Year 2 Net has continued to be used in all government schools. It has been received well by primary teachers and has had a positive impact on their teaching of mathematics (Nisbet & Warren, 1999). For instance, teachers have become more alert to individual students' needs, and have reported using a wider variety of assessment techniques (notably individual interviews & observations), using assessment data for planning instruction, having a greater sense of accountability, and including more problem solving and hands-on activities in their teaching.

At the national level, outcomes-based assessment was promulgated across the nation, and all states were given individual responsibility for its implementation. In Queensland, it was introduced as Student Performance Standards (SPS), but it faced huge opposition by teachers and was withdrawn. The scheme was perceived as imposing too much demand on teachers' time and as offering too little support for teachers. Hence its introduction was less than successful (Nisbet, Dole, & Warren, 1997). Soon afterwards, a National Literacy and Numeracy Plan (NLNP) was adopted in all states of Australia in 1997 with a number of purposes, including (i) to identify students at risk, (ii) to conduct intervention programs, (iii) to assess all students against national benchmarks, and (iv) to introduce a national numeracy reporting system. As a consequence of the NLNP, in 1998, annual compulsory state-wide testing was introduced for students in Years 3, 5 and 7 (with Year 9 to be added in the near future). In August each year therefore, all students in Years 3, 5 and 7 in Queensland schools sit for tests in literacy and numeracy. The tests are devised by the officers of the Queensland Studies Authority (QSA) (previously the Queensland School Curriculum Council, QSCC) and are distributed to all government schools. Although the benchmarks are considered to be national, the states have been given the responsibility to devise tests specifically for their own students, and based on the local curricula.

The Queensland, the numeracy tests assume a broad interpretation of the term numeracy and embrace the notion offered by Willis (1998) that numeracy can be seen from three perspectives, namely, (i) numeracy includes concepts, skills and processes in mathematics, (ii) numeracy is described in terms of everyday situations in which mathematics is embedded, and (iii) numeracy implies that students can choose and use mathematical skills as part of their strategic repertoire. Hence the Queensland numeracy tests include items covering the topics of number, measurement, geometry, chance and data. Pupils are tested on skills of calculation (written, mental and calculator methods), and problem solving in real world contexts.

A review of the Year 3, 5 & 7 testing program by the Queensland School Curriculum Council (1999) identified potential benefits and concerns relating to state-based testing. The suggested benefits for teachers include the identification of students' strengths and weaknesses, the provision of data to inform planning and classroom teaching, the provision of results for various groups (boys, girls, students of non-English speaking backgrounds, & indigenous students), and identifying staff professional development needs. Issues of concern suggested in the review include a narrowing of the curriculum, a tendency for teachers to teach to the test, having assessment items that are not based on the classroom program, and the potential for misuse of results (e.g., the publication of 'league tables' of 'good' and 'bad' schools).

The reports sent to schools at the end of each year contain extensive information on the results of the tests for the school (with comparisons with the state average), including the following data:

- Overall results for each Year level (3, 5, 7) for each section (number, space, measurement & data) –
- for the whole school year-level cohort,

- for various subgroups (boys, girls, NESB students, indigenous students), and
- for each individual student.

Results for each item –

- for the whole school year-level cohort,
- for various subgroups (boys, girls, NESB students, indigenous students), and
- for each individual student.

Further, all incorrect answers are recorded for each item for each student, and items which the school did 15% above and below the state average are noted. With such information supplied to schools, teachers and administrators have the information to be able to identify specific strengths and weaknesses, compare their results with those of other schools, and take what they may consider to be appropriate action.

The nature and extent of the action taken by schools naturally varies across the state, and some of this information has been gathered by QSCC/QSA in surveys of participating schools. For example the survey undertaken in relation to the reports sent to schools about the 2001 tests indicated that schools would make extensive use of the information in the reports. For instance, 80% of schools indicated that they would be using the data for diagnosis of individual students' needs. See Table 1 below for a full list of intended uses.

Table 1

Schools' ways of using of data in 2001 test reports (Source QSCC report, 2002)

USE OF DATA	% OF SCHOOLS USING THE DATA
Diagnosis of individual students' needs	80
Inform school programming	78
Assist school accountability reporting	75
Inform class programs	73
Assist in parent/teacher interviews	68
Assist teacher accountability	51

However, as the school surveys are probably completed by one member of the school administration team in the school (perhaps a deputy principal overseeing the testing process), it is not known to what extent these results reflect the opinion of individual teachers and the extent to which the schools actually put the test data to such uses. Anecdotal evidence gathered by the researcher in a number of schools suggests that although schools may have good intentions with respect to analysing and acting on the information, it occurs only to a very limited extent. This pilot study and the subsequent study have been designed to shed some light on the extent to which schools actually analyse and use the test data.

The study also has been designed to ascertain how well the Year 3, 5 & 7 tests have been received by teachers. The adoption of the tests has been yet another change that

primary teachers in Queensland have had to cope with in recent times. Much of the literature on teacher change and professional development acknowledges the importance of teacher beliefs as well as teacher knowledge in the cycle of professional growth. For instance, the importance of teachers' knowledge and beliefs in the cycle of professional growth was confirmed by Kyriakides (1996) who found that the failure of a mathematics curriculum change in a centralized system was due to the fact that teachers' perceptions of mathematics were inadequately considered at the adoption and implementation stages. Similarly, Philippou and Christou (1996) noted that if new ideas are to find their way into mathematics classrooms, it is imperative that change agents have a deeper understanding of classroom teachers' views, beliefs, conceptions and practices. Their study found that although teachers may be aware of and accept contemporary ideas (in their case about assessment), there can be a distance between their knowledge and intentions on the one hand, and their actual practice (in assessment) on the other hand.

The traditional model of implementing curriculum innovation assumes that teacher change is a simple linear process along the following lines. Staff development activities lead to changes in teachers' knowledge beliefs and attitudes, which, in turn, lead to changes in classroom teaching practices, the outcome of which is improved student learning outcomes (Clarke & Peter, 1993). Later models recognise that teacher change is a long term process (Fullan, 1982) and that the most significant changes in teacher attitudes and beliefs occur *after* teachers begin implementing a new practice successfully and see changes in student learning (Guskey, 1985). The professional development model of Clarke (1988) has refined the Guskey model by recognising the on-going and cyclical nature of professional development and teacher change. Later Clarke and Peter (1993) adapted the Guskey model further by broadening the original conceptual elements within the model. *Staff Development Activity* was broadened to include any external source of Information, Stimulus or Support, and was labelled as the *External Domain*. *Classroom Practice* became the *Domain of Practice* to include any Classroom Experimentation. *Student Learning* became the *Domain of Inference* to include any Valued Outcomes. Finally, *Teacher Beliefs* became the *Personal Domain* to include Teacher Knowledge and Beliefs (see Figure 1).

Such a model can help explain why some educational innovations turn out to be successful, and others not so successful. The introduction of the Year 2 Diagnostic Net in Queensland during the mid 1990s was successful because teachers saw the outcomes of its introduction as positive and they valued the overall effect of the Net (Nisbet & Warren, 1999). However the introduction of Student Performance Standards (SPS) in mathematics was less successful because teachers did not believe that it was worth all the extra work entailed and they received little support for the change (Nisbet, Dole & Warren, 1997).

This study aims to tap into teachers' beliefs about the Year 3, 5 & 7 tests – their support for the tests, their perceptions of the validity of the tests, and the effect of the tests on students – because these beliefs may be related to the impact of the tests on teachers' practices and the extent to which the test data is used in the school. It also aims to identify other issues of concern to teachers about the numeracy tests and the effect they have on students and teachers.

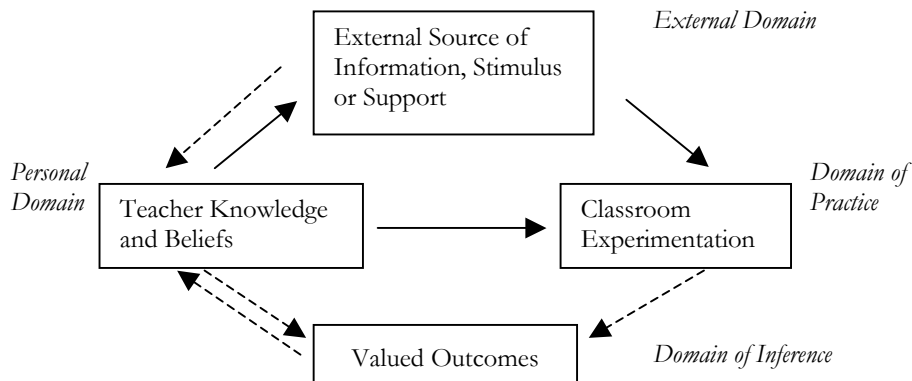


Figure 1.
The Clarke-Peter model of professional growth.

Note: Solid line = *enactive* mediating process; broken line = *reflective* mediating process. The mediating processes translate growth in one domain into another. The term *enactive* distinguishes the translation of a belief or a pedagogical model "into action" from simply "acting". Acting occurs in the Domain of Practice and each action represents the enactment of something a teacher knows, believes or has experienced (Clarke & Peter, 1993).

Methodology

This investigation is a pilot study conducted as a forerunner of a larger study to assess the impact of the Year 3, 5 & 7 Numeracy Tests on the teaching of mathematics in Queensland primary schools. The aims of the pilot study were (i) to obtain an indication of the range of teachers' perceptions and attitudes towards the tests, (ii) to assess how the tests may have influenced teachers' teaching of mathematics, and (iii) to trial the use of a questionnaire for later refinement and use with a larger, more representative sample.

The sample used for the pilot study included teachers from two different geographical areas – the Brisbane metropolitan area and a rural area. The Brisbane teachers were the staff at a regular suburban government school (20 teachers attending a staff meeting) and the rural teachers were from seven country schools in a western Queensland district (16 teachers attending a conference). The sample included class teachers (the majority) along with principals (teaching and non-teaching), deputy principals, support teachers, and teachers of LOTE and Special Education.

The confidential questionnaire had 20 items relating to the Year 3, 5, & 7 tests, and two further items relating to the position of the teachers (year level taught or role in school) and number of years teaching experience.

The items in the questionnaire about the Year 3, 5 & 7 tests covered issues raised in the QSCC/QSA survey of uses of test data, and were grouped in four categories. The first category included items relating to the teachers' perceptions of the validity of the tests, e.g. the extent to which the test results are an indication of pupils' numeracy abilities, an indication of the teacher's ability to teach mathematics, and an indication of

the quality of school's numeracy program. The second category related to the use of data by the school – e.g. the extent to which the school analyses the results; the use of the data to judge class progress, to identify individual students having difficulties, to inform students about their strengths, to inform students about their weaknesses, to encourage students, to plan teaching, to inform parents about their child, to inform parents about the school's overall performance, and to inform the community about school's overall performance.

The third category related to the impact of the tests on students – how students cope with the test experience, and levels of anxiety exhibited by students. The fourth category of items related to the impact of the tests on teachers – on their planning, on what mathematics teachers teach, on how they teach mathematics, and how they assess mathematics. Another item related to the extent the school prepared students for the tests.

Respondents were able to indicate their extent of agreement with the statements on a 5-point scale – "none" (1), "a little" (2), "moderately" (3), "quite a lot" (4), and "a great extent" (5). Some indicated they were "not sure" with a question mark, or "not applicable" with N/A. Teachers were also invited to make comment on the issues raised in the items. The survey forms were distributed in person to the teachers and they responded to the items in a short 10 minute sessions, and handed the forms back to the researcher once completed.

This is a pilot study so the data have been analysed to observe general trends and patterns. Analysis has been carried out without the use of tests of statistical significance. Comments made about the survey data relate to the sample only, and whilst they are not generalisable, they point to issues which may be of greater concern and worthy of exploration with a larger, more representative sample.

Results

General comments

The first general comment that can be made about the data is that the patterns of teachers' responses showed a wide range of opinion about the Year 3, 5 & 7 tests. In 12 of the 20 substantive items, responses ranged across all of the five values [from 1 (no extent) to 5 (a great extent)]. In seven of the other eight items, opinions ranged across four of the five response values [usually from 1 (no extent) to 4 (quite a lot)], and only in one item did the responses range across just three values [from 2 (a little) to 4 (quite a lot)].

Secondly, there seemed to be very little difference of opinion between the city and country teachers. The patterns of responses for both groups were quite similar. Hence the data for the two sub-groups have been combined for this paper.

Respondents

A total of 34 teachers responded to the survey and they included teachers of Pre-school, Primary and Secondary grades, along with support teachers (special education teachers, LOTE teachers, teacher-librarian), principals and deputy principals. Table 2 below shows the number of teachers in each year level or role for the city and rural schools.

Table 2

Number of teachers in each year level or role

PRE-SCHOOL	1	2	3	4	5	6	7	8-12	SUPPORT TEACHERS	DEPUTY PRINC.	PRINC.	TOTAL
1	2	4	3	2	2	2	3	3	6	1	4	34

Teaching experience of the teachers in the sample ranged from less than 1 year to 34 years. Table 3 below shows the number of teachers in each category of years of teaching experience.

Table 3

Number of teachers in each category of years of teaching experience

LESS THAN 2 YEARS	2 - 5 YEARS	6 - 10 YEARS	11 - 19 YEARS	20 - 29 YEARS	30 + YEARS
1	3	6	10	10	3

Agreement with testing system in principle

Opinion is very divided about the whole idea of compulsory numeracy testing (mean response = 3.3). Although 36% agreed moderately, 33% showed no or little agreement, and 30% agreed quite a lot of to a great extent. Positive comments made in this item included (i) that the tests were a good indication of numeracy standards, (ii) comparisons could be made with the rest of the state, and (iii) the tests provide a measure of accountability. Negative/cynical comments included that (i) the tests may serve political purposes rather than educational needs, (ii) test results should not be made public to show the schools with the best results, (iii) the tests do not support students' learning nor indicate students' ability, and (iv) the tests may lead to too much emphasis on testing.

Validity of tests

Responses to the items on test validity showed that the teachers believe that the test results give more of an indication of the pupils' numeracy ability (mean response = 3.1) than the quality of the school's numeracy program (mean response = 2.5) or the teacher's ability to teach mathematics (mean response = 2.2). One teacher's comment indicated that the test could be trusted because it was a state test. Another teacher indicated that the numeracy ability was related to the test content, whilst another was concerned about the tests catching students on a "bad day".

Preparation before and analysis after the tests

It appears from the teachers in this sample that there is less effort given to preparing the pupils for the tests (mean response = 2.4) than to analysing the results afterwards (mean response = 3.2). The type of preparation that occurs is mainly giving the students previous years' tests for practice and giving students practise at filling in their responses on the forms correctly (so that their answers are recorded accurately during computer

scanning). The post-test analyses included looking for possible gaps in teaching and identifying weaknesses by examining questions which had poor performance.

Impact of the tests on teachers

The data show that the numeracy tests have influenced what mathematics content they teach (mean response = 2.6) more than how they teach (mean response = 2.2), and more than how they assess mathematics (mean response = 2.1). In regard to *what* they teach, some teachers now teach more problems solving, more space (geometry), and more of 'what's on the test'. In regard to *how* they teach, some now use the language and vocabulary of the tests, and some look at the weaknesses of their pupils.

Impact on students

There seems to be a mixture of opinion about the impact of the tests on students. Although teachers thought overall that students were able to cope with the tests to a moderate extent (mean response = 2.9), teachers also thought that many students became anxious to a moderate extent (mean response = 3.3). Some teachers commented that students got confused with some of the language used in the tests, and that some students (especially in Year 3) became distraught during the test. One special education teacher noted that the tests were frustrating for visually impaired students.

Table 4

Mean responses for items relating to the use of test results

[Response values: 1 = none; 2 = a little; 3 = moderately; 4 = quite a lot; 5 = a great extent]

NO.	ITEM	MEAN RESPONSE
12	To what extent do you use the results of the Numeracy Tests to judge how well the class is progressing?	2.6
13	To what extent do you use the results of the Numeracy Tests to identify individual students who are having difficulties?	2.7
14	To what extent do you use the results of the Numeracy Tests to plan your teaching?	2.5
15	To what extent do you use the results of the Numeracy Tests to give students feedback on their strengths and abilities?	2.0
16	To what extent do you use the results of the Numeracy Tests to inform students about their weaknesses?	1.6
17	To what extent do you use the results of the Numeracy Tests to encourage students to learn their work?	1.7
18	To what extent do you use the results of the Numeracy Tests to notify parents about their child's performance?	2.7
19	To what extent does the school use the results of the Numeracy Tests to notify parents about the school's <u>overall</u> performance?	2.3
20	To what extent does the school inform the community about the school's overall performance in the Numeracy Tests ?	2.5

Use of results

Although schools indicate that they use the results of the tests, the responses to these items indicate that they don't seem to make a lot of use of the data. All mean responses to these items were less than 3 (moderate extent). The uses that received the highest responses were Item 13 (to identify individual students having difficulties, 2.7), Item 12 (to judge how well the class is progressing, 2.6) and Item 18 (to notify parents about their child's performance, 2.7). The items receiving the lowest mean responses were Item 16 (to inform students about their weaknesses, 1.6) and Item 17 (to encourage students to learn their work, 1.7). Table 4 shows the mean responses for all Items 12 to 20.

One teacher commented that the results of the tests came too late in the year for the class teacher to make meaningful use of the data. The reports of results are sent to schools in December, just before the end of the school year. So it's too late for the school as a whole and the class teachers to analyse the results and take account of the data in their planning.

Discussion

It appears from this pilot study that, just from a small sample of teachers, there is a wide diversity of opinion about the Year 3, 5 & 7 tests. Whilst some teachers agree in principle with the tests to a great extent, a sizable proportion of teachers don't agree. It would be not only interesting but also important to determine the distribution of views in a larger, more presentative sample of teachers.

There's also a wide diversity in the impact that the numeracy testing system has had on teaching practices. Some teachers are taking advantage of the tests results and are using the data to inform their planning and give students feedback on their performance. The classes of such teachers would benefit from such practices whereas other classes (perhaps those of teachers who don't agree as much with the testing) are not being given the same opportunities. The implication is that inequities may be occurring in the system and these may be compounding in subsequent years. The literature on teacher change and professional development indicates that changes in teaching practices go hand in hand with changes in teachers' beliefs, and this could well be the case here with compulsory numeracy testing. A study with a significantly larger sample would allow testing for a correlation between the teachers' beliefs and practices with reference to the numeracy tests.

It's interesting to speculate about the reasons behind teachers' beliefs about the validity of the tests, namely, thinking that the tests are more of an indication of the pupils' numeracy ability, rather than the teachers' ability or the school's numeracy program. It may be that teachers don't believe in the effect of their own actions, or that they don't have sufficient confidence that their teaching can make a difference to their students' performance in numeracy. Maybe it's easier to attribute success to the pupils' ability levels than their teaching abilities. Such reasons could also be behind the relatively low mean responses for the items concerning the impact on teachers' practices – i.e. what and how they teach mathematics, and how they assess mathematics. If teachers believe that their teaching does not contribute significantly to their pupils' performance, then it would not be worthwhile to change what they do. These issues need further investigation with a larger sample of teachers.

Although most teachers think that their students cope with the tests in general, there is some concern for the negative impact in relation to anxiety levels, especially with Year 3 students. It seems that teachers perceive the Year 3, 5 & 7 tests quite differently to the Year 2 Diagnostic Net, which has been seen in a very positive light (Nisbet & Warren, 1999). If the concerns about testing children in Year 3 are widespread then there may be reason to investigate (a) the validity and appropriateness of putting children of a young age through such an experience, and (b) the alternative of extending the Diagnostic Net into Year 3.

With regard to schools analysing the test results and making use of the data, there seems to be a discrepancy between schools' intentions which are signalled in their reports sent to QSCC/QSA and what happens in reality afterwards. Although the test data sent to schools is comprehensive, schools may need assistance firstly in interpreting the data, and secondly in working out what to do in the light of the interpretation.

Another relevant factor appears to be the lateness of reports being sent to schools. One teacher commented that the results of the tests came too late in the year for the class teacher to make meaningful use of the data. The Year 7 students graduate to secondary school the following year, so there is no time to act on the data. Although the majority of Year 3 and Year 5 students remain at the school for the following year, the business of starting the new school year probably distracts the school from taking appropriate action in many cases. Hence the late arrival of the report in schools may explain the relatively low mean response values for the items concerning how teachers use the test data. The issue is worth being considered by the testing authority with a view to giving schools more opportunity to take advantage of the data available.

In terms of the Clark and Peter (1993) model of professional growth, practical issues such as lateness of the school reports and lack of expertise or support for analysing and interpreting the test data are probably limiting the amount of activity in the *Domain of Practice* which in turn is limiting teachers seeing valued outcomes (*Domain of Inference*) and influencing teachers knowledge and beliefs (*Personal Domain*). Thus the cycle of professional growth is severely impeded. It appears that the potential for enhancing numeracy outcomes and improving teaching practice has not yet been fully tapped.

In conclusion, there is enough information arising from this pilot study to warrant further investigation with a larger, more representative sample. Issues such as beliefs about test validity and attitudes towards the tests should be studied in relation to the impact the tests have on the teaching and assessing of mathematics, and the use schools make of the test results. Findings may stimulate debate in schools and could be referred to policy makers for consideration.

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Appendix 1

Survey items and summary of results

NO.	ITEM	NONE	A LITTLE	MODER- ATELY	QUITE A LOT	A GREAT EXTENT	NOT SURE OR N/A
1	To what extent do the results of the Year 3, 5, & 7 Numeracy Tests give an accurate indication of the pupils' numeracy ability? Comment:	0	6	16	9	0	5
2	To what extent do the results of the Year 3, 5, & 7 Numeracy Tests give an accurate indication of the teacher's ability to teach mathematics? Comment:	8	11	11	1	0	5
3	To what extent do the results of the Year 3, 5, & 7 Numeracy Tests give an accurate indication of the quality of the school's numeracy program? Comment:	3	11	13	3	0	6
4	To what extent does your school prepare pupils for the Year 3, 5, & 7 Numeracy Tests? Explain how:	1	8	13	4	2	8
5	To what extent does your school analyse the results of the Year 3, 5, & 7 Numeracy Tests after the results are received? Explain how:	2	5	7	8	3	7
6	To what extent do the pupils cope easily with the Numeracy Test experience? Comment:	1	7	14	5	0	10
7	To what extent do the pupils become anxious with the Numeracy Tests? Comment:	0	8	7	9	3	9
8	To what extent do you agree with the whole idea of compulsory Numeracy Tests being conducted in all schools? Why?	2	9	12	6	4	4

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NO.	ITEM	NONE	A LITTLE	MODER- ATELY	QUITE A LOT	A GREAT EXTENT	NOT SURE OR N/A
9	To what extent have the Numeracy Tests influenced <u>what</u> you teach in mathematics? Explain:	5	11	10	5	1	4
10	To what extent have the Numeracy Tests influenced <u>how</u> you teach in mathematics? Explain how:	8	13	7	4	0	4
11	To what extent have the Numeracy Tests influenced how you <u>assess</u> the pupils in mathematics? Explain how:	10	9	13	0	0	5
12	To what extent do you use the results of the Numeracy Tests to judge how well the class is progressing?	5	7	13	0	3	7
13	To what extent do you use the results of the Numeracy Tests to identify individual students who are having difficulties?	6	8	7	5	3	6
14	To what extent do you use the results of the Numeracy Tests to plan your teaching?	6	8	13	3	1	7
15	To what extent do you use the results of the Numeracy Tests to give students feedback on their strengths and abilities?	10	10	7	1	0	7
16	To what extent do you use the results of the Numeracy Tests to inform students about their weaknesses?	10	8	8	1	0	7
17	To what extent do you use the results of the Numeracy Tests to encourage students to learn their work?	12	7	8	1	1	7
18	To what extent do you use the results of the Numeracy Tests to notify parents about their child's performance?	5	10	7	2	5	7

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NO.	ITEM	NONE	A LITTLE	MODER- ATELY	QUITE A LOT	A GREAT EXTENT	NOT SURE OR N/A
19	To what extent does the school use the results of the Numeracy Tests to notify parents about the school's <u>overall</u> performance?	6	13	5	3	1	7
20	To what extent does the school inform the community about the school's overall performance in the Numeracy Tests ?	5	10	6	5	1	8

