THE 2004 NATIONAL ASSESSMENT OF MATHEMATICS ACHIEVEMENT

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EDUCATIONAL RESEARCH CENTRE

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Preface

The 2004 National Assessment of Mathematics Achievement (NAMA 2004) in Irish primary schools is the fifth in a series of such assessments dating back to the late 1970s, and the first since the introduction of the 1999 Primary School Mathematics Curriculum (PSMC). As an assessment was carried out in Fourth class in 1999, using an instrument broadly similar to that used in the current study, it was possible to compare performance in 1999 with performance in 2004.

The context of the report is described in Chapter 1, which provides terms of reference, introduces key variables of interest, and illustrates how the current assessment relates to other national and international assessments of mathematics. Details of test instruments, their similarity with the 1999 instruments, and how items relate to the content strands and process skills identified in the PSMC are presented in Chapter 2. Sampling methodology and proficiency levels are detailed in Chapter 3. In Chapter 4, overall levels of mathematics achievement are analysed by content strand and process skill, at key benchmarks, and by proficiency level, and teacher judgements of pupils' achievements are described. Performance on items for which pupils could use calculators is also described. Chapter 5 provides a description of pupil characteristics, such as attendance, classroom behaviour, and attitudes to mathematics, particularly in relation to gender. Home background variables, such as family structure, socioeconomic status, parents' educational attainment and involvement in children's schooling, and availability of educational resources in the home are considered in Chapter 6. Aspects of the classroom environment, including teachers' backgrounds and attendance at in-career development courses, classroom composition, and issues associated with the planning and teaching of mathematics are outlined in Chapter 7. School-level variables are considered in Chapter 8. These include school size, structure, and location, designated disadvantaged status, socioeconomic composition, availability of support for lower-achieving pupils, home-school links, and curriculum implementation. Chapter 9 focuses on learning support for mathematics, including provision, experience and training of learning support teachers, issues affecting the provision of learning support, and the availability and use of resources in learning support lessons. The views of inspectors on the teaching, learning, and assessment of mathematics are presented in Chapter 10. Conclusions and recommendations follow in Chapter 11. Where relevant, chapters include a section in which the findings of the 1999 and 2004 studies are compared.

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Seán O'Cearbhaill	Department of Education and Science (Chair)
Paraic Barnes	Department of Education and Science
Shirley Brook	Church of Ireland Board of Education
Sarah Fitzpatrick	National Council for Curriculum and Assessment
Maria Murphy	National Parents' Council – Primary
Deirbhile Nic Craith	Irish National Teachers' Organisation
Dónal Ó hAinifféin	Gaelscoileanna
Valerie O'Dowd	Primary Curriculum Support Programme
Seán de Paor	An Foras Pátrúnachta

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Executive Summary

The 2004 National Assessment of Mathematics Achievement (NAMA 2004) was administered to 4171 pupils in Fourth class in 130 primary schools in May 2004. The survey – the first since implementation of the 1999 Primary School Mathematics Curriculum began in schools in 2002 – involved the administration of a test of mathematics to pupils, and the completion of questionnaires by the pupils, their parents, and their class teachers, learning support teachers and school principals. Primary school inspectors also completed a questionnaire.

Performance on the Overall Scale and on Mathematics Content Strands and Skills

The test used in 2004 was broadly similar to the one used in a national assessment in 1999. Both assessments were based on the 1999 Primary School Mathematics Curriculum. The 2004 test comprised 150 items – 116 items from the 1999 test, 9 items to replace those dropped from the 1999 test, and a new section of 25 items for which a calculator was available to pupils. Items were grouped into sections of 25, and each pupil was asked to complete three sections (75 items). The 2004 test was scaled using Item Response Theory, with the 1999 scale used as an anchor. The overall mean score in 2004 was 250.8. This was not significantly different from the overall score of 250.0 in 1999. There was a significant increase in achievement in two mathematics strands – Shape & Space, and Data – and in one mathematics skill – Reasoning. Pupils performed less well on the items for which they had access to a calculator than on other item sections.

Performance on the Mathematics Proficiency Scales

A five-level mathematics proficiency scale developed for the first time in 2004 allows performance to be interpreted with reference to key content and process skills that pupils in Fourth class are likely to have achieved. At any given level, pupils have about a 50% chance of answering the items at that level correctly, a greater than 50% chance of answering items at a lower level correctly, and a less than 50% chance of answering items at a higher level correctly. Twelve percent of pupils achieved at an advanced level (Level 5); 26% at a high level (Level 4); 26% at a moderate level (Level 3); 22% at a basic level (Level 2); and 12% at a minimal level (Level 1). Three percent achieved below the basic level. Although pupils scoring below basic may have had some mathematics skills, NAMA 2004 did not assess them. According to teachers, just over one-fifth of pupils (22%) were performing below the level expected of pupils in Fourth class in mathematics.

Gender Differences and Other Pupil Characteristics

In NAMA 2004, there was no overall difference in the performance of boys and girls in mathematics achievement, although boys performed significantly better at the 75th and 90th percentiles, and achieved a significantly higher mean score on items in the Measures content strand. Teacher ratings of pupil classroom characteristics, such as attention and persistence in schoolwork, were moderately correlated with mathematics performance, with girls likely to be rated higher than boys on such characteristics. Boys reported a higher average level of self-efficacy (confidence) in mathematics than girls, and this variable was also associated with mathematics achievement ($r = .36$). Although girls reported a higher average level of enjoyment of mathematics, the variable did not correlate significantly with achievement.

Home Background and Achievement

Pupils' average mathematics achievement increased in line with their parents' level of educational attainment. Pupils in two-parent families achieved a mean score that was two-fifths of a standard deviation higher than mean of pupils in lone-parent families, while pupils with one, two or three siblings achieved higher mean scores than pupils with no siblings, or pupils with four or more. The mean score of pupils who were members of the traveller community was significantly lower (by over one standard deviation) than that of pupils in the settled community. Pupils born in Ireland (89% of pupils) and pupils born elsewhere (11%) did not differ significantly in achievement.

Pupils with access to a suitable study area at home, a home computer, the Internet, or a calculator achieved significantly higher mean mathematics scores that pupils without access to these resources, while pupils who had a computer/games console, a television, or a video/DVD player in their bedroom had significantly lower mean scores than pupils who did not. Pupils who spent one to two hours playing computer/console games on a daily basis (8% of pupils) achieved a mean score that was significantly lower than that of pupils who spent up to one hour on such games (20%) and pupils who spent no time (73%). Pupils who did not spend any time reading at home on a daily basis (20%) achieved a mean score that was significantly lower than the means of pupils who spent up to one hour (52%), one to two hours (22%), or more than two hours (6%).

Although pupils in NAMA 2004 did well on Data items, relative to other content strands, just 80% of parents were satisfied with their pupils' progress in this strand, compared with 92% for Number, and 88% for Shape & Space. Parents' overall satisfaction with their children's mathematics was positively associated with the children's mathematics achievement and self-efficacy. Just 3% of parents had participated in a programme designed to assist them in supporting their child's mathematics achievement.

Parents said that 90% of pupils received mathematics homework at least three or four times a week, and that 75% spent 15 minutes a day or less doing it. Pupils needed most help with homework relating to problem solving. Pupils whose parents reported that they spent about 5 minutes a day on mathematics homework performed significantly better than pupils who, according to their parents, spent greater amounts of time, suggesting that homework was easier for higher-achieving than for lower-achieving pupils. Similarly, those pupils who received most help on mathematics homework from their parents performed less well than pupils who received little or no help.

Classroom Environment

In 2004, 46% of pupils were taught by teachers with fewer than 10 years experience, compared to 1999, when 17% of pupils in Fourth class were taught by a teacher under 30 years of age, suggesting that pupils in 2004 were taught by less experienced teachers than in 1999. On the other hand, whereas in 1999, just 16% of pupils had been taught by teachers who had attended in-career development courses in the previous five years, in 2004 the corresponding percentage was 94, reflecting participation in in-career development associated with the introduction of the 1999 Primary School Mathematics Curriculum. Teachers who had attended courses related to the revised curriculum were more satisfied with the amount of ICD they had received on Number and Integrating & Connecting than on Shape & Space and Applying & Problem Solving. Aspects of mathematics which teachers would like to see covered more in ICD courses include using information and communication technologies, identifying learning difficulties, interpreting standardised test scores, grouping children, and conducting classroom-based assessments.

In 2004, pupils in Fourth class received an average of 216 minutes of mathematics instruction per week. This is significantly lower than in 1999, when the corresponding average was 250 minutes. The average class size in single-grade Fourth classes in 2004 (27.3 pupils) was significantly lower than in 1999, when the corresponding average was 30.0 pupils. On the other hand, average class size in multi-grade classes that included Fourth class did not change significantly between the two years (27.0 in 1999; 27.4 in 2004).

In 2004, teachers of 95% of pupils said that they used textbooks in mathematics classes on a daily basis. In contrast, 78% of pupils were in classes in which calculators were used no more than once or twice a month, while 85% were in classes in which computers were used to teach mathematics with similar infrequency. Although one-half of pupils were in classes in which concrete materials were used at least once a week, the remainder were in classes in which such materials were used no more frequently than once or twice a month.

Most pupils in 2004 were taught by teachers who agreed that the attitude towards the 1999 PSMC in their school was positive, and that their school had a clear set of goals for teaching mathematics. Fewer were taught by teachers who agreed that their school had a clear set of goals and priorities for staff development.

School Environment

A number of school-level variables were associated with pupils' mathematics achievement including designated disadvantaged status, the percentage of pupils in the Schools Books for Needy Pupils scheme, average school socioeconomic status (based on the average SES of pupils in the school), and average level of school attendance. The mean achievement score of pupils in designated schools was some seven-tenths of a standard deviation lower than the mean of pupils in non-designated schools, while 25.6% of pupils in designated schools, but only 7.6% in non-designated schools achieved scores that were at or below the 10th percentile. On the mathematics proficiency scale, 7.8% of pupils in designated schools, but only 1.7% in non-designated schools, performed below minimum level.

The most serious issues identified by school principals as affecting the teaching of mathematics were inadequate learning support provision, large classes, inadequate classroom accommodation, and multi-grade classes. Lack of in-career development opportunities, shortages of concrete materials and equipment, and teaching multi-grade classes were viewed as relatively less serious in 2004 than in 1999.

Attitudes of principals towards the 1999 PSMC and its implementation in the classroom were largely positive, with the vast majority indicating that teachers were receptive towards the PSMC, that it had resulted in greater engagement of pupils in practical activities, and that it had been implemented successfully in their schools. However, principals were not in agreement with one another that calculators were an important component of the PSMC, that the PSMC had improved pupils' problem solving skills, or that it had enhanced their overall achievement in mathematics.

Learning Support

In 2004, just under half of pupils in Fourth class attended schools in which learning support for mathematics was provided, with pupils in larger schools more likely to access such support than pupils in medium-sized and small schools. In that year, fewer pupils (14.4%) were identified as needing learning support for mathematics than in 1999 (20.5%). Across all schools, 6.5% of pupils were in receipt of learning support for mathematics in 2004. This was lower than, but not significantly different from, the corresponding figure in 1999 (7.7%). In 2004, just over 4% of pupils with a specific or general learning disability were in receipt of resource teaching that included an emphasis on mathematics (the corresponding percentage for 1999 is not available). Fewer pupils in the Junior classes were in receipt of learning support compared to the Senior classes. On average, learning support teachers who taught mathematics allocated twice as much time to providing learning support for English as for mathematics.

Just 57% of teachers who provided learning support for mathematics had completed a one-year, part-time in-service course, or were completing a course at the time of the study. Most of these were satisfied with the content of such courses as they related to mathematics and to learning support. The areas of working with parents, working with class teachers, interpreting standardised tests, and developing individual learning programmes were identified as requiring additional attention. Learning support teachers indicated that they concentrated on the content strands of Number and Algebra, and on the skills of Implementing, Integrating & Connecting, and Understanding & Recalling in learning support classes.

Most learning support teachers who provided learning support in mathematics agreed that the *Learning Support Guidelines* as they related to mathematics were being implemented in their school, and that they were useful. However, fewer believed that class teachers were familiar with the *Guidelines*. By 2004, the main criterion used for selecting pupils for learning support for mathematics had changed from teacher observations to standardised test scores.

Views of Inspectors

While 86% of inspectors who responded to a questionnaire as part of the current survey were at least satisfied with the teaching of Number, 82% with Measures, and 70% with Shape & Space, just 54% expressed satisfaction with the teaching of Algebra, and 36% with the teaching of Data. There were also differences in inspectors' satisfaction with the teaching of mathematics skills. While 84% reported satisfaction with the teaching of Understanding & Recalling, just one-quarter were satisfied with Applying & Solving Problems. More inspectors were dissatisfied than satisfied with how mathematics was taught to low-achieving pupils and with the integration of class and learning support programmes for pupils with learning difficulties in mathematics. While the quality of feedback provided to pupils for class work was considered to be adequate, the quality of feedback to pupils on homework was not. Inspectors supported the provision of more learning support for mathematics, and improved integration between class and learning support/resource teaching programmes for mathematics. While almost three-quarters viewed class teachers' knowledge of mathematics concepts and processes to be very or quite comprehensive, teachers' knowledge of methods of teaching mathematics was identified as an area in need of improvement.

List of Abbreviations and Acronyms

CI	Confidence Interval
DES	Department of Education and Science
ERC	Educational Research Centre
ICD	In-Career Development
ICTs	Information and Communication Technologies
ISEI	International Socio-Economic Index
IRT	Item Response Theory
NAER	National Assessment of English Reading
NAMA 1999	National Assessment of Mathematics Achievement 1999
NAMA 2004	National Assessment of Mathematics Achievement 2004
NCCA	National Council for Curriculum and Assessment
OECD	Organisation for Economic Co-operation and Development
PCSP	Primary Curriculum Support Programme
PSMC	Primary School Mathematics Curriculum
PISA	Programme for International Student Assessment
SEG	Socioeconomic Group
SE	Standard Error
SED	Standard Error of the Difference
SES	Socioeconomic Status
TIMSS	Third International Mathematics and Science Study

1. The Context of the 2004 National Assessment of Mathematics Achievement

The purpose of this chapter is to describe the context in which the 2004 National Assessment of Mathematics Achievement of Fourth class pupils was carried out. The first section outlines the terms of reference for the study. In the second, earlier national and international assessments involving students in Ireland are reviewed. The third, fourth, and fifth sections summarise recent research findings concerning relationships between mathematics achievement and pupil, school, and classroom characteristics. The sixth section summarises results of recently published evaluations of the implementation of the 1999 Primary School Mathematics Curriculum (PSMC), and the seventh considers the preparation of teachers to teach mathematics.

TERMS OF REFERENCE FOR THE CURRENT STUDY

The terms of reference for the 2004 National Assessment of Mathematics Achievement, agreed between the Department of Education and Science and the Educational Research Centre in January 2004, are as follows:

1. To conduct a study of the mathematics achievements of a representative national sample of pupils in Fourth class in primary schools.
2. To compare the performance of pupils in 2004 with the benchmarks established in the 1999 National Assessment of Mathematics Achievement in Fourth class.
3. To examine the use of calculators by pupils in Fourth class.
4. To examine associations between mathematics achievement and relevant pupil, teacher, and school factors, and report on any changes arising since the 1999 national assessment.
5. To examine ways in which the teaching and assessment of mathematics have evolved since the introduction of the revised Primary School Mathematics Curriculum.
6. To obtain the views of members of the inspectorate (primary level) on the teaching and assessment of mathematics in schools.
7. To make recommendations with regard to the teaching and assessment of mathematics in schools.

The terms of reference refer to the 1999 National Assessment of Mathematics Achievement (NAMA 1999), which gathered baseline data on the performance of pupils in Fourth class, prior to the introduction of the 1999 PSMC (DES/NCCA, 1999b, 1999c) in September of that year. Although an earlier curriculum (*Curaclam na Bunscoile*) was in place in schools when NAMA 1999 was implemented (in May 1999), the assessment employed a test of mathematics that was broadly compatible with the 1999 Curriculum (see Chapter 2), allowing comparisons with subsequent assessments based on the 1999 PSMC. Thus, the 2004 study provided an opportunity to consider the initial impact of the 1999 PSMC on the teaching and assessment of mathematics, in the context of the baseline data provided by principals, teachers, parents, and pupils in 1999.

Since an important development in the 1999 PSMC was the introduction of calculators into classrooms on a systematic basis, the current study examined the performance of pupils on a set of test items for which calculators were available, and also the use of calculators by pupils in mathematics classes.

EARLIER NATIONAL AND INTERNATIONAL ASSESSMENTS OF MATHEMATICS ACHIEVEMENT

National assessments of mathematics achievement involving pupils in primary schools have been conducted in Ireland since 1977 (Table 1.1), while Irish pupils – both primary and post-primary – have participated in international surveys of achievement in mathematics (and science) since 1988 (Table 1.2). The focus of this section is on assessments involving primary-level pupils

National Assessments of Mathematics Achievement

Following implementation of the 1971 curriculum (Department of Education, 1971), a series of surveys was conducted by the Department of Education and Science, beginning in 1977 (Table 1.1). The purpose of the surveys was to ‘assess the level of achievement of pupils in mathematics specified in the primary school curriculum’ (Martin, 1990). Sets of objectives were drawn up, based on the mathematics framework and content presented in Curaclam na Bunscoile (see Department of Education, 1978), and criterion-referenced tests were developed around those objectives. Performance was reported in terms of the percentages of pupils achieving each key objective.

Table 1.1 *National Assessments of Mathematics Achievement 1977-2004*

Year	Population Assessed	Report
1977	Second and Fourth classes (primary)	Department of Education (1980)
1979	Sixth class (primary)	Department of Education (1980)
1984	Sixth class (primary)	Department of Education (1985)
1999	Fourth class (primary)	Shiel and Kelly (2001)
2004	Fourth class (primary)	

A feature of the earlier assessments was the strong emphasis on Number. In the 1977 assessment in Fourth class, for example, 18 of the 32 objectives assessed were in the areas of Operations with Whole Numbers, Whole Number Structure, and Fractions and Decimals, while just 3 were in the area of Spatial Experience (Geometry).

The outcomes of the 1977 assessment at Fourth class showed that pupils were strongest on Operations with Whole Numbers (75% correct). Performance was in the average range in three areas – Whole Number Structure (59%), Measurement (58%) and Fractions and Decimals (58%) – and relatively weaker in three – Spatial Experiences (Geometry) (50%), Graphs (53%) and Problems (41%) (Department of Education, 1980). The 1979 and 1984 assessments in Sixth class revealed again that pupils were strongest in Operations with Whole Numbers (85.7% correct in 1979, and 83.3% in 1985) and Operations with Fractions (70.0% and 75.2%), and weakest in the areas of Problems (52.2%; 50.8%), Metric Measure (44.0%; 48.8%) and Geometry (34.2%; 37.1%).

After a lapse of several years, a new series of national assessments of mathematics achievement began in 1999. The main purposes of the first of these (NAMA 1999) were to generate baseline data that could be used to monitor achievement over time, to identify factors related to the mathematics achievement of pupils, and to make recommendations with regard to the teaching and assessment of mathematics. The assessment framework was closely aligned to the 1999 Primary School Mathematics Curriculum. A set of assessment tasks was designed to ascertain pupils' performance in five mathematics content strands and five mathematics skills in the curriculum. Just one skill – Communicating & Expressing – was not assessed, since it was judged that it could not be tested using a paper and pencil test. Pupils did not have access to a calculator during the assessment (Shiel & Kelly, 2001).

NAMA 1999 provided several indicators of pupils' achievements in mathematics. Overall performance was summarised in terms of a mean score of 250 and a standard deviation of 50. Scaled scores corresponding to the 10th, 25th, 50th, 75th, and 90th percentile ranks on the overall performance scale were also identified.

A more detailed breakdown of the curriculum by strand showed that pupils performed best on items in the Data (mean percent correct score = 68.6%), Number (59.6%) and Algebra (58.4%) strands, and less well on Measures (54.1%) and Shape & Space (45.3%). Performance on mathematical skills was strongest on items tapping lower-level skills such as Understanding & Recalling Terminology, Facts & Definitions (62.9%) and Implementing Mathematical Procedures & Strategies (58.0%), and somewhat weaker on items tapping higher-level processes such as Engaging in Mathematical Reasoning (55.4%), Applying & Problem Solving (54.0%) and Understanding & Making Connections between Mathematical Processes & Concepts (54.0%). According to their teachers, 15% of pupils in Fourth class were 'weak' in mathematics. Eighteen percent were judged to be achieving at a Third class level, while a further 2% were rated as performing at Second class level or lower.

International Assessments of Mathematics Achievement

Ireland has participated in a number of international assessments of mathematics achievement since the late 1980s (Table 1.2). The most recent study in which Irish pupils in primary schools participated was the Third International Mathematics and Science Study (TIMSS) in 1995.

Table 1.2 *International Assessments of Achievement Involving Mathematics, in which Students in Ireland Have Participated, 1980-2003*

Year	Study	Population(s)	Report
1980	Second International Mathematics Study (SIMS)*	1st Years and 6th Years	Carey (1990)
1989	International Assessment of Educational Progress I (Mathematics and Science) (IAEP I)	13-year olds	Lapointe, Mead & Phillips (1989)
1991	International Assessment of Educational Progress II (IAEP II)	9- and 13-year olds	Lapointe, Mead & Askew (1992); Martin, Hickey & Murchan (1992)
1995	Third International Mathematics and Science Study (TIMSS)	3rd/4th classes 1st/2nd years	Beaton et al. (1996)
2000	OECD Programme for International Student Assessment (PISA 2000)	15-year olds	OECD (2001); Shiel et al. (2001)
2003	OECD Programme for International Student Assessment (PISA 2003)	15-year olds	OECD (2004); Cosgrove et al. (2004)

**Ireland participated in the curriculum analysis component of SIMS (see Oldham, 1989). Achievement data were only gathered in the context of a follow-up study in First year (Carey, 1990), but were not analysed at international level.*

In TIMSS 1995, nationally representative samples of pupils in Third and Fourth class (as well as First and Second years, post-primary) participated in assessments of mathematics and science that were based on aspects of school mathematics deemed to be important by participating countries. Third class pupils in Ireland achieved an overall mean score of 470 points, and a ranking of 7th among 16 countries that satisfied sampling and response rate criteria (Mullis, Martin, Beaton, Gonzalez, Kelly, & Smith, 1997). At Fourth class, pupils in Ireland achieved a mean score of 529 on the same scale, and a ranking of 6th. At both levels, students in Korea, Singapore, Japan, Hong Kong, and the Czech Republic performed significantly better than students in Ireland, while students in England, New Zealand and Norway did significantly less well. While the mean performance of Third class pupils in Ireland did not differ significantly from the international country average, the mean performance of Fourth class pupils was significantly higher (Mullis et al., 1997). The Fourth class mean was also significantly higher than the mean score of participating OECD countries (OECD, 2000).

Fourth class students in Ireland achieved mean scores that were significantly higher than the corresponding international average percent correct scores in four mathematics strands assessed by TIMSS: Whole Numbers; Fractions & Proportionality; Data Representation, Analysis & Probability; and Patterns, Relations & Functions. They achieved mean scores that were not significantly different in the remaining two: Measurement, Estimation & Number Sense; and Geometry.

The most recent study involving mathematics in which Irish 15-year olds in post-primary schools participated was the OECD Programme for International Student Assessment (PISA) in 2003 (Cosgrove, Shiel, Sofroniou, Zastrutzki, and Short, 2005; OECD, 2004). In this study, Irish students achieved an overall mean score of 502.8, which was not significantly different from the OECD country average of 500. Ireland's overall ranking was 17th of 29 OECD countries and 20th of 40 participating countries that met criteria for sampling/participation. Hong Kong-China had the highest mean score (550.4), while Finland ranked second (544.3), and Korea (542.2) third. Performance in Ireland was above the OECD country average scores in two content areas: Change & Relationships, and Uncertainty. Performance was not significantly different from the OECD country average in one area: Quantity. Performance was significantly below the OECD country average on Space & Shape (which included elements of Geometry).

PUPIL CHARACTERISTICS

The purpose of the current survey is to not only describe the achievements of pupils in mathematics, but also to identify variables associated with achievement. The review that follows summarises pupil-level associations with achievement in earlier national and international assessments of mathematics, as well as in research conducted in other contexts.

Pupil Gender

Recent international and national studies of mathematics achievement conducted at primary level indicate minimal differences between the performance of male and female pupils. In TIMSS 1995, girls in Ireland achieved a marginally higher mean score than boys in Third grade (479 vs. 473), and in Fourth grade (551 vs. 548) (Mullis et al., 1997). Neither difference was statistically significant. Only a few TIMSS countries showed significant overall gender differences in mathematics achievement, all in favour of boys: Norway, Iceland, Japan, Korea, and Hong Kong at Third grade and Japan and Korea at Fourth grade. In Ireland, differences in performance in the mathematics content areas at Third- and Fourth-class levels were small, and none reached statistical significance. Neither were the proportions of girls and boys in Ireland scoring in the bottom and top quintiles on the overall mathematics scales at these class levels statistically different.

In NAMA 1999 in Fourth Class, the overall mean score of boys was 250.4, while that of girls was 249.6, a difference that is not statistically significant (Shiel & Kelly, 2001). More boys than girls achieved scores that were at or below the 10th percentile (11.0% vs. 9.0%) but again the difference is not statistically significant. However, significantly more boys than girls achieved scores that were at or above the 90th percentile (12.3% vs. 7.8%). Differences in average achievement between boys and girls on the five mathematical strands and five mathematics skills were small, and none reached statistical significance.

In PISA 2003, male students in Ireland had a mean score that was 14.8 points (one-sixth of a standard deviation) higher than the mean score of females. Further, males outperformed females in all four PISA overarching ideas, with the largest difference – one-quarter of a standard deviation – occurring in Space & Shape.

Significantly more males (13.7%) than females (9.0%) achieved Levels 5 or 6 on the PISA overall mathematics proficiency scales, an outcome that is similar to that found for mathematics in Fourth class in NAMA 1999, where significantly more boys than girls achieved scores at or above the 90th percentile.

Home Background

A number of national and international studies have shown moderately strong links between indicators of home background and mathematics performance. The indictors include measures of parental education, parental employment status, home educational environment, and home educational resources.

In NAMA 1999, a correlation of .34 was obtained between parental education (the highest level of education of a pupil's mother or father) and mathematics achievement. In PISA 2003, a correlation of .27 was obtained between parental educational attainment and mathematics achievement. These correlations indicate that, as parental educational levels increase, students' mathematics achievement also increases, though the relationship is not a perfect one. Also in PISA 2003, a correlation of .32 was obtained between a measure of parents' socioeconomic status (based on the highest occupation of either parent) and students' mathematics achievement.

Research highlights the importance of SES because of the opportunities it affords. Children from middle-class families are more likely to attend a greater number of extra-curricular activities than children from lower-class families, and are more likely to succeed academically. Horvat, Weininger and Lareau (2003) proposed that middle-class families have greater reserves of social capital to draw upon, providing greater access to resources, professional connections, and awareness of information structures. As a result, parental networks (and their capabilities) vary dramatically by social class. Parents from middle-class families are more likely to know the child's teacher, have a proactive role in determining the child's class/teacher, have more numerous links to other parents and more informal contacts with educators and other professionals, and are more likely to draw on this support and respond collectively to problems or issues, while working- class parents are more likely to respond at an individual level.

In addition to social capital, the cultural capital provided by families, exhibited in the structure and activities of homes relating to language use, planning of activities, discussion of ideas, guidance, aspirations and expectations, can contribute to the development of competencies in school (Bloom, 1981; Kellaghan, 2001; Kellaghan, Sloane, Alvarez, & Bloom, 1993). In a number of national and international assessments, the number of books in the home has been used as a proxy for cultural capital. In NAMA 1999, this variable was strongly correlated with mathematics achievement. There was a gap in achievement of over one standard deviation between pupils in Fourth class with zero to ten books in the home and those with 200 or more (Shiel & Kelly, 2001). In PISA 2003, the correlation between number of books in the home and mathematics achievement in Ireland was .36 (Cosgrove et al., 2005).

In an exploration of the role of cultural capital in the achievements of children living in an economically disadvantaged environment in Dublin, Kellaghan (1977) found significant correlations between six home environment variables (achievement press, language model, academic guidance, family activeness, intellectuality and work habits) and performance on a number of cognitive tests for 8 to 9 year olds whose parents worked in a disadvantaged area of Dublin. In a stepwise multiple regression analysis, academic press (defined as parental aspirations for education) predicted 30% of the variance in children's performance on a mental arithmetic test. In NAMA 1999, children of parents who expected them to complete a third-level degree course had a significantly higher mean score (273.6 points) than children of parents with lower expectations for educational attainment, such as a post-Leaving Certificate course (233.9), or the Leaving Certificate only (218.9).

SCHOOL CHARACTERISTICS

School Socioeconomic Status

School socioeconomic status has been associated with achievement in a number of curricular areas, including mathematics. One indicator of socioeconomic status is whether a school is in the Department of Education and Science's Designated Disadvantaged Area Schools Scheme. Schools in the scheme are provided with additional support, including additional teaching posts, and enhanced grants for equipment, resources, and home activities.

In NAMA 1999, pupils in schools designated as disadvantaged achieved a mean score in mathematics that was one-quarter of a standard deviation lower than the mean of pupils in non-designated schools. Moreover, 20.5% of pupils in designated schools, but only 8.0% in non-designated schools, achieved scores at or below the 10th percentile (Shiel & Kelly, 2001). In its evaluation of the teaching of literacy and numeracy in 12 designated disadvantaged schools, the DES Inspectorate reported that two-thirds of pupils (in First to Sixth classes) achieved scores that were in the bottom quintile (at or below the 20th percentile) on standardised tests administered by their teachers (DES, 2005). Moreover, the achievement in mathematics of pupils in these designated schools was found to decline, relative to pupils' generally, as they progressed through the school. In Fifth and Sixth classes, 73% of pupils scored in the bottom quintile (compared to an expected 20% in the general population).

School Problems and Resources

In NAMA 1999, principal teachers identified a lack of learning support in mathematics, inadequate in-service training for teachers, and multi-grade classes as the most significant problems in providing for the teaching and learning of mathematics. Problems that were deemed to affect larger proportions of pupils in designated than in non-designated schools included pupils' lack of interest in learning, shortages of computer hardware and software, and insufficient support from some parents.

Number, Measures, and Shape & Space were identified as areas in which additional equipment for teaching was needed by schools in general. Although all schools had computers, principal teachers indicated that they were not extensively used in teaching mathematics, and, where used, it was to address basic skills rather than reasoning, problem solving, or other higher-order skills (Shiel & Kelly, 2001).

School Development Planning

In NAMA 1999, the vast majority of pupils attended schools with policy statements on the teaching and learning of mathematics. Areas in which almost all schools had written policies included assessment of pupils' mathematics achievement and communication of pupils' progress in mathematics to parents. While the study noted that most pupils attended schools with policies on teaching computation across classes, just 30% of pupils attended schools with policies on teaching strategies for mathematical problem solving.

Four-fifths of pupils in NAMA 1999 attended schools with policies in relation to the administration of standardised tests of mathematics. A similar proportion of pupils attended schools in which standardised tests in mathematics were administered at least once a year. Fifty percent of pupils attended schools in which progress tests in mathematics (such as those accompanying some textbook series) were administered. The most common form of assessment was the use of teacher-made tests.

CLASSROOM CHARACTERISTICS

Class Size

In TIMSS 1995, the average number of Fourth-class pupils in a class in Ireland was 26. Average class sizes were considerably larger in a number of higher-scoring countries including Hong Kong (36 pupils), Korea (43) and Singapore (39). On the other hand, average class size in Ireland was one of the highest among participating European countries. Average class size in Scotland was similar to Ireland (26), while in England it was slightly larger (28). In general, class size was not associated with mathematics achievement. In Ireland, for example, the performance of pupils in small classes (1-20 pupils) was not significantly differently from the performance of pupils in large classes (30 or more students) (Mullis et al., 1997). In NAMA 1999, the average number of pupils in classes that included Fourth class pupils was 29, with multi-grade classes having a smaller average class size (27) than single-grade classes (30). The mean score of pupils in multi-grade classes (254) did not differ significantly from the mean score of pupils in single-grade classes (247) (Shiel & Kelly, 2001).

Time for Teaching Mathematics

In TIMSS 1995, 40% of pupils in Fourth class in Ireland received more than 5 hours instruction in mathematics per week, while 34% received between 3½ and 5 hours. No achievement differences were observed between pupils in receipt of varying amounts of instructional time (Mullis et al., 1997).

In NAMA 1999, teachers reported allocating an average of 4 hours and 9 minutes a week to the teaching of mathematics in Fourth class. Average lesson time was 53 minutes in single-grade Fourth classes and 46 minutes in multi-grade Fourth classes (Shiel & Kelly, 2001). In the Introduction to the Primary School Curriculum (DES/NCCA, 1999a), it is suggested that a minimum of 3 hours be allocated each week to the teaching of mathematics. Discretionary curriculum time (2 hours per week), which could be allocated to mathematics, is also available.

Use of Calculators

Just 4.5% of pupils in NAMA 1999 were in classes in which calculators were available during mathematics lessons. Although pupils in classes with access to calculators had a lower mean score than pupils in classes in which calculators were not available, the difference was not statistically significant. The Primary School Mathematics Curriculum (DES/NCCA, 1999b) now includes several learning statements from Fourth class onwards that refer to use of a calculator. Hence, patterns of calculator usage may be expected to have changed since 1999.

In-Career Development

In NAMA 1999, just 3.4% of pupils in Fourth class were taught by teachers who had attended an in-career development course since initial training, while fewer than 1% were taught by teachers who had attended a course in the 12 months preceding the survey (Shiel & Kelly, 2001). Given these low participation rates, it was not possible to ascertain aspects of in-career development with which teachers were satisfied and areas in which they needed additional support. Since a variety of in-career development and school development planning opportunities connected with implementation of the 1999 Primary School Mathematics Curriculum have been available to teachers since NAMA 1999, it is likely that participation levels in these activities will have increased.

Planning Mathematics Lessons

In TIMSS 1995, 46% of pupils in Fourth class in Ireland were taught by teachers who rarely, if ever, met with fellow teachers to discuss and plan the curriculum or the teaching of mathematics. In contrast, fewer than 10% of pupils in Scotland and Singapore were taught by teachers who met this infrequently for planning purposes (Mullis et al., 1997). In NAMA 1999, 94% of pupils were taught by teachers who prepared an annual plan for mathematics teaching, while 90% were taught by teachers who prepared a weekly or fortnightly plan (Shiel & Kelly, 2001). Teachers indicated that, while pupils' textbooks, and the manuals accompanying them, were important sources of information for planning, *Curaclam na Bunscoile* and the Plean Scoile were rarely drawn on. This, of course, may have reflected that fact that, at the time of the study, many teachers were waiting for the publication of the Primary School Mathematics Curriculum, and the possible revision of school plans based on that curriculum.

IMPLEMENTATION OF THE 1999 PRIMARY SCHOOL MATHEMATICS CURRICULUM

The 1999 Primary School Mathematics Curriculum (PSMC) is broadly similar to its predecessor in terms of mathematics content (see Chapter 2). However, unlike its predecessor, it advocates the widespread use of resources and practical activities at all class levels to develop mathematics concepts. It also embraces a constructivist approach to teaching problem solving that entails hypothesis setting, trial and error, and discussion. The 1999 PSMC also advocates group work for teaching mathematics. It introduces the use of the calculator from Fourth class onwards.

In 2004, a number of surveys were conducted that examined aspects of the implementation of the 1999 primary school curriculum, including mathematics.

DES Inspectorate Evaluation of Curriculum Implementation

The Inspectorate of the Department of Education and Science conducted its evaluation of curriculum implementation in mathematics in 61 classrooms in 28 schools (DES, 2005b). Focusing on both whole-school and class levels, the evaluation included observation of teaching and learning, as well as an inspection of planning documents and interviews with key personnel in schools. The following conclusions were reached:

- Teachers generally had a good understanding of the structure of the curriculum and were implementing the strands and embracing new teaching approaches.
- Whole-school planning was weak in over one-half of schools, and often referred only to content derived from textbooks.
- Classroom planning was weak in two-fifths of classrooms, and again relied too much on textbooks to select and sequence content.
- In one-half of classrooms, there was lack of planning for use of resources or differentiation in teaching.
- Almost one-third of teachers experienced difficulty with the methodologies for implementing the mathematics curriculum.
- Some teachers struggled to relate mathematics to other areas of the curriculum.
- Problem-solving skills were poorly taught in one-third of classrooms.
- In a quarter of classrooms, a more structured approach to the development of mathematics language was required.
- In more than two-thirds of classrooms, there was over-reliance on whole-class teaching.
- In one-half of classrooms, teachers did not use standardised test results effectively, or did not maintain continuous records of pupils' achievement.

The inspectorate provided a set of recommendations designed to address short-comings in curriculum implementation, including improved whole-school planning and reporting on curriculum implementation, classroom planning based on the whole-school plan, a stronger focus on estimation strategies and data (constructing and interpreting graphs), and the implementation of a broader range of assessment tools. It was also recommended that pupils be provided with more structured opportunities to undertake problem-solving strategies, engage in discussion, and work with concrete materials.

NCCA Primary Curriculum Review (Phase 1)

The National Council for Curriculum and Assessment used a teacher questionnaire/template (719 teachers in 170 schools) and interviews with groups of teachers, principals, parents and pupils in its evaluation of the implementation of the 1999 PSMC (NCCA, 2005). The following conclusions were drawn:

- Number was the mathematics strand that received the greatest level of approval from teachers, while Data was reported to be least useful. The Chance component of Data was reported as being problematic in Third to Sixth classes.
- Although 58% of teachers reported using ICTs to teach mathematics, most use was limited to content-based software programmes, and relatively little use was made of the Internet.
- Whole-class organisation was most frequently used by teachers during mathematics lessons, followed by individual work. Limited use of pair and group work was reported.
- Teachers reported that doing practical work was the greatest success of the PSMC, followed by increased enjoyment of mathematics by children.
- Teachers reported difficulties in catering for the diversity of children's individual strengths and needs, and in teaching in multi-grade classes with at least two different class programmes.
- Among the perceived effects of the PSMC on pupils' learning were self-confidence/success, improved skills development, increased awareness of the relevance of maths in everyday life, greater enjoyment, and greater achievement for less-able pupils.

The recommendations in the NCCA review referred to a need to further investigate teachers' implementation of the Data strand (specifically those elements dealing with Chance), to provide more detailed advice and support for teachers on using assessment for teaching and learning, to provide advice to parents and schools on involving parents in supporting children's learning, and to further exemplify the potential of ICTs to support the mathematics curriculum.

DES Inspectorate Study of Numeracy in Disadvantaged Schools

The Inspectorate conducted a study in 2003 on the teaching of numeracy (and literacy) in schools designated as disadvantaged (DES, 2004d). In addition to describing mathematics achievement, the report identified weaknesses in planning at school and class levels, and proposed the following:

- The establishment of time-related targets in mathematics at school, class, and individual pupil levels.
- Greater use of scores from standardised and teacher-made tests to inform strategic initiatives throughout the school, including curriculum differentiation.
- The provision of learning support for all pupils with very low achievement in mathematics.
- The establishment of a team of teachers with relevant expertise to support designated schools that have prioritised the teaching of numeracy.
- A greater involvement by special duty post holders with responsibility for numeracy in developing teaching and learning, including policy and planning.
- The development in classrooms of mathematics-rich environments in which concrete materials would be used to a much greater extent.
- A greater focus on whole number, place value, estimation, the decimal system, and links between fractions and percentages.
- Improved links with parents of pupils in the middle and senior classes.

DES Inspectorate Study of Newly Qualified Teachers

The DES Inspectorate conducted a study of beginning teachers (usually teachers in their first year of teaching) in 2004 (DES, 2005c). As part of the study, 192 beginning teachers (from a sample of 354) responded to a survey about how their pre-service teacher education had prepared them for teaching various curriculum subjects in their first year of teaching. Twenty-eight percent reported that they were poorly or very poorly prepared to teach mathematics. For English and Irish, the corresponding percentages were 12 and 16, indicating that teachers felt less-well prepared to teach mathematics than other core subjects. Substantial percentages of beginning teachers also felt unprepared for recording monthly progress (56%), providing differentiation for pupils with additional needs (46%), arranging classroom layout and organisation (29%), and dealing with classroom management and discipline (21%).

The survey also summarised the outcomes of observations of the work of beginning teachers in mathematics classes by inspectors. The recommendations most frequently made to teachers concerned:

- Use of a range of concrete materials in mathematics lessons.
- Differentiation in the teaching of mathematics concepts, in the pace of the lessons, and in the activities provided to pupils.
- Provision of challenging activities for more able pupils.
- Use of real-life problem-solving situations in lessons and a reduced emphasis on the role of the textbook.
- Inclusion of more oral mathematics in lessons.
- Concentration on and consolidation of number facts.
- Systematic teaching of the language of mathematics.
- Appropriate balance of teacher-talk with emphasis on pupils’ engagement with, and discussion of, concepts.

Taken together, the four reports provide an initial indication of the issues surrounding curriculum implementation for teachers in general, and for particular groups of teachers (beginning teachers, teachers in disadvantaged schools). The reports by the Inspectorate are significant to the extent that they recognise the broader, whole-school and classroom planning contexts in which mathematics teaching occurs. The NCCA review complements these by presenting the views of teachers, parents and pupils in considerable detail.

PRESERVICE TEACHER EDUCATION

A recent review of primary preservice teacher education, *Preparing Teachers for the 21st Century* (2002), included a consideration of needs in the area of mathematics. The review noted that

> the relatively poor performance of Irish pupils on mathematics tasks involving problem-solving activities and realistic contexts [in national and international assessments] does not bode well for the success of the more constructivist approach to learning espoused in the revised curriculum, and merits particular attention, both in primary school classrooms and in teacher education programmes. (p. 99)

The Working Group which carried out the review agreed that there was a need to strengthen preparation to teach mathematics in primary schools, to develop skills in using concrete materials, to develop ability to conduct discourse in which pupils' understanding of mathematics processes could be probed and developed, to develop familiarity with areas of the 1999 PSMC that students may not have encountered while at school themselves, and to develop assessment and diagnostic skills. Specific recommendations focused on the introduction in colleges of education of a professional mathematics course, with the objective of improving students' competence in the subject and developing their skills to teach mathematics in primary schools. The report also recommended a higher minimum requirement in the Leaving Certificate Examination in mathematics for students entering colleges of education.

SUMMARY

The purpose of the 2004 National Assessment of Mathematics Achievement (NAMA 2004) is to describe performance in mathematics at Fourth class level in primary schools, and to compare performance with the 1999 National Assessment, which was conducted before the 1999 PSMC was implemented in schools. NAMA 2004 also seeks to describe the use of calculators by pupils in Fourth class; to examine associations between pupil, teacher, and school factors and mathematics achievement; to consider how the teaching and assessment of mathematics have evolved since the introduction of 1999 PSMC; and to make recommendations with regard to the teaching and assessment of mathematics in schools.

The 1999 National Assessment of Mathematics Achievement provided baseline data against which to compare the performance of pupils in subsequent assessments. The framework underpinning NAMA 1999 was closely aligned to the 1999 PSMC, even though the curriculum was not in place at the time of the assessment. In 1999, pupils performed best in the Data strand, and least well on Measures and Shape & Space. Performance on lower-level mathematics skills (Understanding & Recalling, Implementing) was stronger than performance in Reasoning, Analysing & Solving Problems, and Integrating and Connecting.

The most recent international assessment in which Irish pupils at primary level participated was TIMSS 1995, in which pupils in Fourth class in Ireland were ranked 6th among participating countries, with a mean score that was significantly higher than the international and OECD country average scores. In the OECD Programme for International Student Assessment (PISA) in 2003, Irish 15-year olds performed at about the OECD average in mathematics.

A number of pupil characteristics have been shown to be associated with mathematics achievement. Gender differences on overall achievement among pupils in Fourth class in both TIMSS 1995 and NAMA 1999, however, were small and not statistically significant.

Among the pupil variables that have been shown to be associated with mathematics achievement in earlier research are parents' educational attainment, parents' socioeconomic status (typically based on parent occupation), home educational processes, and home educational resources (e.g., number of books in the home). The association between mathematics achievement and time spent on mathematics homework is less clear. In NAMA 1999, for example, lower-achieving students spent more time on homework than higher-achieving students.

School characteristics associated with achievement include socioeconomic status. In NAMA 1999, 21% of pupils in designated disadvantaged schools achieved scores at or below the 10th percentile on the overall achievement scale, compared to 8.0% in non-designated schools, while in a recent study by the DES Inspectorate in 12 designated schools, 73% of pupils in Fifth and Sixth classes scored in the bottom quintile (DES, 2005d).

In NAMA 1999, the majority of pupils attended schools with policies on the assessment of mathematics, and on reporting to parents. However, just 30% attended schools with policies on teaching strategies for mathematics problem solving.

A number of class-level variables, such as class size and time allocated to the teaching of mathematics, were not shown to relate to mathematics achievement in the expected direction in NAMA 1999. The average time allocated to mathematics in Fourth class reported by teachers of pupils in the study was 4 hours and 9 minutes per week. This is greater than the 3 hours a week recommended in the 1999 Primary School Curriculum, though 2 hours of discretionary time per week that could be allocated to mathematics are also available.

A number of studies have been conducted on aspects of implementation of the 1999 Primary School Curriculum, including mathematics. An evaluation of curriculum implementation in mathematics by the DES (2005b) reported problems in whole-school planning, which was weak in over 50% of schools, and was often based exclusively on textbook content. Other areas identified as weak were planning (by teachers) for use of resources and differentiation in teaching, relating mathematics to other aspects of the curriculum, and teaching problem solving skills. In its review of curriculum implementation, the NCCA pointed to Data (and specifically to the chance component of Data) as a strand with which teachers were not fully confident, to whole-class organisation as the dominant organisation structure for mathematics lessons, to difficulties experienced by teachers in catering for diversity in learning needs, and to the challenges offered by multi-grade classes (NCCA, 2005). A study by the DES (2005d) Inspectorate that looked at literacy and numeracy in designated disadvantaged schools also identified aspects of teaching and learning in need of development. These included the organisation of mathematics programmes at school level, the establishment of mathematics-rich environments in classrooms, and a greater focus on aspects of mathematics content during instruction.

Concern has been expressed about the preparedness of teachers to teach mathematics in schools. The Working Group on Primary Preservice Teacher Education, in its report, *Preparing Teachers for the 21st Century* (2002), recommended that a professional mathematics course be made available to teachers in colleges of education to improve their mathematics competence and their ability to reason mathematically. The Group also recommended that the minimum requirement in mathematics achievement for teachers entering colleges of education be raised.

2. Assessment Instruments

In this chapter, the assessment instruments that were used in 2004 National Assessment of Mathematics Achievement (NAMA 2004) are described. First, the framework and item specifications underpinning the tests used in NAMA 1999 and 2004 are described and compared. Second, the development and content of questionnaires are outlined.

FRAMEWORK AND ITEM SPECIFICATIONS

The NAMA 1999 Framework

The curriculum in place in primary schools in 1999 was *Curaclam na Bunscoile* (Department of Education, 1971). However, in developing the mathematics test for NAMA 1999, a decision was taken to incorporate the framework (content strands and process skills) described in the 1999 Primary School Mathematics Curriculum (PSMC), although the curriculum documents for the revised curriculum would not be available to schools until September 1999, and full-scale implementation would not begin until the start of the 2002-03 school year. This decision was based on the observation that the strands and skills underpinning the 1999 PSMC in Fourth class did not differ substantially from their predecessors (see Table 2.1 for a list of new content objectives in the 1999 PSMC), though the teaching approach was intended to be very different. The decision led to the development of a test that was compatible with the 1999 PSMC and could be attempted successfully by most pupils in Fourth class. The observation that pupils in Third and Fourth classes in Ireland did reasonably well on items assessing probability in TIMSS 1995 suggested that pupils in NAMA 1999 would not find new content on chance to be unduly difficult.

Table 2.1 *New Content Objectives in the 1999 PSMC – Fourth Class*

	Content Objective
a	Use a calculator to check multiplication and division estimates (Number)
b	Use a calculator to develop problem solving strategies and verify estimates (Number)
c	Explore, extend and describe sequences (relating to objects, shapes or numbers) (Algebra)
d	Read time in one-minute intervals on analogue and digital clock (12 hour clock) (Measures)
e	Express digital time as analogue and vice versa (Measures)
f	Use the vocabulary of uncertainty and chance (Data)
g	Order events in term of likelihood of occurrence (Data)
h	Identify and record outcomes of simple random processes (Data)

Source: DES/NCCA, 1999b, pp. 64-83

It was not possible to assess the use of calculators to solve mathematics problems as most pupils did not have experience with, or access to, calculators in 1999. It was not possible either to assess pupils' performance on one of the six mathematics skills specified in the 1999 PSMC – Communicating & Expressing – as this strand could not be readily assessed using a paper-and-pen test.

The 1999 test included a total of 125 items (although individual pupils were asked to attempt just 75). Table 2.2 provides a breakdown of the items by content strand and skill. While over one-third of items were in the Number strand, the emphasis on number was less than in earlier national and international assessments. It is also relevant to note that higher order skills such as Reasoning, and Integrating & Connecting were well represented, as was Applying & Problem Solving.

The test administered in 1999 consisted of two item types: short-answer (42%) and multiple-choice (58%).

Table 2.2 *Distribution of Items in NAMA 1999, by Mathematics Content Strand and Skill*

Strand	N	%
Number	46	36.8
Algebra	6	4.8
Shape & Space	18	14.4
Measures	44	35.2
Data	11	8.8
Total	125	100

Skill	N	%
Understanding & Recalling	17	13.6
Implementing	37	29.6
Reasoning	27	21.6
Integrating & Connecting	8	6.4
Applying & Problem Solving	36	28.8
Total	125	100.0

The NAMA 2004 Framework

While the 1999 PSMC formed the basis of the 2004 NAMA framework, a number of changes were made to the framework used in 1999, and hence, to the test. First, it was decided to add an additional section of calculator items to assess mathematics in the context of calculator availability. The items, which were distributed over all five strands, were designed to assess aspects of mathematics for which it was deemed that a calculator would be helpful to pupils in Fourth class. The items included:

- Compare the performance of athletes over two rounds of a high-jump competition, where heights are given as decimal numbers (e.g., 1.55 m).
- Identify the number in a number sentence that should be removed to make it correct (e.g., 175 + 236 + 318 + 240 = 733).
- Supply a missing digit to make a number sentence correct (e.g., 4__5 ÷ 9 = 45).
- Indicate the operations (+, -, X, ÷) that would make a number sentence correct [e.g., 25___ (31___11) = 500].
- Given the number of newspapers delivered to a newsagent every day (including Sunday), find the number delivered in 4 weeks.
- Identify the last number in a sequence of numbers (e.g., 4.2, 8.4, 16.8, ____).

- Find the perimeter of a field, where the sides are represented by decimal numbers.
- Solve one- and two-step problems where measures (money, length, weight, capacity) are presented as decimal numbers.

A small number of items on the 1999 test were identified as unsatisfactory, either because they had poor statistical qualities (based on the 1999 data), or because they were judged not to measure relevant aspects of the 1999 PSMC. Furthermore it was observed that aspects of Shape & Space dealing with perimeter, 3-D shapes, and perpendicular lines, needed to be better represented in the 2004 assessment. Hence, in conjunction with a calculator pilot study, 15 new non-calculator items were tried out.

A set of 30 calculator-appropriate items and the 15 additional items were trialled in 20 Fourth classes in 10 schools in north Dublin in February 2004, to ascertain how the items performed, and to identify those that would be most suitable to include in the main study. One-half of the pupils in each participating class attempted the calculator items with the aid of a calculator, while the other half did not have a calculator. Students with access to a calculator did marginally better (average percent correct score = 33%) than students without a calculator (28%) on the calculator appropriate items. Despite the overall difficulty of the calculator items, a decision was taken to proceed with the inclusion of a calculator section in the NAMA 2004 test, on the basis that it was an important element of the 1999 PSMC, and performance could be expected to improve over time. A set of 25 items, with an estimated percent correct value of about 40%, was selected for inclusion in the main test. A decision on whether to pool the calculator items with the other 125 items in scaling the test, or to report on the calculator items separately, was postponed until after the main test had been scored and the outcomes analysed.

As well as the calculator items, 9 of the 15 non-calculator items piloted were selected to replace items from the 1999 test which were deemed unsatisfactory. This meant that the 2004 test would consist of 5 sections of 25 items from the 1999 assessment (with 116 of 125 items remaining exactly the same) and an additional section of 25 calculator-appropriate items would be added.

The 150 items selected for inclusion in the 2004 assessment were divided into 6 sections, which were distributed over 5 test booklets, with each booklet comprising 3 sections. Each pupil who participated in the assessment was assigned one booklet that included a common section (Section B), and 2 additional sections, giving 75 items in total. As indicated in Table 2.3, each section (except Section B) appeared once in the beginning position in a booklet, and once in the final position. For example, the calculator section (Section F) appeared in the final position in Booklet 4, and in the initial position in Booklet 5.

Table 2.3 *Structure of Test Booklets – NAMA 2004*

Booklet	First Section	Second (Common) Section	Third Section
1	A	B	C
2	C	B	D
3	D	B	E
4	E	B	F*
5	F*	B	A

**Calculator section (pupils had access to calculator for this section only)*

Mathematics Strands and Skills

The 116 items in NAMA 2004 that were drawn from the 1999 assessment retained the item classifications assigned to them in 1999. The additional items (25 calculator items, 9 new or edited non-calculator items) were categorised according to the procedures used in 1999. The strand (and strand unit) associated with each item was first identified using the list of 5 strands and 18 strand units for Fourth class on page 61 of the 1999 PSMC (DES/NCCA, 1999b). Where items involved more than one strand or strand unit, the predominant one was assigned. Table 2.4 shows the distribution of items by content strand. The distribution is broadly similar to that for 1999 (Table 2.2), though there is a reduction in the percentage of items assessing Measures (from 35.2 in 1999 to 32.0 in 2004) and an increase in the percentage assessing Data (from 8.8 to 10.0). The classification of items by mathematics strand unit (e.g., Number – Multiplication and Division) was for the purpose of developing proficiency levels, which are described in Chapter 3.

Table 2.4 *Distribution of Items in NAMA 2004, by Mathematics Content Strand*

Strand	N	%
Number	58	38.7
Algebra	7	4.7
Shape and Space	21	14.0
Measures	48	32.0
Data	16	10.7
Total	150	100.0

The new items in NAMA 2004 were also classified by mathematics skill and skill category using the 5 skills and the 19 skill categories on pages 62-63 of the 1999 PSMC[1]. When the outcomes of the skill ratings for these items were pooled with ratings for the 116 items classified in 1999, the distribution in Table 2.5 was obtained. The skill category classification called principal process skills was used in connection with developing proficiency levels (see Chapter 3).

[1] The skill, Communicating & Expressing, and associated sub-skills were not used.

Table 2.5 *Distribution of Items in NAMA 2004, by Mathematics Skill*

Skill	N	%
Understanding & Recalling	19	12.7
Implementing	42	28.0
Reasoning	31	20.7
Integrating & Connecting	10	6.7
Applying & Problem Solving	48	32.0
Total	150	100.0

The distribution reported in Table 2.5 is broadly similar to that obtained in 1999 (Table 2.2), although there was a greater percentage of items categorised as Applying & Problem Solving in 2004 (32%) than in 1999 (29%), while there was a drop in the percentages classified as Understanding & Recalling, and Implementing in 2004 (about 1% in each case). This was mainly due to the strong representation of items categorised as Applying & Problem Solving in the new calculator section.

The distributions of items assessing the skills in each content strand in the 1999 and 2004 assessments are summarised in Table 2.6.

Table 2.6 *Distribution of All Skill Items Across Content Strands, 1999 and 2004*

	Implementing		Int/connecting		Prob solving		Reasoning		Und/recalling	
	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004
Number	17	20	4	5	10	14	8	12	7	7
Algebra	1	1	2	2	-	-	2	3	1	1
Shape/space	1	1	-	1	-	-	10	10	7	9
Measures	13	11	2	2	24	31	3	2	2	2
Data	5	9	-	-	2	3	4	4	-	-

Int/connecting = Integrating & Connecting; Prob solving = Applying & Problem Solving; Und/recalling = Understanding & Recalling

The distributions in Table 2.6 illustrate the predominance of items assessing the strands Number and Measures in both 1999 and 2004 reflecting the relative emphasis on these strands in the PSMC. They also show an emphasis on Applying & Solving Problems in the Measures strand. A similar breakdown of items by mathematics skill and content strand for the 116 items common to the 1999 and 2004 studies is presented in Table 2.7. These common items were used when comparing performance between 1999 and 2004 in each content strand and process skill (Chapter 4).

Table 2.7 *Distribution of Common Skill Items Across Content Strands, 1999 and 2004*

	Implementing	Int/connecting	Prob solving	Reasoning	Und/recalling
Number	17	4	9	8	6
Algebra	1	2	-	2	1
Shape/space	1	-	-	9	7
Measures	11	2	21	2	2
Data	5	-	2	4	-

Int/connecting = Integrating & Connecting; Prob solving = Applying & Problem Solving; Und/recalling = Understanding & Recalling

Sample Items

This section provides examples of the types of items that pupils in NAMA 2004 were asked to attempt. The items are similar to those that appear on the test. For each, the percentages of pupils who attempted the item and answered it correctly, and the proficiency level at which it was placed, are also provided. The item in Box 2.1 is categorised in the Number strand in the 1999 PSMC. In terms of skill, it is categorised as Applying & Problem Solving. The more detailed principal process skill describes it as 'solve routine word problem involving use of division facts'. The item is categorised as a short-answer item, as pupils are invited to write an answer to the question, rather than select the answer from a number of alternatives (multiple-choice).

Box 2.1 Sample Item 1

Content strand: Number
Skill category: Applying & Problem Solving
Principal process skill: Solve routine word problem involving use of division facts
Item type: Short-answer

Mum has a box of 36 chocolates. She divides them among 9 children so that each gets the same number of chocolates. How many chocolates does each child get?

Answer: 4

Similar Item	N	% Attempted	% Correct	Proficiency Level
A05	1622	97.2	77	1

Boxes 2.2 to 2.10 provide additional examples of the types of items that appeared in NAMA 2004. The sample items are intended to represent the different strands and skills that were assessed in NAMA 2004.

Box 2.2 Sample Item 2

Content strand: Number
Skill category: Implementing
Principal process skill: Implement a procedure to list and count numbers
Item type: Short constructed response

How many odd numbers are there between 6 and 16?

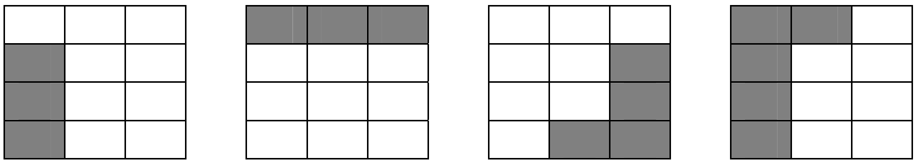
Answer: 5

Similar Item	N	% Attempted	% Correct	Proficiency Level
A13	1669	95.9	57	2

Box 2.3 Sample Item 3

Content strand: Number
Skill category: Integrating & Connecting
Principal process skill: Connect modes of representing fractional numbers
Item type: Multiple-choice

Which of these figures has one-third shaded? *(Circle one letter, A, B, C, or D)*



A **B** **C** **D**

Answer: C

Similar Item	N	% Attempted	% Correct	Proficiency Level
A20	1669	95.7	39	4

Box 2.4 Sample Item 4

Content strand: Algebra
Skill category: Integrating & Connecting
Principal process skill: Connect verbal and symbolic problem representations
Item type: Multiple-choice

□ holds the number of press-ups Eva does every morning. Which of these shows the total number of press-ups Eva does in a week?

A 7 + □
B 7 x □
C □ ÷ 7
D 5 x □

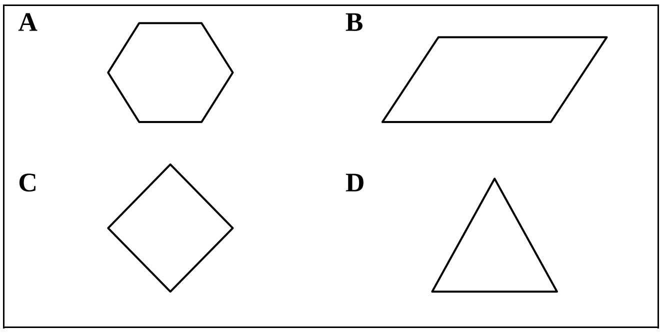
Answer: B

Similar Item	N	% Attempted	% Correct	Proficiency Level
B14	4171	92.3	61	3

Box 2.5 Sample Item 5

Content strand: Shape & Space
Skill category: Understanding & Recalling
Principal process skill: Understand and recall meaning of parallel and perpendicular lines
Item type: Multiple-choice

Which of these shapes has perpendicular lines?

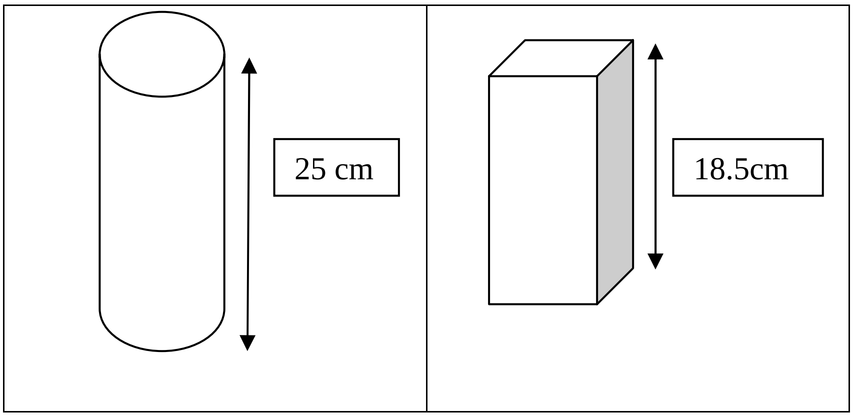


Answer: C

Similar Item	N	% Attempted	% Correct	Proficiency Level
B24	4171	92.2	60	4

Box 2.6 Sample Item 6

Content strand: Measures
Skill category: Applying & Problem Solving
Principal process skill: Solve routine problems involving measure of length
Item type: Short-answer



How much taller is the cylinder than the box?

Answer: 6.5 cm

Similar Item	N	% Attempted	% Correct	Proficiency Level
B23	4171	97.1	42	3

Box 2.7 Sample Item 7

Content strand: Number (Fractions)
Skill category: Applying & Problem Solving
Principal process skill: Solve routine problems involving fractions
Item type: Short-answer

Peter ordered a pizza. He ate ¼ of it. His sister Niamh ate $^{1}/_{3}$ of it. What fraction of the pizza was left?

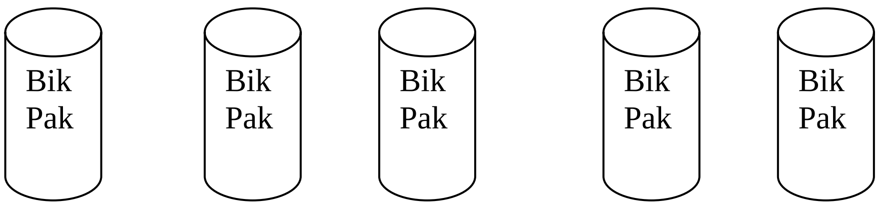
Answer: $^{5}/_{12}$

Similar Item	N	% Attempted	% Correct	Proficiency Level
B22	4171	94.2	06	5

Box 2.8 Sample Item 8

Content strand: Number (Fractions)
Skill category: Applying & Problem Solving
Principal process skill: Solve routine problems involving ratio (unitary method)
Item type: Short-answer

There are 40 biscuits in 5 packets of biscuits. How many biscuits in two packets?



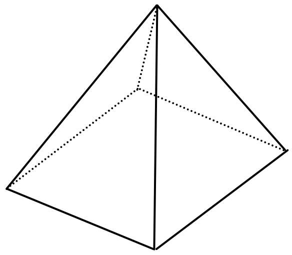
Answer: 16

Similar Item	N	% Attempted	% Correct	Proficiency Level
A15	1669	95.9	50	3

Box 2.9 Sample Item 9

Content strand: Shape & Space
Skill category: Reasoning
Principal process skill: Reason spatially with 3-D shapes
Item type: Short-answer

How many edges has this square based pyramid altogether?



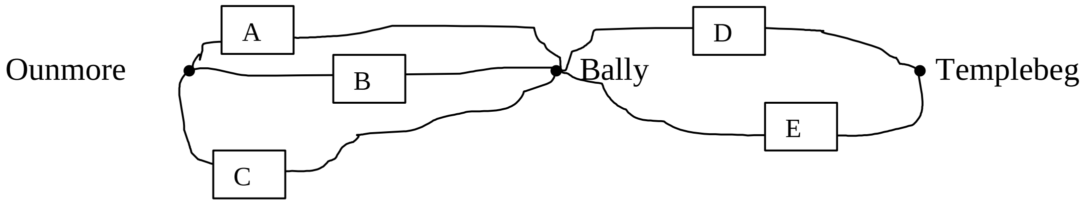
Answer: 8

Similar Item	N	% Attempted	% Correct	Proficiency Level
C24	1673	91.5	32	4

Box 2.10 Sample Item 10

Content strand: Data
Skill category: Reasoning
Principal process skill: List systematically all possible routes on a map
Item type: Multiple-choice

This part of a map shows five roads, A, B, C, D, E. What are all the different ways you can drive from Ounmore to Templebeg?



A CD, BD and AE
B CD, AD, BD and AE
C AE, CD, BD, AD, and BE
D AE, AD, BD, BE, CD, and CE

Answer: D

Similar Item	N	% Attempted	% Correct	Proficiency Level
D20	1665	93.3	35	4

Item Types

As in NAMA 1999, NAMA 2004 consisted of a combination of multiple-choice and short-answer items. Short-answer items included not only those that asked for an answer (see Box 2.7, Box 2.8) but also items that asked pupils to complete such tasks as drawing a line of symmetry through a two-dimensional shape or adding bars to a bar graph after referring to a data table. Table 2.8 gives the distribution of items by type.

Table 2.8 *Distribution of Items in NAMA 2004, by Format*

Section	Multiple-Choice		Short-Answer	
	N	%*	N	%
A	11	44.0	14	56.0
B	21	84.0	4	16.0
C	12	48.0	13	52.0
D	12	48.0	13	52.0
E	17	68.0	8	32.0
F	7	28.0	18	72.0
Total	80	53.3	70	46.7

**Row (Section) percentages sum to 100*

Across all sections, 53.3% of items are multiple-choice, while 46.7% are short-answer. While Section B (the common section) consisted mainly of multiple-choice items (84%), Section F (the calculator section) consisted mainly of short-answer items (72%).

Reliability of Item Classification

In November 2005, four members of the Primary Curriculum Support Programme who were involved in the provision of in-career development in mathematics were asked to identify the content strand underlying each of 15 items from NAMA 2004, and to indicate the principal skill that pupils would be expected to use to answer each item. Each rater worked independently, and responses were then compared with the original ratings (done at the ERC), and with the responses of other raters. For the content strand classification (Number, Shape & Space, Measures etc.), average agreement exceeded 95% for both comparisons.

Average agreement was weaker for the classification of items by skill (Understanding & Recalling, Integrating & Connecting etc.). There was an average of 80% agreement with the original (ERC) ratings, and an average agreement of 77% between raters. Most differences occurred in relation to the higher-level processes (Reasoning, Integrating & Connecting, and Applying & Problem Solving). However, if these had been combined into a single category (e.g., Higher Order skills), levels of agreement would have exceeded 90%.

DEVELOPMENT AND CONTENT OF QUESTIONNAIRES

Six questionnaires were developed for NAMA 1999: a School Questionnaire, a Teacher Questionnaire, a Pupil Questionnaire, a Parent Questionnaire, a Pupil Rating Form, and a Questionnaire for Inspectors. The questionnaires were reviewed by the National Advisory Committee in preparation for NAMA 2004, and an additional Questionnaire for Learning Support Teachers was developed. The School Questionnaire and the Questionnaire for Learning Support Teachers were also used as part of the National Assessment of English Reading (NAER 2004). These two questionnaires included items that were relevant to both studies, as well as separate sections dealing with mathematics and English reading.

Since the implementation of the 1999 PSMC was of particular interest in NAMA 2004, revisions to the 1999 questionnaires involved the addition of questions designed to examine various aspects of curriculum implementation. In the subsections that follow, the content of each of the questionnaires is outlined. The questionnaires can be viewed at http://www.erc.ie/national/2.php

School Questionnaire

The School Questionnaire, which school principals were asked to complete, was designed to capture aspects of the organisation of mathematics instruction at school level, including the process and content of whole-school planning. The first section, *General Information*, asked about the location of the school, the language of instruction, and the numbers of pupils in the school and in Fourth class in the School Books for Needy Pupils' scheme. The second section, *Staff in Your School*, asked about the number of staff in the school as well as the frequency and content of staff meetings. The next two sections relating to mathematics asked about *Provision of Learning Support and Resource Teaching*, and *School Resources* (including problems in providing for the teaching and learning of mathematics at school level). The fifth section, *Home-School Links*, asked about ways in which the school involved parents in mathematics programmes, and about the involvement of parents' associations in the work of the school. The final two sections, *School Planning* and *Assessment* addressed ways in which schools planned for the teaching and assessment of mathematics. School principals were also asked to respond to a series of statements about the implementation of the 1999 PSMC in their school, and to offer comments relating to the teaching and assessment of mathematics.

The content of the School Questionnaire in 1999 and 2004 was broadly similar, with the exception of additional questions in 2004 on the first language of pupils attending the school and questions specifically relating to implementation of the 1999 PSMC.

Teacher Questionnaire

The Teacher Questionnaire was targeted at teachers of mathematics in Fourth class. The first section, *General Information*, sought background information on teachers of pupils in the survey, including their qualifications and experience. The second section, *Teaching Mathematics*, asked about the frequency and duration of mathematics lessons, the organisation of pupils in Fourth class for instruction, the frequency with which various materials were used during instruction, and specific ways in which computers and calculators were used. The third section, *In-career Development and Pre-Service Training*, asked about teachers' participation in in-career development courses offered by the Primary Curriculum Support Service and other groups, their satisfaction with the courses they attended, and their satisfaction with pre-service training as it related to teaching mathematics. The fourth section, *Learning Support and Resource Teaching*, asked about the integration of pupils' class and support programmes in mathematics. The fifth section, *Your School*, sought information on a variety of issues related to school climate, including acceptance of the 1999 PSMC. The final sections, *Homework/Home-School Links*, and *Assessment of Mathematics*, sought information on the frequency of assigning mathematics homework, and of administering various assessment tools to pupils in Fourth class.

Again, there was strong overlap with the 1999 Teacher Questionnaire, allowing for comparisons on such issues as the amount of time allocated to teaching mathematics, the uses made of computers and calculators during mathematics instruction, and the frequency of use of various resources to plan for and teach mathematics.

Pupil Rating Form

The Pupil Rating Form was designed to gather contextual information about each pupil who participated in the survey. In both the 1999 and 2004 surveys, class teachers were asked to provide background information on each pupil (e.g., participation in learning support in mathematics, attendance at school), and to rate each one in respect of several characteristics related to learning (e.g., participation in class, persistence in school work). Teacher ratings of pupils' achievement in mathematics were also obtained.

Pupil Questionnaire

In the Pupil Questionnaire, pupils were asked about the frequency with which they engaged in various study and leisure activities at home, their attitudes towards mathematics, and participation in various activities during mathematics classes. Items designed to identify strategies used by pupils when they encountered difficulties in mathematics problems were also included. The 2004 version of the questionnaire was very similar to the 1999 version.

Parent Questionnaire

As in 1999, the Parent Questionnaire in 2004 was designed to identify the strategies used by parents to support their children's work in mathematics, including the level and nature of help provided with homework. It also included questions about parents' educational background, employment status, and the availability of various educational resources in the home.

Learning Support Teacher Questionnaire

The Learning Support Teacher Questionnaire, which was administered for the first time in 2004, addressed the work of learning support teachers in the areas of English and mathematics. Some sections were designed to be completed by all learning support teachers, regardless of subjects taught. Others were specific to either English or mathematics. The first section, *General Information*, asked about teaching experience, including experience as a learning support teacher and coursework completed in the area of learning support. The section, *Your Work*, asked about the numbers of pupils to whom the teacher provided learning support, as well as the proportion of time allocated to planning and instruction in English and mathematics. The third section, *Learning Support for Mathematics*, asked teachers about their level of satisfaction with the coverage of various topics in PCSP courses, in the one-year part-time course on learning support, and in other courses. Teachers were also asked about the selection of pupils for learning support in mathematics and about the level of support that their school offered them in their work.

Questionnaire for Inspectors

The Questionnaire for Inspectors was broadly similar to that administered in the NAMA 1999, except that, in 2004, it focused on English as well as mathematics. The first section, *General Information*, asked about experience as an inspector, familiarity with recent national and international assessments of mathematics achievement, and views on the effectiveness of specific approaches to instruction and grouping for developing the mathematics competence of pupils in Fourth class. Subsequent sections on *Teaching Mathematics* and *Resources/Technology for Mathematics*, asked for inspectors' evaluations of the implementation of various aspects of 1999 PSMC, including the emphasis placed on different mathematics strands and skills in classrooms, and the use of concrete materials during instruction. A section on *Teachers' Professional Development* asked inspectors to identify aspects of the 1999 PSMC that might be emphasised more strongly in pre-service and in-career professional development contexts. The final section looked at the *Assessment of Mathematics* in classrooms. The Questionnaire overlapped to a significant extent with that used in NAMA 1999. However, the rating scale used by inspectors to indicate satisfaction/dissatisfaction with various approaches to instruction and assessment varied slightly across the two surveys. In 1999, the scale included the response options of very satisfied, satisfied, somewhat satisfied, and dissatisfied. The four points on the 2004 scale were very satisfied, satisfied, dissatisfied, and very dissatisfied.

SUMMARY

The test used in NAMA 2004 was broadly similar to that used in NAMA 1999. Of the 125 items in NAMA 1999, 116 were retained for NAMA 2004. Nine items were not used again, either because they were problematic in some respect, or because it was necessary to include additional items to assess aspects of the curriculum that had not been adequately addressed in NAMA 1999. An additional block of 25 calculator-appropriate items was developed specifically for NAMA 2004, as pupils' competence in solving problems that could be facilitated by access to a calculator had not been assessed in 1999. Hence, in 2004, there was a total of 150 items distributed over 6 sections (compared to 5 in 1999). Pupils would have access to a calculator only for the section that included calculator-appropriate items. Sections were rotated so that each one (apart from a common central section) would appear at the beginning and end of a booklet once. Each pupil was expected to complete three sections (75 items). A pilot study involving the calculator-appropriate items found that they were quite difficult, possibly because many pupils were not very familiar with the use of the calculator to solve problems, but also because the items emphasised problem solving. A decision on whether to include the calculator section in the overall scale for NAMA was postponed until after the main study.

Questionnaires employed in the 1999 assessment were revised for 2004. Several of the revisions focused on the implementation of the 1999 PSMC. In 2004, a Questionnaire for Learning Support Teachers was administered for the first time. It addressed a broad range of issues specific to the provision of learning support in mathematics, as well as more general issues on learning support provision in schools.

3. Survey Procedures

In this chapter the procedures used in NAMA 2004 are described. First, the procedures used to sample schools and pupils are outlined. Second, procedures used in administering the test of mathematics achievement and questionnaires are described. Third, the response rates for the survey instruments are provided. Fourth, the procedures used in computing sampling weights are outlined. Fifth, the procedures used to scale the test are outlined. Sixth, procedures used to analyse achievement and questionnaire data are described. Seventh, the development and interpretation of proficiency levels is discussed.

SAMPLE

Target Population

The target population consisted of all pupils in Fourth class in Irish primary schools in May 2004, with some exceptions. All pupils in 'ordinary' (i.e., mainstream) classes in primary schools were eligible for selection, but pupils attending private schools (1.25% of the total population of pupils in Fourth class)[1], special schools (0.82%), and special classes in ordinary schools (2.00%), were excluded. Thus, the defined target population included about 96% of all pupils in Fourth class in the country.

Pupils were also excluded at the second stage of sample selection (described below) if, in the view of the school principal, they had a learning or physical disability that would prevent them from attempting the test. 'Newcomer'[2] pupils whose proficiency in English was so limited that they could not attempt the test were also exempted. It was emphasised to the test administrators that exclusions should be rare. Definitions of the target and excluded populations are given in Table 3.1.

Table 3.1 *Defined and Excluded Populations in NAMA 2004*

Defined Target Population	Pupils in ordinary Fourth classes in ordinary primary schools.
Excluded Population	**Stage 1:**
	(Pupils attending) private schools
	(Pupils attending) special schools.
	Stage 2:
	Pupils in special classes in ordinary schools;
	Pupils whose physical or learning disability meant that they could not attempt the test;
	Non-national pupils whose proficiency in English meant that they could not attempt the test.

[1] Percentages are estimates extrapolated from data in the 2001/02 *Statistical Report* (Department of Education and Science, 2003, p. 15)

[2] The Department of Education and Science advises the use of the term 'newcomer' to denote non-national pupils

A sample of 136 schools was selected to participate in the NAMA 2004 (Fourth class) survey[3]. Schools were selected using the Department of Education and Science (DES) 2002/03 schools database as the sampling frame. The database includes the names of all primary schools and the numbers of male and female pupils enrolled at each class level.

The sample of 136 schools is larger than the 120 schools selected for NAMA 99. However, while all eligible pupils were chosen in selected schools in 1999, a maximum of two classes were selected in 2004. Several considerations were taken into account in deciding on the number of schools to be selected, including the following:

- *Clustering between schools:* an estimate of the extent of the differences in mathematics achievement between schools (*rho*) was obtained using data from earlier national assessments of reading and mathematics (in NAMA 1999, the value of *rho* was 0.19).
- *Cluster size:* an estimate of the average number of pupils likely to be enrolled in Fourth class in each stratum was computed using the DES schools database. Cluster size was smaller for schools in the "large" strata in 2004 compared to 1999 since a maximum of two classes (rather than all classes) were selected.
- *Probable response rate within schools:* an estimate (91.7%) was obtained from NAMA 1999.
- *Required number of responses per test item:* scaling requirements dictated that approximately 1000 responses per test item would be required.
- *The need to achieve an effective sample size of at least 400 pupils:* the sample should provide the same information as a sample 400 pupils in Fourth class selected at random across all primary schools would provide. (The effective sample size was estimated to be 560, based on *rho* of 0.21.)

All schools on the database were stratified into three size categories: large (defined as 35 or more pupils in Fifth class[4]), medium (21-34 pupils), and small (fewer than 21 pupils). Schools were also classified according to whether they had pupils in First, Fourth, and Fifth classes (vertical schools), or pupils in Fourth and Fifth classes, but not in First class (senior schools). Hence, six strata were established: large, medium, and small vertical schools; and large, medium, and small senior schools. Within these strata, to ensure a representative mix of school types, schools were sorted by designated disadvantaged status, area/language of instruction (Gaeltacht, Scoil lán-Ghaeilge, Ordinary School), proportion of female pupils, and measure of size (Table 3.2).

[3] In total, 152 schools were selected for the NAMA 2004 (Fourth class) survey and the concurrently run National Assessment of English (NAER 2004) (First and Fifth class) survey. In 136 schools, it was intended to assess pupils in Fourth class in mathematics, and pupils in First and Fifth class in English reading. An additional 16 junior schools (without senior classes) were surveyed at First class for NAER 2004.

[4] Although the sample was drawn to serve the purposes of two surveys, the measure of size (mos) on which sampling was based was the number of pupils in Fifth class. This figure is similar to the number in Fourth class.

Table 3.2 *Numbers and Percentages of Schools in the Defined and Excluded Populations in NAMA 2004, Estimated Numbers of Eligible Pupils, and Percentages of Eligible Pupils*

Stratum	Number of schools in population	Percent of schools in population	Estimated number of eligible Pupils	Percent of eligible pupils
4th & 5th class (Small <21)	99	3.14	927	1.78
4th & 5th class (Medium 21-34)	42	1.33	1056	2.02
4th & 5th class (Large 35+)	100	3.17	6330	12.14
1st, 4th & 5th class (Small <21)	2003	63.49	19154	36.73
1st, 4th & 5th class (Medium 21-34)	442	14.01	11353	21.77
1st, 4th & 5th class (Large 35+)	262	8.30	13162	25.24
Subtotal	2948	93.44	51982	99.67
Omitted	207*	6.56	170	0.33
Total	3155	100	52152	100

**Schools were omitted either because they had no pupils in Fourth class or they had no pupils in two of the three grade levels (First, Fourth and Fifth) of interest in NAMA or the concurrent National Assessment of English Reading (NAER).*

Using an estimate of the school (Primary Sampling Unit) cluster size derived from mean number of Fourth class pupils within schools in each stratum as listed in the DES schools database, the sample was designed to yield an expected sample of approximately 4,812 pupils across 136 schools (Table 3.3).

Table 3.3 *Numbers and Percentages of Schools and Pupils in the Designed Sample, by Stratum*

Stratum	Percent of eligible pupils in the population	No. of schools in designed sample	Estimated no. of pupils in designed sample	No. of pupils in the designed sample	Percent of pupils in designed sample
4th & 5th class (Small <21)	1.78	10	9 per school	90	1.87
4th & 5th class (Medium 21-34)	2.02	10	25 per school	250	5.20
4th & 5th class (Large 35+)	12.14	16	63 per school	1008	20.95
1st, 4th & 5th class (Small <21)	36.73	24	10 per school	240	4.99
1st, 4th & 5th class (Medium 21-34)	21.77	24	26 per school	624	12.97
1st, 4th & 5th class (Large 35+)	25.24	52	50 per school	2600	54.03
Total	99.67	136	-	4812	100
Omitted	0.33	0	(<1 per school)	0	0.00

Sample Selection

First-stage selection. Schools within strata were selected with a probability proportional to size (PPS), using a random-start, fixed interval selection procedure. In Table 3.4, numbers in the schools selected are compared with population numbers on selected markers of class size, gender composition, disadvantaged status, and Gaeltacht location.

Second-stage selection. In schools with two or fewer Fourth classes all pupils were chosen to participate in the assessment. In schools with more than two Fourth classes, two were selected at random. Where there were more than two Fourth classes, the Educational Research Centre selected two Fourth classes at random. All pupils in selected classes were expected to participate in the assessment except pupils whose teachers deemed them unable to attempt the mathematics test. Letters were dispatched in February 2004 to Principal teachers inviting their participation in the study. An inspector of the Department of Education and Science subsequently telephoned each school that agreed to participate to arrange a day on which the assessment could be administered and to discuss which pupils, if any, would be exempted.

Table 3.4 *Numbers of Pupils in Fourth Class in the Defined Population and in the Selected Sample, by Class Size, Gender Composition, Disadvantaged Status, and Gaeltacht Location*

	Number of Pupils	
	Defined Population (All Schools)	**Selected Schools**
Mean no. in Fourth class	17.63 (SD = 17.93)	37.86 (SD =27.39)
Boys' schools	8555 (16.46%)	951 (18.47%)
Girls' schools	8037(15.46%)	1177 (22.86%)
Mixed schools	35390 (68.08%)	3021 (58.67%)
Total number of pupils	51982	5149
Schools designated disadv.	7220 (13.89%)	829 (16.10%)
Gaeltacht schools	1149 (2.21%)	55 (1.07%)

SD = Standard Deviation.

Achieved Sample

One hundred and twenty-six of the 136 selected schools (92.64%) agreed to participate in the survey. The addition of 4 replacement schools increased the number to 130. In all, 4,171 pupils (93.1% of selected pupils in participating schools or 89% of pupils in the 136 selected schools[5]) sat the test of mathematics achievement on a designated day during a two-week test administration frame (May 10-21, 2004). The pupils ranged in age from 9 years, 2 months to 12 years, 5 months, with an average age of 10 years, 6 months (SD = 5.1 months). Numbers of pupils in the achieved sample are shown in Table 3.5.

[5] 89% is 93.1% multiplied by the fraction 130/136, the ratio of the number of participating schools to the number of selected schools.

Table 3.5 *Numbers of Pupils in Fourth Class in the Selected and Achieved Samples, by Stratum*

Stratum	Numbers of schools in achieved sample	Numbers of pupils in selected classes	Numbers of pupils completing the test
4th & 5th class (Small <21)	7	119	103
4th & 5th class (Medium 21-34)	10	272	245
4th & 5th class (Large 35+)	16	840	777
1st, 4th & 5th class (Small <21)	23	287	278
1st, 4th & 5th class (Medium 21-34)	24	643	610
1st, 4th & 5th class (Large 35+)	50	2292	2158
Total	130	4480	4171

The discrepancy between the numbers of pupils in selected classes and the number of completed mathematics tests can mainly be attributed to absenteeism on the days on which the test was administered. Furthermore, a small number of pupils (27 in 16 schools) were exempted from taking the test, usually because their principal or classroom teacher indicated that they had a general or specific learning difficulty that would have made it impossible for them to attempt the test.

ADMINISTRATION OF TESTS AND QUESTIONNAIRES IN SCHOOLS

Following the first stage of sampling, the Educational Research Centre wrote to the principal teachers of selected schools, providing information about the purpose and format of the study, and inviting their participation. Schools indicated their agreement to participate by returning a completed School Form that gave the numbers of pupils enrolled in all First, Fourth and Fifth classes in the school. Gaeltacht schools and scoileanna lán-Ghaeilge were asked to indicate if they wished to administer the NAMA 2004 mathematics test in English or Irish.

In cases where a school had more than two classes at a particular class level, two classes were selected at random. Otherwise, all listed classes were selected. Schools were then sent the names of participating classes and copies of the School, Class Teacher, Learning Support Teacher, Pupil and Parent Questionnaires, and Pupil Rating Form (see Chapter 2). A letter from the National Parents’ Council (Primary) accompanied each Parent Questionnaire encouraging parents to complete it, and return it to the school. Principal teachers were asked to complete the School Questionnaire; class teachers were asked to complete the Teacher Questionnaire and a short Pupil Rating Form in respect of each pupil in their Fourth class; and learning support teachers were invited to complete the Learning Support Teacher Questionnaire. It was intended that all these materials would be completed before the day on which pupils would be administered the mathematics test.

An inspector of the Department of Education and Science was assigned to each school. Following a training day, on which procedures related to the administration of the survey were outlined, each inspector made an initial contact with the school(s) assigned to him/her to arrange a suitable date on which tests could be administered, between May 10 and 21, 2004. The inspector also discussed with the principal pupils who might be excluded from testing because of a physical disability, a moderate or severe general learning disability, or insufficient knowledge of the test language.

On the day designated for testing, the inspector visited the school and monitored the administration of tests. Class teachers administered the tests and the Pupil Questionnaires, except in a few small schools, in which the inspector assisted with test administration. Upon completion of testing, inspectors collected all completed and unused test booklets, questionnaires and rating forms and returned them to the Educational Research Centre. Schools in which some questionnaires had not been completed were given a mailing label, which they could use to return materials to the Educational Research Centre after they had been completed.

Implementation of the survey was generally satisfactory, and reflected the strong commitment to the study of inspectors, principal teachers, class teachers, learning support teachers, parents and pupils. Unlike 1999, no school elected to use the Irish form of the mathematics test, so difficulties that arose in the administration of the test in 1999 (e.g., frequent requests from some pupils for help with translation) did not arise on this occasion.

Following receipt of completed test materials from a school, a letter of acknowledgement was sent to the principal teacher for distribution to teachers who had participated in the study.

RESPONSE RATES

In general, response rates for the all instruments were satisfactory (Table 3.6). Over 93% of the pupils selected in schools which agreed to participate in the study completed the test (approximately 89% of the selected sample). In participating schools, all but one teacher completed the Teacher Questionnaire.

Table 3.6 *Completion Rates for the Assessment Instruments*

			Percentage Completed	
Instrument	**No. Received**	**No. in Sample**	**Of 130 schools taking part**	**Of 136 schools initially selected***
School Questionnaire	129	136	99.23	94.85
Test Booklet	4171	4480	93.10	88.99
Teacher Questionnaire	194	195	99.49	95.10
Parent Questionnaire	4202	4480	93.79	89.65
Pupil Rating Form	4462	4480	99.60	95.21
Pupil Questionnaire	4318	4480	96.38	92.13
Learning Support Questionnaire**	172	182	94.51	90.34

**Apart from the figure for the School Questionnaire, these figures are estimates based on the percentage completion for the 130 schools multiplied by 130/136*
*** Common questionnaire completed by Learning Support teachers of English and Mathematics*

SAMPLING WEIGHTS

Sampling weights were calculated prior to the analysis of the test data. Weights are necessary since schools and classes (and therefore pupils) were sampled disproportionately with regard to their overall presence in the population. Weighting of data ensures that the contribution of groups of pupils (e.g., pupils attending large schools) are not over-represented in the data and therefore do not bias findings. To prevent such bias, each pupil's score is multiplied by the inverse of the pupil's probability of being selected. The probability of selection is the product of the probability of the school being selected multiplied by the probability of the particular class being selected within a selected school.

The weighting process had two further features. The first was a correction to account for non-response at each level (e.g., a school declining to take part in the study or a pupil being absent on the day of testing) and is simply the number of schools or pupils selected divided by the number of schools or pupils from which data were returned. The second involved multiplying the weights calculated in the manner described above by the overall sampling fraction (the number of pupils in the sample divided by the number of pupils in the population). This step means that the number of cases in the weighted data set is the same as the number in the sample and helps to avoid confusion between sample estimates and total population parameters that are reported elsewhere.

The final weights for the survey were calculated as follows:

n/**N** (**sbw** x **scnr** x **cbw** x **pcnr**)

where

n is the number of pupils in the sample,

N is the number of pupils in the population,

sbw is the school base weight or the inverse of the probability of the school being selected,

scnr is the correction for non-response at the school level,

cbw is the class base weight or the inverse of the probability of the class being selected,

pcnr is the correction for non-response at the pupil level.

After weighting, a bias was discovered in terms of the weighted number of male pupils (the weighted proportion of males in the data set was greater than the proportion of males in the population).[6] To correct this, a correction factor (the actual proportion of male and female pupils within a stratum in the population divided by the corresponding weighted proportions of male and female pupils in the stratum in the sample) was applied within each stratum.

[6] This bias was the result of over sampling rather than a function of the weighting.

SCALING OF NAMA 2004

Following the main study, NAMA 2004 was scaled using Item Response Theory methodology. An IRT model was implemented using the BILOG programme (Mislevy & Brock, 1990). For multiple-choice items, three parameters – item difficulty, item discrimination, and guessing – were estimated. For short-answer items, strong prior distributions were set on the guessing parameter. One item was removed from the analysis as it had a negative item/total correlation[7]. The likelihood-ratio chi-square statistics generated by BILOG flagged 13 of the remaining 149 items as potentially fitting poorly to the underlying IRT model. However, an examination of the response curves for the items indicated no substantial deviations from the theoretical curves. Since classical item statistics for these items were satisfactory, and other reasons for eliminating them such as a large percentage of missing responses were discounted, it was decided not to omit any of them.[8] A regression of the derived IRT scale scores on the number of items answered correctly (raw scores) resulted in an R^2 of 96.5%, indicating that the IRT scale provided a satisfactory representation of pupils' achievement on the test.

To facilitate comparisons between results from the 1999 and 2004 NAMA surveys, the 2004 scores were set on the scale used in 1999, using the following procedure.

1. Item parameters were calculated and pupil scores derived for all 2004 items (i.e. both new items and items common to NAMA 1999 and 2004).
2. The new item parameters for the common 1999/2004 items were used to rescore the cases in the 1999 survey and the mean m_n and standard deviation s_n of the new scores were computed.
3. The cases in the 1999 survey were then scored using the 1999 item parameters for the common items, and the corresponding mean m_o and standard deviation s_o of these scores were computed.
4. Pupil scores for the 2004 survey (calculated at step 1) were rescaled to obtain scores for the new test on the old scale using $y_i^* = (s_o / s_n)(y_i - m_n) + m_o$, where y_i is the ith pupil's score on the 2004 scale and y_i^* is the 1999 equivalent score.

Following scaling, a scaled score was available for each pupil who completed NAMA 2004 on the scale for NAMA 1999. The 1999 scale had a mean of 250 and a standard deviation of 50.

PROCEDURES FOR ANALYSING THE DATA

Where possible, questionnaire data were linked to the achievement test scores of pupils. In the case of most questionnaire items, two issues are examined:

[7] One of the new calculator items.
[8] Three of the 13 items were in the new calculator block. Nine poor-fitting items were reported in 1999. None of these items corresponds to the 10 poor-fitting common items in 2004.

(1) the proportion of pupils with the particular attributes measured by the item (e.g., attendance at a school in which a school plan for mathematics has been prepared);
(2) the average achievement scores of pupils having/not having the attribute.

A number of statistical techniques, designed to take account of the stratified and clustered nature of the sample, were used in analyzing data. Traditional techniques are applied under the assumption that the cases in a sample are drawn from the population of interest using a Simple Random Sampling (SRS) procedure, where every unit in the population has an equal and non-zero probability of selection. However, in the current study, pupils were selected in clusters (classes/schools) in which pupil characteristics (e.g., mathematics achievement) are likely to be correlated with each other. This means that the amount of variance within the sample (and population) may be under-estimated. The standard errors around estimates of percentages and means for the sample are also likely to be under-estimated. This could have the effect of rendering differences statistically significant, when in fact they are not. To address this issue, it was necessary to use special techniques to present accurate statistics derived from the sample that can be extrapolated to the population.

Computing Standard Errors

Every mean and percentage reported in this study is accompanied by its standard error. A standard error is a measure of the extent to which a sample estimate (e.g., mean or percentage) is likely to differ from the true (unknown) score of a population on a given measure. In a complex sample, for the reasons outlined above, it is necessary to calculate this measure within a specialised statistical package such as WesVar (Westat, 2000) which uses a re-sampling technique to generate a standard error for each estimate, taking account of the design of the sample. The result is that standard errors around population estimates are larger than they would be for a simple random sample (SRS), and so provide a more accurate representation of the estimate.

A confidence interval for a statistic (ranging from 1.96 standard errors below the statistic to 1.96 standard errors above it) may be constructed so that, if the sampling procedure were repeated a large number of times, and the sample statistic re-computed on each occasion, the confidence interval would be expected to contain the population value 19 times out of 20. For example, for a sample mean of 250 and a standard error of 2, it is possible to say with 95% confidence that the population mean lies within two standard errors of the sample mean, that is between 246.1 and 253.9.

In addition to estimating standard errors, WesVar allows for a comparison between means, percentages, and other statistics using multiple regression and chi-square analyses, which also take account of the complexity of the samples upon which these statistics are based.

Making Multiple Comparisons

In a study such as this, where it is necessary to compare a number of different mean scores at the same time, there is an increased probability of making Type 1 errors; that is, the likelihood is increased that statistical differences will be reported between means as a function of chance alone. To control for this possibility, it was necessary to adopt a more conservative significance level than the traditional .05 level that would suffice for a single comparison. This was achieved by dividing the desired significance level (e.g., 0.05) by the number of comparisons that were to be made and looking up the appropriate critical value for this adjusted significance level in the normal distribution (see example below). This is known as the Dunn-Bonferroni procedure (Dunn, 1961).

Example:
No. of comparisons being made: 5
Desired significance level = 0.05
Adjusted significance level = (0.05/5) = 0.01 (for two-tailed tables)
Critical Value = 2.654

A further step involves calculating the standard error of the difference between each pair of means, using the jackknifed error associated with each separate mean, as follows:

$$se_{diff} = \sqrt{se_1^{\,2} + se_2^{\,2}}$$ (se_{diff} = Standard Error of the difference)

where se_1 and se_2 are the standard errors of the two means to be compared. The standard error of the difference is then used to calculate the standardised difference between the two means. This in turn, is compared with the appropriate (adjusted) critical value for the number of simultaneous comparisons being made. The standardised difference is calculated as

$$stddff = \frac{x_1 - x_2}{\sqrt{se_1^{\,2} + se_2^{\,2}}}$$ (*stddff* = Standardised Difference between two means)

where x_1 is the first mean and x_2 the second mean being compared, and the denominator is the standard error of the difference (see above). If the standardised difference between the two means is larger than the adjusted critical value for the number of comparisons being made, the difference between the two means is deemed to be statistically significant.

Correlations Between Variables

Another statistic which features regularly in this report and which is also affected by the complexity of the sample is the simple correlation between two variables. While the actual values of the correlations between variables in the sample remain unaffected, their significance levels need to be adjusted for the sample design. This was achieved by carrying out a series of simple X on Y regression analyses within

WesVar between the variables of interest, and focussing on the significance level of the *t* statistic for the parameter estimate of the independent variable. The significance level of the parameter is in effect the significance level of the correlation between the two variables, which within a regression analysis containing two variables is the square root of R^2 for the regression equation.

The *t* statistic of the parameter estimate is obtained by dividing the parameter estimate (the β coefficient) by its standard error. This is where WesVar provides a more conservative estimate of significance level. The standard error that WesVar generates for the parameter estimate is larger than the standard error derived from a regression analysis carried out under the assumptions of a simple random sample in a package such as SPSS, because it uses the replication method to take sampling complexity into account. Therefore, the *t* value for the parameter is smaller and the statistical significance of the parameter, and of the correlation, is reduced. The significance levels of correlation coefficients in this report were calculated using this methodology.

DEVELOPING PROFICIENCY LEVELS

In 2004, a new mathematics proficiency scale was developed to allow for the provision of more specific information on the achievements of pupils performing at different levels on the test. To accomplish this, the difficulties of test items (the logit scores derived in the course of IRT scaling) were plotted on a scale in increasing order of difficulty, and were examined to identify specific clusters or groupings of items on the scale (see Appendix, Table E3.1 for a full listing of the 149 scalable items in order of difficulty).[9] Two criteria were used. First, there had to be identifiable sets or clusters of items. Second, the sets had to have a common substantive interpretation in terms of their underpinning process skills. Where ‘natural breaks’ were found along the distribution of test items, the associated items and process skill descriptions were examined to determine if a common substantive interpretation could be formed. This resulted in five proficiency levels (see Table 3.7).

Table 3.7 *Definition of Proficiency Levels*

Level	Descriptor	Interval
Level 5	Advanced	>1.05 (logits)
Level 4	High	>0.35 and <=1.05
Level 3	Moderate	>-0.25 and <=0.35
Level 2	Basic	>-0.95 and <=-0.25
Level 1	Minimum	>-2.05 and <=-0.95
Below Level 1	Achievements not assessed	<=-2.05

Since IRT places pupils and items on the same scale, it was possible to assign a level to each pupil, based on his/her overall performance on the test (also expressed

[9] A three-parameter IRT model was used. One item (F25) was not scalable, as it had a negative biserial value.

as a logit value). Pupils scoring at a particular level (e.g., Basic Level or Level 2) have about a 50% chance of getting items at that level correct. They have a greater than 50% chance of getting items at lower (easier) levels correct, and a less than 50% chance of getting items at higher (more difficult) levels correct. As the range of item values is narrower than the range of pupil values, pupils with logit values that were lower than the item with the lowest logit value could not be assigned to a level. These pupils were considered to have scored below Level 1. The descriptor 'achievements not assessed by NAMA' is used to describe the performance of these pupils.

Table 3.8 provides a summary of the process skills assessed at each proficiency level. This is an abbreviated version of the list in Appendix (pp. 175-179), which details the principal (or dominant) process skills assessed by all 149 valid items.

Table 3.8 *NAMA 2004 Proficiency Levels – Summary Descriptions*

Level 5 (>= 1.05) Advanced Level of Mathematics Achievement
Implement procedures for estimating sums and quotients
Connect decimal and fraction notation in measure contexts
Extend more complex patterns in number
Hypothesise and test answers for correctness (mixed operations number sentences)
Apply concepts of ratio and proportion in practical contexts
Solve non-routine multi-step problems involving fractions and measures
Level 4 (< 1.05 ≥ 0.35) High Level of Mathematics Achievement
Recall and use definitions of parallel and perpendicular lines
Identify angle types in 2-D shapes
Partition 2-D shapes using fractions
Add measures of length
Identify missing information in problems
Identify a fraction between two fractions
Make informal deductions about properties of 2-D shapes
Apply concept of scale to reading maps
Hypothesise and test answers for correctness in multiplication or division sentences
Convert fractions to decimals
Solve routine problems involving calculation of perimeter
Level 3 (< 0.35 ≥ – 0.25) Moderate Level of Mathematics Achievement
Calculate a fraction of a number
Divide a decimal by a whole number
Round four-digit numbers
Estimate products of whole numbers
Implement procedure for division of whole numbers
Order fractions in terms of magnitude
Identify fractional areas of regular 2-D shapes
Visualise properties of 3-D shapes from 2-D nets
Complete number sentences involving associative and distributive properties
Connect verbal, diagrammatic and symbolic representations of problems
Hypothesise and test answers for correctness (single operation number sentence)
Solve non-routine one-step problems involving operations with fractions and measures
Level 2 (< – 0.25 ≥ – 0.95) Basic Level of Mathematics Achievement
Calculate area of regular shapes using a grid
Identify decimal between two decimals
Implement procedures for multi-digit subtraction and long multiplication
Select appropriate units of measure
Connect diagrammatic and verbal representations of problems
Visualise and identify properties of 2-D and 3-D shapes
Extend decimal number patterns

Reason with place value and notation of 4-digit numbers and decimals Hypothesise answers and test them for correctness (addition number sentences) Apply Unitary Method in everyday contexts Make informal deductions about simple graphical data Analyse tables of data to solve routine and non-routine problems Solve routine problems involving operations with whole numbers, fractions, and measures Solve non-routine problems involving operations with whole numbers
Level 1 (< – 0.95 ≥ – 2.05) Minimum Level of Mathematics Achievement Recall basic multiplication and division facts Identify place value in four-digit numbers and in two-place decimals Identify properties of 2-D shapes Implement procedures for multi-digit addition and short multiplication Order simple events in terms of likelihood of occurrence Read and interpret bar charts, line graphs, tables, decimal scales, and area diagrams Identify and extend simple number patterns Combine and partition 2-D shapes into sets of specified shapes Solve simple, routine word problems involving multiplication/division facts; calendar; subtraction; chance
Below Level 1 (< - 2.05) Level of mathematics knowledge not assessed by this test

Table 3.8 shows that pupils scoring at Level 5 (Advanced level) could be expected to succeed on such tasks as implementing procedures for estimating sums and quotients, connecting decimal and fraction notation, extending more complex number patterns, and solving non-routine problems involving fractions and measures. These represent the most difficult items on NAMA 2004, and a relatively small proportion of pupils would be expected to answer them correctly. Pupils achieving Level 5 can also be expected to do well on items at lower levels on the proficiency scale.

In contrast, pupils achieving Level 1 (described as a Minimum level of mathematics achievement) can recall basic number facts, identify place value in whole numbers and decimals, identify the properties of 2-D shapes, and identify and extend simple number patterns. They can also solve simple, routine word problems involving multiplication/ division facts, subtraction, and chance. Pupils achieving this level would not be expected to do well on test items at higher levels.

Pupils scoring below Level 1 have less than a 50% change of getting items at Level 1 correct. Although they may have mathematics skills, those skills are not assessed by NAMA 2004.

It is possible to select a specific aspect of mathematics (e.g., 2-D shapes) and follow its progress through the proficiency levels. For example, pupils scoring at Level 1 can be expected to identify the properties of 2-D shapes. Those scoring at Level 3 can be expected to identify fractional areas of regular 2-D shapes, while those at Level 4 can be expected to identify angle types in 2-D shapes, and make informal deductions about the properties of such shapes. Similarly, problem solving advances from solving simple, routine word problems involving operations with whole numbers (Level 1), to solving non-routine problems involving operations with whole numbers (Level 2), to solving non-routine one-step problems involving operations with fractions and measures (Level 3), to solving non-routine multi-step problems involving fractions and measures (Level 5).

SUMMARY

The target population for NAMA 2004 was all pupils in Fourth class in Irish primary schools in May 2004, with the exception of pupils attending private schools, special schools, and special classes in ordinary schools. Pupils who had, in the view of the school principal, a learning disability or physical disability that would prevent them from attempting the test, and 'newcomer' pupils whose proficiency in English was so low that they could not attempt the test, were also exempted.

All schools on the DES schools database were categorised according to whether they were large, medium, or small, and whether they had pupils in First, Fourth, and Fifth classes, or pupils in Fourth and Fifth classes only. Within these six strata, schools were sorted by designated disadvantaged status, area/language of instruction, proportion of female pupils, and a measure of class size to ensure a representative mix of school types. Schools were first selected from within the six strata with a probability proportional to size to yield a selected sample of 136 schools and 4,812 pupils. One hundred and twenty-six of the originally sampled schools and four replacement schools agreed to take part in the study, giving 130 schools in all. In selecting pupils within schools, where there were more than two Fourth classes, two classes were selected at random. In schools with one or two Fourth classes, all classes were selected. All pupils in participating classes were expected to participate, except those who had been exempted. The final sample consisted of 130 schools and 4171 pupils. Once participating classes had been identified, schools were sent copies of the School, Class Teacher, Pupil, Learning Support Teacher, and Parent Questionnaires, and Pupil Rating Form.

An inspector of the Department of Education and Science was assigned to each school to liaise with the school principal and to monitor the administration of the test on an agreed date.

Approximately 93% of selected pupils participated in the study. The data were weighted to ensure different groups of pupils were appropriately represented in the sample. Data were scaled using a three-parameter Item Response Theory model. To facilitate comparisons between results of the 1999 and 2004 NAMA surveys, the 2004 scores were set on the scale used in 1999. A scaled score was then available for each pupil who participated in the 2004 study on the 1999 scale.

A novel aspect of the current study was the development of a mathematics proficiency scale, which allows for the provision of more specific information on the achievements of pupils performing at different levels on the test. Pupils scoring at a particular level have about a 50% chance of getting items at that level correct. They have a greater than 50% chance of getting items at a lower level correct, and a less than 50% chance of getting items at a higher level correct. Six levels were identified, ranging from Advanced (Level 5) to 'Below Level 1'. Pupils scoring below Level 1 had a less than 50% chance of getting the easiest (Level 1) items on NAMA 2004 correct. Descriptions of the process skills that pupils at each level would be expected to demonstrate were derived.

4. Mathematics Achievement of Pupils in Fourth Class

In this chapter, the performance of pupils on NAMA 2004 is described under the following headings: performance on the overall scale, including performance at key benchmarks such as the 10th and 90th percentiles; performance on the mathematics content strands and skills outlined in the 1999 PSMC; performance on the mathematics proficiency scale; the performance of pupils, based on ratings provided by their teachers; the performance of pupils on the calculator items in NAMA 2004; and estimated between- and within-school variance in mathematics. Throughout the chapter, comparisons are drawn with the performance of students in the NAMA 1999, where appropriate.

PERFORMANCE ON THE OVERALL SCALE

Performance on the 2004 test booklets is described, followed by performance on the overall mathematics scale and performance at key benchmarks, in 1999 and 2004.

Performance on the National Assessment Booklets

As in the 1999 study, each pupil in the current study attempted one test booklet comprising three sections (see Chapter 2), with 25 items in each section. As displayed in Table 4.1, the unweighted mean percent correct score across the booklets was 55.1 (see e-appendix E4.1 for the full table of raw scores and percent correct scores). This can be interpreted as indicating that, overall, the test was at an appropriate level of difficulty for pupils in Fourth class.

Results of an Analysis of Variance (in which ‘percent correct score’ was the dependent variable, and ‘booklet’ the independent variable) indicated that the difference in difficulty between booklets was statistically significant [$F(4, 4171) = 14.51$, $p < .01$]. The difference between performance on Booklets 4 and 5 is not significant, but performance on these booklets is significantly lower than on Booklets 1, 2 and 3 (see e-appendix E4.2 for comparisons). One reason for this was the relative difficulty of the calculator-appropriate section (Section F). Pupils taking this section as part of Booklet 4 achieved a mean percent correct score of 38.7, and those taking it as part of Booklet 5 achieved a mean percent correct score of 40.3 (see Table 4.12 for more information on percent correct scores on the calculator section). These scores are considerably lower than scores for the other sections.

Table 4.1 *Unweighted Mean Percent Correct Scores (and SDs), by Booklet, 2004*

Booklet	Section	% Correct Score	
		Mean	SD
Booklet 1 (n=835)	A	57.5	22.43
	B	63.6	19.94
	C	51.0	22.14
	Total	57.3	20.12
Booklet 2 (n=838)	C	49.0	19.19
	B	62.3	19.37
	D	52.4	22.52
	Total	55.6	19.51
Booklet 3 (n=827)	D	55.1	23.4
	B	63.4	19.79
	E	53.6	21.20
	Total	57.3	20.11
Booklet 4 (n=837)	E	53.5	20.58
	B	62.8	18.56
	F	38.7	19.14
	Total	51.7	17.70
Booklet 5 (n=834)	F	40.3	20.45
	B	63.0	19.22
	A	56.5	21.80
	Total	53.3	18.65
All Booklets		55.1	19.36

The data indicate that Section B, which was taken by all students participating in the study, was easiest. Mean percent correct scores on this section ranged from 62.3 (Booklet 2) to 63.6 (Booklet 1). Differences in performance on Section B across the 5 booklets are not statistically significant, indicating that any observed differences across booklets are unlikely to have been due to differences in the mathematics ability of pupils taking the different booklets.

Performance on the Overall Mathematics Scale

As indicated in Chapter 3, pupils' scores were scaled using item response theory (IRT) methods. Since performance in 2004 is reported on the scale used for NAMA 1999, it is possible to compare performance across the two assessments. In 1999, the mean and standard deviation were set at 250 and 50 respectively (Table 4.2). In 2004, the obtained mean score was 250.8, and the standard deviation 49.03. The mean score difference (0.8 points) is not statistically significant (SED = 3.23; 95%CI = 7.24 to 5.64), indicating that overall performance did not change between 1999 and 2004.

Table 4.2 *Mean Scores on Overall Mathematics Scale, 1999 and 2004*

Year	N	Mean Scale Score	SE	SD
1999	4747	250.0	2.20	50.0
2004	4171	250.8	2.36	49.03

Performance at Key Benchmarks

Performance on the overall scale was examined with respect to the scores of pupils at key benchmarks, i.e., the 10th, 25th, 50th, 75th and 90th percentile ranks. The scores of pupils at all except the 50th percentile rank were marginally higher in 2004 than in 1999, while the performance of pupils at the 50th percentile was marginally lower (Table 4.3). None of the differences reached statistical significance.

Table 4.3 *Performance at Key Benchmarks on the Overall Mathematics Scale, 1999 and 2004*

	1999		2004	
Percentile	**Score**	**SE**	**Score**	**SE**
10th	181.0	3.01	182.9	3.04
25th	217.3	2.73	221.2	2.96
50th	256.3	2.39	253.6	2.78
75th	284.4	1.82	285.0	2.89
90th	308.7	1.75	311.2	2.81

PERFORMANCE ON MATHEMATICS CONTENT STRANDS AND SKILLS

Performance on the NAMA Content Strands

Each item in the assessment was categorised according to the mathematics strand it assessed (see Chapter 2). The distribution of items across strands reflects their representation in the 1999 Primary School Mathematics Curriculum. The weighted mean percent correct scores for each of the five mathematics strands, aggregated across the five booklets, are presented in Table 4.4

Table 4.4 *Percentages of Items and Mean Percent Correct Scores, by Mathematics Content Strand, 2004*

Strand	% of Items	Mean % Correct	SE
Number	38.7	55.6	0.92
Algebra	4.7	55.9	1.19
Shape & Space	14.0	55.9	1.08
Measures	32.0	49.2	1.09
Data	10.7	68.8	0.86
Total	100	57.6	0.94

Pupils achieved the highest mean percentage correct score on items relating to Data (68.8% correct), and lowest on items dealing with Measures (49.2% correct). Mean scores for Number, Algebra, and Shape & Space items were close to the overall mean of the test (57.6%).

Comparisons between performance in 1999 and 2004 were limited to the 116 items that were common to both years (see Table 2.7). Significant differences between the two years were discernible for two strands only (Table 4.5). The mean scores for items assessing Shape & Space, and Data are significantly higher in 2004 than in 1999. For both, the increase was in the order of 5%.

Table 4.5 *Mean Percent Correct Scores on Common Items, and Mean Score Differences, by Mathematics Content Strand, 1999 and 2004*

Strand	1999 Study		2004 Study		Diff with 1999	SED	95%CI	
	%	SE	%	SE				
Number	57.4	.93	56.7	.901	–0.74	1.30	-2.7	4.2
Algebra	58.3	.94	61.0	1.16	2.68	1.49	-6.5	1.3
Shape & Space	50.8	.87	55.7	1.10	**4.96**	**1.40**	**-8.7**	**-1.2**
Measures	54.1	.89	54.0	1.07	–0.03	1.40	-3.4	3.7
Data	66.0	.81	71.3	0.92	**5.30**	**1.22**	**-8.5**	**-2.1**
Total	57.3	.78	57.6	0.94	0.23	1.22	-2.1	2.7

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*

Performance by Mathematics Skills

The percentage of items assessed in each mathematics area in NAMA 2004, and the mean percent correct score for each are presented in Table 4.6. Pupils achieved the highest mean scores on items assessing basic mathematics skills – Understanding & Recalling (61.7%) and Implementing (57.9%). They performed least well on items assessing higher-order skills, including Applying & Problem Solving (48.2%).

Table 4.6 *Distribution of Common Items by Mathematics Skill, and Mean Percent Correct Scores, 2004*

Skills	% of Items	Mean % Correct	SE
Understanding & Recalling	12.3	61.7	1.03
Implementing	28.0	57.9	0.92
Reasoning	20.3	57.0	0.94
Integrating & Connecting	7.3	55.5	1.27
Applying & Problem Solving	32.0	48.2	0.98
Total	100	57.6	0.94

SE = Standard Error

A comparison of performance on the 116 items common to the 1999 and 2004 assessments revealed a significant increase in 2004 for one skill, Reasoning, for which the mean score increased by almost 4% (Table 4.7). In both years, pupils achieved the highest scores on Understanding & Recalling, and the lowest on Applying and

Problem-Solving. A more detailed breakdown of the performance on each content strand by process skill can be found in e-appendix E4.3.

Table 4.7 *Mean Percent Correct Scores on Common Items, and Mean Score Differences, by Mathematics Skill, 1999 and 2004*

Skill	1999 Study		2004 Study		Diff with 1999	SED	95%CI	
	%	SE	%	SE				
Applying & Prob. Solving	50.5	0.90	49.0	0.99	–1.5	1.32	-1.96	5.02
Integrating & Connecting	53.2	1.00	55.0	1.37	1.5	1.72	-6.57	2.57
Reasoning	56.8	0.87	60.7	1.00	**3.9**	**1.31**	**-7.52**	**-0.58**
Implementing	58.8	0.89	59.4	0.92	0.5	1.29	-3.88	2.96
Understanding & Recalling	61.9	0.88	63.8	1.05	1.8	1.36	-5.42	1.78
Total	57.3	0.78	57.6	0.94	0.2	1.22	-2.14	2.74

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

PERFORMANCE ON THE MATHEMATICS PROFICIENCY SCALE

Table 4.8 presents the percentages of pupils scoring at each proficiency level in NAMA 2004. Twelve percent achieved at an ‘Advanced’ level (Level 5). Pupils performing at this level are likely to succeed on the most complex tasks in NAMA 2004, such as implementing procedures for estimating sums and quotients, and solving non-routine problems involving fractions and measures. Pupils achieving at this level would also be expected to do well on items at lower levels. Pupils are evenly distributed at the centre of the distribution of proficiency levels, with 26% achieving a ‘High’ level (Level 4), 26% a ‘Moderate’ level (Level 3), and 22% a ‘Basic’ level (Level 2). Pupils achieving a High level can be expected to succeed on items such as recalling and using definitions of parallel and perpendicular lines, partitioning 2-D shapes using fractions, and solving routine problems involving the calculation of perimeter. Pupils achieving a Moderate level can be expected to succeed on items that involve rounding whole numbers, estimating products of whole numbers, and solving non-routine one-step problems involving operations with fractions and measures. Pupils at the Basic level can be expected to visualise and identify properties of 2-D and 3-D shapes, solve routine problems involving operations with whole numbers, fractions and measures, and solve non-routine problems involving operations with whole numbers. Twelve percent of pupils achieved a ‘Minimum’ level (Level 1). These pupils can be expected to recall basic number facts, identify place value in whole numbers and decimals, and solve simple, routine word problems involving multiplication/division facts, subtraction and chance (see Table 3.8). The mathematics achievements of pupils scoring below Level 1 (3%) are not assessed by NAMA 2004.

Table 4.8 *Numbers and Percentages of Pupils at Each Proficiency Level on the Overall Mathematics Scale, 2004*

Level	Descriptor	Number	% of Pupils	SE
Level 5	Advanced	488	11.7	1.11
Level 4	High	1072	25.7	1.50
Level 3	Moderate	1087	26.1	1.33
Level 2	Basic	906	21.7	1.47
Level 1	Minimum	512	12.3	1.06
Below Level 1	Below Minimum Level	106	2.6	0.55

SE = Standard Error

TEACHERS' JUDGEMENTS ABOUT PUPILS' MATHEMATICS ACHIEVEMENT

In both 1999 and 2004, teachers rated the performance of pupils in their classes, by indicating the class level at which each pupil was functioning. Table 4.9 shows the percentages of pupils judged to be performing at each of several class levels, and the corresponding mean scale scores, for both the 1999[1] and 2004 studies. In both years, teachers indicated that approximately three-quarters of their pupils were performing at Fourth class level or higher. More pupils in 2004 than in 1999 were judged to be performing at a Fifth class level (9.4% vs. 7.0%), a difference that is significant at the 90% level (SED = 1.36; 90%CI = –4.67 to –0.14). None of the other differences are statistically significant.

Table 4.9 *Percentages of Pupils Judged by their Teachers to be Functioning at Various Grade Levels, and Corresponding Scale Scores, 1999 and 2004*

Class Level	Year	Percentage of Pupils		Scale Score	
		%	SE	Mean	SE
6th class or above	1999	1.2	0.41	308.3	6.48
	2004	0.8	0.28	308.7	17.77
5th class	1999	7.0	0.94	303.3	3.25
	2004	9.4	0.98	301.6	4.20
4th class	1999	67.9	1.52	262.5	1.98
	2004	67.6	2.15	260.6	2.03
3rd class	1999	18.4	0.94	205.1	2.39
	2004	15.6	1.21	210.1	3.22
2nd class or below	1999	5.5	0.65	167.3	3.68
	2004	6.7	0.84	171.4	3.45

SE = Standard Error

[1] In NAMA 1999, there were two additional categories – First class or below and Post-primary level. In the analysis presented here, these were collapsed with adjacent categories.

The mean scores achieved by pupils judged to be performing at different class levels were quite similar in 1999 and 2004. In both years, for example, pupils reported to be performing at Fourth class level achieved a mean score around 260 points (one-fifth of a standard deviation above the mean), while the mean scores of pupils performing at Fifth class level were about 300 points (one standard deviation above the mean).

PERFORMANCE ON CALCULATOR ITEMS

One of the main differences between the 1999 and the 2004 national assessments was the inclusion of 25 calculator-appropriate items (included as the last section in one booklet, and the first in another) in 2004. We have already noted that pupils did less well on the calculator section than on other item sections, with an overall percent correct score of just under 40%, compared to an average of 55% across all sections. In this section, performance on the calculator items is considered in greater detail.

Item Difficulty

Table 4.10 indicates, for each of several items, the percent correct score, and the relatively level of difficulty of the item within the calculator section.[2] (Difficulty levels associated with the remaining items are given in e-appendix E4.4.)

Table 4.10 *Descriptions of Selected Calculator Items, Percent Correct Scores, and Item Difficulties, 2004*

Item	Description	% Correct	Difficulty
F2	Identify the number in a number sentence that should be left out to make it correct (e.g. 175 + 236 + 318 + 240 = 733)	66.1	Easy
F8	Supply a missing digit to make a number sentence correct (e.g. 4_5 ÷ 9 = 45)	42.9	Difficult
F9	Indicate the missing operation to make a number sentence correct (e.g. 27 _ (31 _ 11) = 540)	49.1	Moderate
F12	Compare the performance of athletes over two rounds of a competition, where distances are presented as decimal numbers.	40.1	Difficult
F16	Identify the next number in a sequence (e.g. 4.2, 8.4, 16.8, ?)	13.8	Difficult
F18	Find the perimeter of a field where the length and width are decimal numbers	37.1	Difficult
F24	Solve a routine problem involving operations with fractions (e.g., The normal price of a toy is €13. Its price is reduced by a quarter in a sale. What is the sale price?)	25.8	Difficult

[2] Difficulty levels were arrived at by identifying the 33rd (46.8%) percentile and 67th percentile (65.4%) on the distribution of percent correct scores for items on the calculator section.

Mathematics Strands and Skills

Table 4.11 indicates the numbers of items in each strand/skill in the NAMA 2004 framework for which a calculator was available, and the percent correct scores of pupils attempting these items.

Table 4.11 *Percent Correct Scores on Calculator-appropriate Items by Mathematics Content Strand and Skill, 2004*

Strand	No. of Items	% Correct	SE	Skill	No. of Items	% Correct	SE
Number	11	50.5	1.32	Reasoning	5	36.23	1.25
Measures	9	22.6	1.23	Applying & Prob. Solving	13	34.61	1.12
Data	4	55.0	1.22	Implementing	7	51.65	1.20
Algebra	1	13.8	1.29	Reasoning	1	13.78	1.29

SE = Standard Error

The highest percent correct score (59%) was obtained on the four Data items. Pupils performed relatively poorly on the Measures items, with a mean percent correct score of just 23 over 9 items. Of the mathematics skills assessed, pupils did best on Implementing, and least well on Applying & Problem Solving.

It should be noted that the level of missingness (items to which pupils did not provide a response) was considerably greater on the calculator items than on items in other sections, and was greatest towards the end of the section (ranging from 4% on item F16 to 46% on item F25). This suggests that pupils took more time to complete the calculator items they attempted, and hence answered fewer items towards the end of the section. Since many of the calculator-appropriate Measures items were clustered towards the end of the calculator section, the relatively low performance on Measures items within the section may be attributed, at least in part, to slow progress through the section.

To ascertain the possible influence of missingness on performance in the calculator section, total mean percent correct scores (based on all the items in the section), and mean percent correct scores on items attempted were compared (Table 4.12). While scores were significantly higher when considered with regard to the number of items attempted rather than by total number of items in the section, the average percent correct score on attempted items (46%) was still considerably lower than the average score on the test. This suggests that, regardless of the number of items attempted, pupils found items in the calculator section more difficult, possibly because most of the Measures items in the section involved the application of problem solving skills.

Table 4.12 *Percent Correct Scores on Calculator Section, Total Items and Attempted Items, 2004*

Score based on:	N	%	SE	Diff	SED	95%CI	
Total Items	1671	39.7	1.03	6.3	0.49	**5.35**	**7.29**
Attempted Items	1670	46.0	1.09				

BETWEEN- AND WITHIN- SCHOOL VARIANCE IN ACHIEVEMENT

Estimates of between school-variance were computed for both NAMA 1999 and NAMA 2004, using regression (maximum likelihood method). The estimates indicate the proportion of variance in achievement in mathematics that can be attributed to differences between schools and the proportion that can be attributed to differences within schools. In general, educational systems with high between-school variance in achievement are viewed as less equitable in terms of learning outcomes than systems with lower between-school variance (Postlethwaite, 1995). In systems with high between-school variance, low-achieving (and high-achieving) pupils tend to be clustered together in the same schools.

In 1999, 18.6% of variance in achievement was attributable to differences between schools, while, in 2004, the percentage was 17.9 (Table 4.13). Based on studies such as PISA (Cosgrove et al., 2005), these percentages can be considered low (i.e., differences in mathematics achievement between primary schools in Ireland are relatively small), particularly in the context of a grade-based assessment.

Table 4.13 *Estimates of Between- and Within-school Variance in Mathematics Achievement, 1999 and 2004*

	1999		**2004**	
	Variance	**% of Total Variance**	**Variance**	**% of Total Variance**
Variance between schools	468.832	18.6	428.774	17.9
Variance with schools	2063.319	81.4	1963.770	82.1
Total variance	2532.151	100.0	2392.544	100.0

SUMMARY

Average percent correct scores attained by pupils across the 5 booklets used in NAMA 2004 indicate that the test was at an appropriate level of difficulty. A calculator item section (25 items designed to assess performance when a calculator was available) was included in the test design for the first time in 2004. Pupils found this section to be more difficult than other sections in the test.

When the 2004 test results were placed on the 1999 scale, the mean score for pupils in 2004 was 250.8 (SD = 50.4), which is not significantly different from the 1999 mean score of 250.0 (SD = 50.0).

In 2004, the mathematics strand on which pupils achieved the highest mean percent correct score was Data (68.8%), while the strand on which they achieved lowest was Measures (49.2%). On items common to both 1999 and 2004, scores were significantly higher for Shape & Space and Data, with an increase of about 5 percentage points in each case.

The mathematics skill on which pupils performed best in 2004 was Understanding & Recalling (61.9%), while pupils did least well on Applying &

Problem Solving (50.5%). The only skill on which the mean score was significantly higher in 2004, in comparison with 1999, was Reasoning, where there was increase of about 3 percentage points.

When overall performance was considered in terms of proficiency levels, 12% of pupils were found to have performed at an Advanced level of mathematics achievement for pupils in Fourth class (Level 5), 26% at a High level (Level 4), 26% at a Moderate level (Level 3), 22% at a Basic level (Level 2), 12.3% at a Minimum level (Level 1), and 2.6% at a level not assessed by the NAMA 2004 test (below Level 1).

In both 1999 and 2004, approximately three-quarters of pupils were judged by their teachers to be performing at a Fourth class level in mathematics. In 1999, 5.5% of pupils were judged to be performing at a Second class level or lower, while in 2004, a similar percentage (6.7%) were judged to be performing at this level.

Almost 18% of variance in pupils' achievement was found to lie between schools, while the remainder (82%) lay within schools. These data suggest that differences in achievement between schools are relatively small, compared to education systems in other countries.

On those items for which pupils had a calculator available to them, performance was poor on items that assessed Measures. This was interpreted in terms of the high level of missingness (not-reached items) towards the end of the calculator section, as well as the fact that most of the Measures items in the calculator section called for the application of problem-solving skills.

5. Pupil Characteristics and Mathematics Achievement

In this chapter, relationships between pupil characteristics and mathematics achievement are described. First, achievement is related to a number of demographic characteristics of pupils. Second, achievement is related to attendance at school and pupil participation in extra-curricular mathematics classes. Third, the achievements of pupils are related to aspects of their classroom behaviour, their learning strategies, and other learning-related characteristics. Fourth, comparisons are drawn between the characteristics of pupils as they relate to achievement in the 1999 and 2004 assessments.

CHARACTERISTICS OF PUPILS

In this section, the association between characteristics of pupils (gender, country of birth, membership of traveller community, and age) and their mathematics achievement is examined (Table 5.1).

Table 5.1 *Mean Mathematics Scores of Pupils, by Gender, Country of Birth, Membership of the Traveller Community, and Age*

	N	%	Mean Score	SE
Gender				
Male	2078	51.2	252.5	2.94
Female	1984	48.8	248.9	2.98
Country of Birth				
Ireland	3631	89.4	251.0	2.68
Elsewhere	431	10.6	249.1	4.97
Member of Traveller Community*				
Yes	80	1.9	**195.0**	7.78
No	4046	98.0	251.8	2.32
Age-Group				
Lower age-group	1082	25.9	250.1	2.6
Middle age-group	1811	43.4	252.2	3.34
Upper age-group	1279	30.7	249.3	3.07

*** *Difference between '**Yes**' and '**No**' significant at the .05 level*

Slightly over half of the sample were male, and just over 10% had been born outside Ireland. Less than 2% were members of the traveller community. The mean age of pupils was 10.5 years. Age categories were created by splitting the age distribution at the 33rd and 67th percentiles to create three categories. The mean age for the lower group was 10 years, for the middle group 10.5 years, and for the upper group 11 years.

The mean achievement score of male pupils does not differ significantly from that of female pupils, although it is almost 4 points higher. A significant difference in achievement was observed between members of the traveller community and non-members (SED = -8.2, 95% CI = -73.2 to -40.4).

A correlational analysis of the variables in Table 5.1 revealed only two variables that correlated significantly with mathematics achievement: gender ($r = -.03$, $t = 1.1$, $p < .05$) and membership of the traveller community ($r = .16$, $t = 6.93$, $p < .01$). Each of these variables is considered in more detail below.

Gender

Differences in achievement scores for males and females at key benchmarks are presented in Table 5.2 and Figure 5.1. (The complete table of scores used for this analysis can be found in e-appendix E5.1).

Table 5.2 *Mean Mathematics Scores at Key Benchmarks, by Gender*

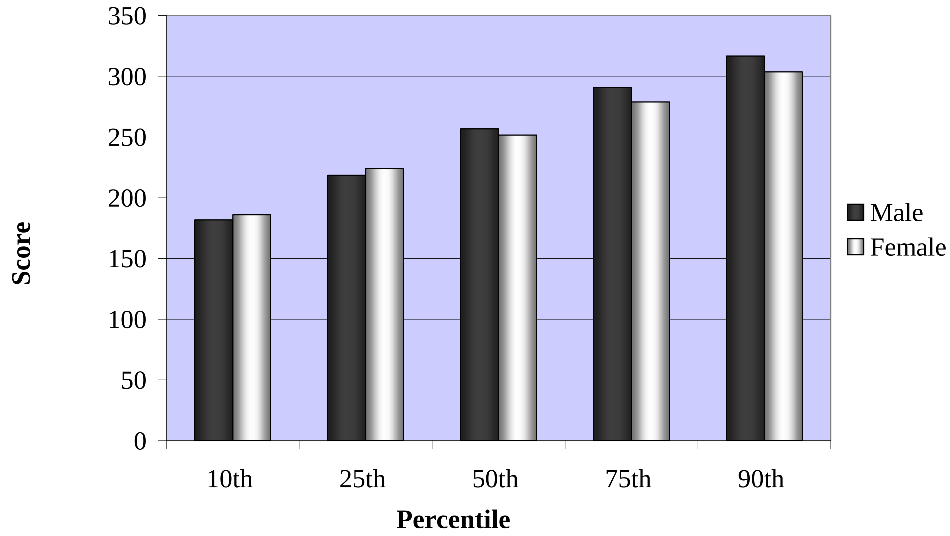
Gender	10th Percentile		25th Percentile		50th Percentile		75th Percentile		90th Percentile	
	Score	SE	Score	SE	Score	SE	Score	SE	Score	SE
Male	181.8	3.30	218.5	3.82	256.7	4.37	**290.7**	**2.85**	**316.6**	**2.74**
Female	185.9	5.19	223.9	3.48	251.5	3.37	**278.9**	**3.21**	**303.6**	**3.07**
Total	182.9	3.04	221.2	2.96	253.6	2.78	285.0	2.89	311.2	2.81

*Values in **bold** indicate a significant difference between male and female pupils*

Although the data in Table 5.1 reveal no overall statistical difference between male and female pupils' mean achievement scores, Table 5.2 and Figure 5.1 illustrate a clear difference in the pattern of scores for males and females at key benchmarks. Female scores were higher than male scores at the 10th and 25th percentiles, but differences are not statistically significant. From the 50th percentile on, males outperformed females, with differences reaching significance at the 75th and 90th percentiles. The latter differences were 11.8 (SED = 4.2) and 13 (SED = 4.1) points respectively (see e-appendix E5.2).

To further explore the difference in performance between male and female pupils, achievement scores on each individual strand (Number, Measures, Algebra, Shape & Space, and Data) and on each individual skill (Applying & Problem Solving, Understanding & Recalling, Integrating & Connecting, Reasoning, and Implementing) were calculated. Male and female performance differed significantly on only one strand. On Measures, the mean score of males (51.1%, SE = 1.28) is significantly higher than that of females (47.1%, SE = 1.31) at the 95% level (95%CI = 1.29 to 6.71, SED = 1.36). There are no significant gender differences on any of the skills. (All confidence intervals are available in e-appendix E5.2)

Figure 5.1 *Mean Mathematics Scores at Key Benchmarks, by Gender*



A comparison of the percentage of male and female pupils who scored at each proficiency level (as detailed in Chapter 3) revealed two significant differences. First, a greater percentage of male (14.8%) than of female (8%) pupils performed at the most advanced level (diff = 6.8, SED = 1.91, 95%CI = 2.99 to 10.61). Second, a greater percentage of female (29.8%) than of male (22.9%) pupils performed at proficiency Level 3 (diff = 6.9, SED = 2.97, 95%CI = -12.23 to -1.57). All statistical comparisons can be found in e-appendix E5.3.

Membership of the Traveller Community

The scores of members of the traveller community and of non-members at the 10th, 25th, 50th, 75th, and 90th percentiles are presented in Table 5.3 and Figure 5.2. (The complete table of scores used for this analysis can be found in e-appendix E5.4).

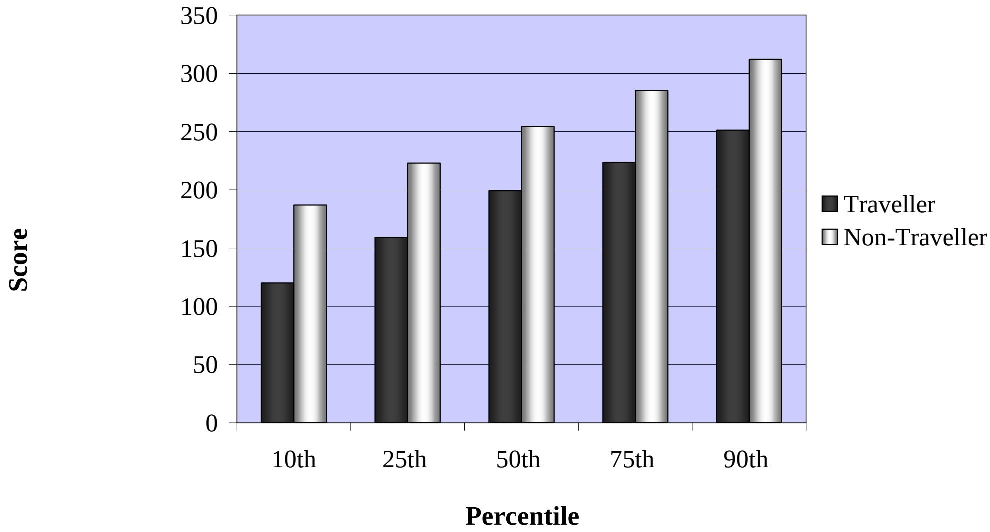
Table 5.3 *Mean Mathematics Scores at Key Benchmarks, by Traveller Status*

Member of Traveller Comm.	10th Percentile		25th Percentile		50th Percentile		75th Percentile		90th Percentile	
	Score	SE	Score	SE	Score	SE	Score	SE	Score	SE
Yes	120.0	8.59	159.2	17.53	199.1	8.96	223.7	8.47	251.3	13.06
No	186.9	3.47	222.9	2.93	254.5	2.73	285.2	2.59	312.1	2.69
Total	182.9	2.94	221.2	2.97	253.6	2.96	285.0	2.70	311.2	2.72

Differences between 'Yes' and 'No' are significant at each percentile rank

Pupils from the traveller community consistently performed at a lower level than other pupils. Their score at the 90th percentile was only marginally higher (251.3) than the overall mean score for the total sample (250.8). Differences in mean achievement scores are statistically significant at the all percentile points considered (confidence intervals available in e-appendix E5.5).

Figure 5.2 *Mean Mathematics Scale Scores at Key Benchmarks, by Traveller Status*



ATTENDANCE AT SCHOOL AND PARTICIPATION IN EXTRA-CURRICULAR MATHEMATICS CLASSES

The responses of teachers on the Pupil Rating Form provided information about the school attendance of each pupil. In addition to analysing the association between school attendance and mathematics achievement, data on the involvement of pupils in extra maths lessons and maths/homework clubs, which were provided by the pupils themselves, are also considered in this section.

School Attendance

The percentage of days that pupils were present at school in the quarter January to March 2004 ranged from 59.7% to 100%, with a mean of 94.8% (SE = 0.2). Two categories were created, by taking values below the 50th percentile as lower attendance, and values at or above the 50th percentile as higher attendance. The percentages of pupils in each category are presented in Table 5.4, which also displays total mean achievement scores by attendance level for male, female, and all students.

Table 5.4 *Mean Mathematics Scores, by Attendance and Gender*

	Lower Attendance			Higher Attendance		
	%	Score	SE	%	Score	SE
Male	22.4	244.42	4.10	28.2	260.43	2.83
Female	23.3	240.98	3.56	26.1	257.12	3.00
Total	45.7	242.66	3.12	54.3	258.84	2.08

Mean scale scores were higher for pupils who had higher rates of attendance than for pupils with lower rates. The difference is statistically significant (95% CI = 11.56 to 20.8; SED = 2.31). This pattern is evident for both male and female pupils. The attendance of male pupils was slightly lower than that of females, though scores attained by male pupils were higher (though not to a statistically significant degree) at each attendance level.

Although there were no differences in performance between higher-attending males and females, or between lower-attending males and females, male students with higher attendance performed significantly better than male students with lower attendance. A similar pattern was found for female pupils. In each case, the difference was in the order of 16 scale points (one-third of a standard deviation). (See e-appendix E5.6 for comparisons and standard errors.)

Participation in Extra Mathematics Classes/ Mathematics Clubs

On the Pupil Questionnaire, pupils were asked if, outside school, they had attended extra lessons in mathematics, or if they had attended a club where they could do mathematics. A relatively small percentage of pupils participated either in extra mathematics lessons (7.5%) or in a mathematics club (9.7%) (Table 5.5).

Table 5.5 *Mean Mathematics Scores, by Participation in Extra Classes and Gender*

	Extra Mathematics Classes					
	Participate			Not Participate		
	%	Score	SE	%	Score	SE
Male	4.1	231.8	6.08	46.7	255.4	3.23
Female	3.2	227.6	5.55	46.0	251.2	2.97
Total	7.5	229.6	4.78	92.5	253.2	2.56
	Mathematics/Homework Club					
	Participate			**Not Participate**		
	%	**Score**	**SE**	**%**	**Score**	**SE**
Male	4.5	226.2	6.23	46.3	256.0	3.03
Female	4.9	218.2	8.83	44.4	253.1	2.65
Total	9.7	221.3	6.68	90.3	254.6	2.33

Pupils who participated in extra classes achieved a significantly lower mean score (–23.6 points) than pupils who did not (95%CI = –34.3 to –12.82, SED = 5.38). This pattern was observed for both male (difference of –23.5, 95%CI = –8.22 to –8.79, SED = 6.41) and female pupils (difference of –23.6, 95%CI = –38.24 to –8.92, SED = 6.39). There are no significant differences across gender. (See e-appendix E5.7 for all statistical comparisons.)

Comparisons relating to participation in a mathematics club followed a similar pattern. Pupils who attended a mathematics/homework club achieved a significantly lower mean achievement score (by 33.3 points) than pupils who did not attend such a club (95%CI = –46.99 to –19.69, SED = 6.39). This pattern was discernible for both male (difference = –29.4, 95%CI = –44.19 to –14.19, SED = 6.44) and female pupils (difference = –34.9, 95%CI = –55.93 to –13.86, SED = 9.17), though gender differences are not significant.

CLASSROOM-RELATED PUPIL CHARACTERSITICS

A number of characteristics of pupils that may be associated with mathematics achievement are considered here: a range of general classroom behaviours, the learning strategies most frequently employed by pupils, and other learning-related characteristics (self-efficacy, enjoyment, and motivation).

Classroom Behaviour

Teachers were asked to rate each pupil on seven characteristics relating to a pupil's behaviour and participation in class, persistence in work, and general academic ability. Mean scores were calculated for each variable to provide a profile of general classroom behaviour across pupils (all confidence intervals and standard errors available in e-appendix E5.8). In addition to presenting these mean scores by gender, Table 5.6 displays the correlation of each item with mathematics achievement.

Table 5.6 *Mean Mathematics Scores on Classroom Behaviour Ratings, by Gender, and Correlations of Ratings with Mathematics Scores*

	Male		**Female**		**Total**		**Correlation with mathematics achievement**		
	Score	SE	Score	SE	Score	SE	r	t	p
Behaviour	4.1	.07	4.5	.06	4.3	.05	.30	14.31	<.01
Participation	3.8	.06	4.1	.07	3.9	.06	.48	14.30	<.01
Attention	3.5	.06	4.0	.07	3.7	.06	.55	17.70	<.01
Persistence	3.7	.05	4.1	.07	3.9	.05	.52	16.18	<.01
Social	4.1	.05	4.3	.05	4.2	.05	.29	6.79	<.01
Supervision	3.6	.06	4.1	.06	3.8	.05	.55	20.50	<.01
Academic	3.7	.06	3.7	.06	3.7	.05	.66	24.44	<.01

Note: Behaviour = behaviour in school, Participation = participation in class, Attention = attention span, Persistence = persistence in school work, Social = getting along with other children, Supervision = ability to work with limited supervision, Academic = general academic ability; ***All correlations significant at .01 level; all mean score differences significant at the .05 level except for gender difference in general academic ability.***

Teacher perceptions of pupils' general academic ability, their ability to work with limited supervision, their attention span, and their persistence at schoolwork all correlate positively and significantly with achievement scores. Pupils with high general academic ability, who can work with limited supervision, who demonstrate greater attention, and who are persistent in their schoolwork, are more likely to achieve higher mean mathematics achievement scores.

Females were rated higher than males on each characteristic and, with the exception of 'academic ability', each difference is significant at the .05 level. For example, teachers considered female pupils to be more attentive (SED = .07; 95%CI = –.6 to –.34) and persistent in their maths schoolwork (SED = .08; 95%CI = –.57 to –.28), and more productive when unsupervised (SED = .07; 95%CI = –.6 to –.34). Teachers did not, however, perceive a gender difference in academic ability (SED = .06; 95%CI = –.18 to .06).

Learning Strategies

Pupils were asked how they would respond if they experienced difficulty in computing a complex sum at school, and the data obtained were used to assess potential differences in the learning strategies of males and females.

The graphs in Figure 5.3 reveal a broadly similar set of learning strategies for male and female pupils, though some differences are discernible (a full list of values and standard errors is available in e-appendix E5.9). A larger percentage of female than of male pupils claimed that they would Always (16.1%) or Sometimes (54.2%) ask a teacher for help (males: 13% and 44.8% respectively). Male pupils were also less likely to ask for help from a friend. While 3.8% of males would ask Always and 37.5% would ask Sometimes, the respective figures for females were 5.8% and 43.4%.

The most commonly reported strategy for both male and female pupils was to ‘re-read and try again’. This is important since this approach is the only strategy which correlates positively with mathematics achievement ($r = .13$, $t = 4.45$, $p < .01$). All other strategies are negatively associated with achievement (see e-appendix E5.10 for full list of correlation coefficients). The percentages of females employing the ‘re-read and try again’ strategy Always (46.9%) or Sometimes (41.2%) were marginally, though not significantly, higher than those of males (45.1% and 39.2% respectively). The difference provides some corroboration for teachers’ perceptions that female pupils were more attentive and persistent that male pupils (Table 5.6).

Other Learning-Related Characteristics

Pupils were asked to respond to a series of statements about their enjoyment of mathematics, confidence in their own ability, and performance relative to friends. For each question, pupils responded on a four-point Likert scale ranging from Strongly Agree to Strongly Disagree.

A Principal Component Analysis was conducted (using Varimax rotation) to identify a factor structure. Several criteria were employed in the selection of factors. Firstly, Eigen values greater than 1 were identified (see Kaiser, 1960); secondly, factor loadings less than .4 were suppressed (see Stevens, 1996); and finally the alpha values for the scale suggested by the factor loadings were examined. Although 4 factors were identified, the fourth was below the .65 level of minimal acceptability advocated by DeVellis (1991). This factor was therefore excluded, resulting in three factors: ‘*Self-efficacy in Maths*’, ‘*Enjoyment of Maths*’, and ‘*Motivation for Maths*’ (The rotated component matrix and alpha levels for the factors can be found in e-appendix E5.11.) The correlation between each factor and mathematics achievement is presented in Table 5.7.

Figure 5.3 *Percentage of Pupils Indicating Frequency of Implementing Strategies for Coping with Difficult Sums in School, by Gender*

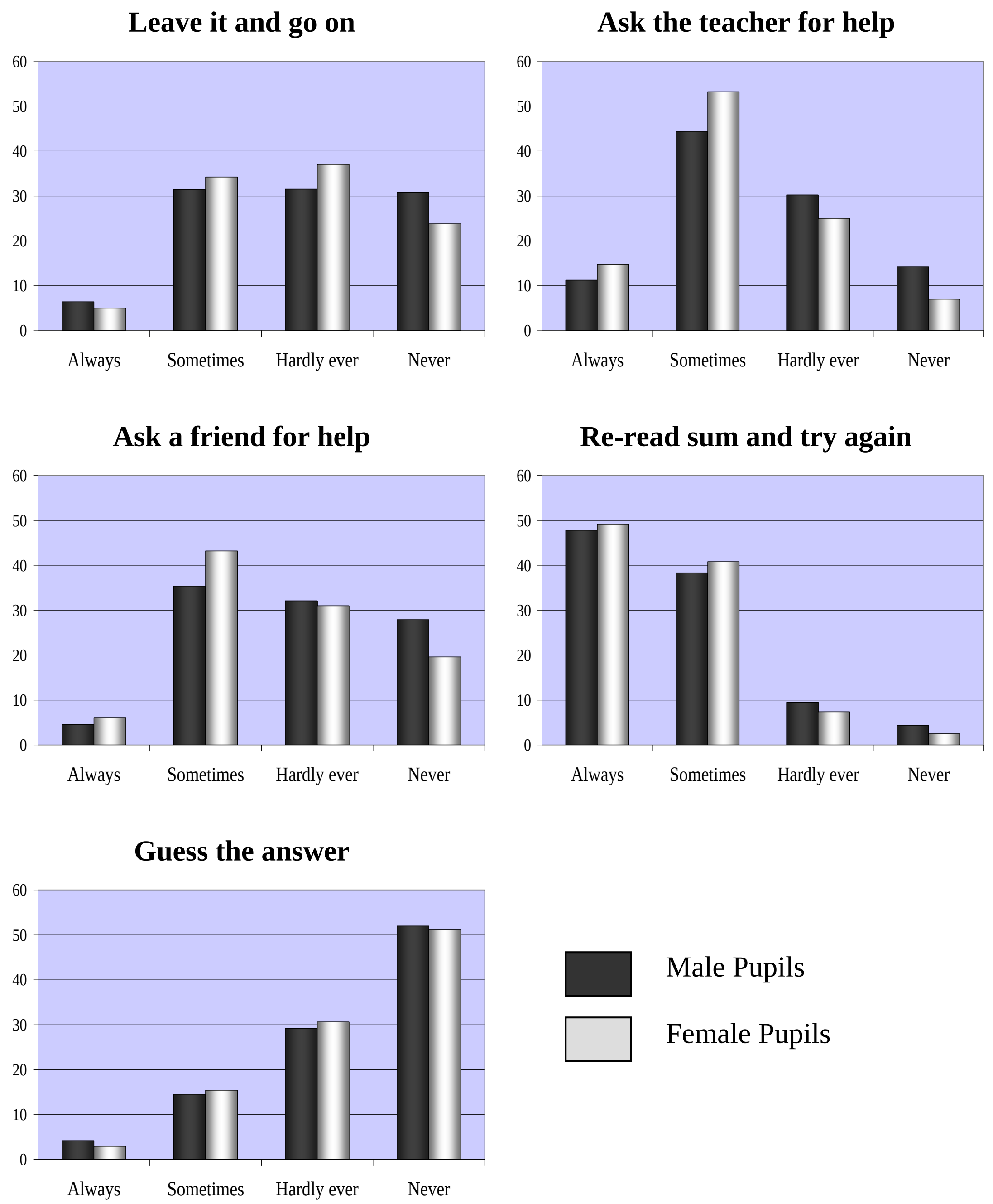


Table 5.7 *Correlations Between Scores on Learning-related Factors and Mathematics Achievement*

	r	t	p
Self-efficacy	**.36**	**13.21**	**< .01**
Enjoyment	.00	.05	.96
Motivation	.00	.30	.77

*Significant correlation in **bold***

A significant correlation was observed between 'Self-efficacy in Maths' and overall mathematics achievement, indicating an association between the degree of confidence pupils have in their mathematics ability and their achievement scores. Pupils' enjoyment of the subject and their motivation were not found to be related to their achievement.

Differences in standardized scores attained on each scale were compared for male and female pupils, and for pupils with high and low attendance (as defined earlier in this chapter). Hence, for the purpose of the analyses that follow, pupils' responses are treated as outcomes in their own right. Comparisons were based on standardized factor scores, where each scale had an overall mean of zero and a standard deviation of one. A summary of the significant differences is presented in Table 5.8.

Significant gender differences were observed on two scales. Females reported lower levels of self-efficacy in relation to mathematics than their male counterparts, a difference of one-fifth of a standard deviation. This is worthy of note since self-efficacy was the only variable that correlated positively with mathematics achievement scores. While male pupils reported higher levels of self-efficacy, however, they reported lower levels of enjoyment. The mean score for females on the 'Enjoyment of Mathematics' scale is one-seventh of a standard deviation higher than that of males.

Table 5.8 *Summary of Mean Standardised Score Differences on Learning-Related Factor Scales, by Gender, Attendance, and Age*

Variable	Scale	Mean Std. Score	SE	SED	95% CI	
Male	Self-Efficacy	.11	.05	.06	**.10**	**.33**
Female		-.11	.04			
Lower attendance	Self-Efficacy	-.1	.07	.08	**-.30**	**-.00**
Higher attendance		.07	.04			
Lower attendance	Enjoyment	.05	.05	.05	**.02**	**.2**
Higher attendance		-.06	.06			
Male	Enjoyment	-.07	.04	.07	**-.28**	**-.02**
Female		.07	.07			
Mid-Age Group	Motivation	.07	.05	.06	**-.30**	**-.03**
Upper-Age Group		-.09	.06			

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*

It was observed earlier that pupils with lower attendance rates achieved a significantly lower mean mathematics score than pupils with higher attendance. Now we find that levels of self-efficacy were also lower among pupils who attended school less frequently. On the other hand, pupils with higher rates of attendance had a mean score that was almost one-seventh of a standard deviation lower on the 'Enjoyment of Maths' scale than the mean of pupils with lower attendance.

The final significant difference is between the 'Motivation for Maths' scores of pupils in the middle- and upper-age groups. Older pupils have a significantly lower score on the motivation for mathematics factor than pupils in the middle group.

COMPARISON WITH THE 1999 STUDY

A number of pupil characteristics as they relate to mathematics achievement were examined in both 1999 and 2004. There were no significant differences in mathematics achievement scores of pupils categorised by country of birth, membership of the traveller community, or age.

While an initial comparison of mean achievement scores by gender (Table 5.9) suggests an improvement in the score of males and a decrease in the score of females since 1999, the differences are not statistically significant. As indicated earlier, mean score differences between males and females were not significant in either year.

Table 5.9 *Mean Mathematics Scores, by Gender, 1999 and 2004*

	1999		2004	
	Mean Score	**SE**	**Mean Score**	**SE**
Male	250.4	2.89	252.5	2.94
Female	249.6	2.20	248.9	2.98

In the 1999 study, teachers perceived female pupils as displaying a greater aptitude for learning than male pupils. A comparison of the classroom behaviour ratings from the 1999 study, and the corresponding ratings from teachers in the current study, suggests that this difference has remained largely unchanged.

The overall mean score for a range of classroom characteristics, and their correlations with mathematics achievement are presented by year in Table 5.10.

Table 5.10 *Classroom Behaviour Ratings and Correlations with Mathematics Achievement, 1999 and 2004*

		1999			2004	
	Mean	**SE**	**Correlation**	**Mean**	**SE**	**Correlation**
Behaviour	4.1	.04	.31	4.3	.05	.30
Participation	3.8	.04	.52	3.9	.06	.48
Attention	3.7	.05	.50	3.7	.06	.55
Persistence	3.8	.05	.54	3.9	.05	.52
Social	4.1	.04	.34	4.2	.05	.29
Supervision	3.7	.04	.55	3.8	.05	.55

Behaviour = behaviour in school, Participation = participation in class, Attention = attention span, Persistence = persistence in school work, Social = getting along with other children, Supervision = ability to work with limited supervision. ***All correlations are significant ($p<0.01$).***

The data indicate that there has been virtually no change in the main classroom behaviours exhibited by pupils between 1999 and 2004. Furthermore, the correlation coefficients with achievement for each behaviour are largely similar, with Attention, Persistence, Participation, and Supervision (the ability to work with limited supervision) correlating most strongly with mathematics achievement in both years.

Rates of attendance at school are not directly comparable (because the method of quantifying attendance rates in the studies differed). However, pupils in the 2004 study appeared to have higher rates of attendance. While in 1999, a total of 87% of pupils were classified as having a good or very good rate of attendance, in 2004, the mean attendance rate was 94.8%.

SUMMARY

The aim of this chapter was to identify characteristics associated with pupils' mathematics achievement. Of the demographic variables considered, only gender and membership of the traveller community correlated significantly with achievement. Due to the small number of pupils from the traveller community, further analyses involving this variable were not conducted.

Although there is no overall significant difference in achievement between male and female pupils, significant differences are discernible at several key benchmarks on the achievement scale. While males at key lower percentiles performed lower (but not to a significant degree) than female pupils, males at key higher percentiles achieved significantly higher scores. With the exception of Measures, on which male pupils achieved a higher percent correct score than females, no statistically significant gender differences were observed on the mathematics strands or skills that were assessed.

Lower levels of participation in extra lessons and mathematics clubs were associated with higher mean achievement scores. This may be because these attract children with poorer performance in an attempt to improve their mathematics proficiency, or it may be due to a greater availability of mathematics/homework clubs in areas of socioeconomic disadvantage.

Female pupils were rated by their teachers as having significantly higher scores than male pupils on each of several learning-related characteristics (including classroom behaviour, participation in class, attention, and persistence). The only non-significant difference was for academic ability.

Gender differences were in evidence in pupils' reports of the learning strategies they employed when faced with complex mathematics questions. Slightly more female pupils reported utilising the only strategy that was positively correlated with achievement (re-read and try again).

Of the measures of classroom-related pupil characteristics, self-efficacy was the most important. Males were more confident than females in their mathematics ability, though they claimed to enjoy the subject less. Pupils with higher school attendance reported higher levels of self-efficacy in maths but less enjoyment of the subject. Levels of motivation were lower for older pupils.

Comparisons between the 1999 and 2004 studies revealed few differences in pupil characteristics. Total mean mathematics achievement scores, and mean scores by gender, remained unchanged. The general perception of teachers that females displayed a greater aptitude for learning was evident in both studies. Classroom behaviour ratings for pupils in the 1999 and 2004 studies were very similar, as were correlation coefficients between pupil characteristics and achievement.

6. Home Background and Mathematics Achievement

The parent/guardian of each child who participated in the NAMA 2004 was asked to complete a Parent Questionnaire. Items on the questionnaire related to the child's home environment, resources available at home, the type of support and encouragement provided for school work, and background information about the child's family. In addition to the Parent Questionnaire, this chapter also draws on some items from Pupil Rating Forms (completed by pupils' teachers) and the Pupil Questionnaire (completed by pupils). Data in the chapter relate to family structure, family socioeconomic status (including parents' educational backgrounds and employment status), parental participation in and support for their children's education, home resources, and homework.

FAMILY STRUCTURE

Family Composition

Parents were asked to indicate who usually resided in the family home. Almost all pupils lived in a home with a mother or female guardian, while 87% lived with a father or male guardian (Table 6.1; see e-appendix E6.1 for missing values).

Table 6.1 *Percentages of Pupils' Parents Who Lived/Did Not Live at Home*

	At Home			Not at Home		
	N	%	SE	N	%	SE
Mother	3854	96.6	.47	136	3.4	.47
Father	3251	82.7	1.62	680	17.3	1.62
Female Guardian	89	2.5	.63	3447	97.5	.63
Male Guardian	155	4.4	.72	3390	95.6	.72

More than four out of five pupils lived with two parents (Table 6.2). In the great majority of cases (90%), the parent/guardian in a lone parent family was female. The mean mathematics achievement score of pupils who lived with two parents is significantly higher than the mean of pupils who lived with one parent.

Table 6.2 *Mean Mathematics Achievement Scores, by Family Structure*

	N	%	Score	SE	Diff from '2 parents'	SED	95%CI	
Two Parents	3381	84.5	255.5	2.59	-	-	-	-
One Parent	621	15.5	236.0	3.72	-19.5	4.60	**10.29**	**28.64**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Number of Siblings

The percentage of pupils with differing numbers of siblings, and their associated mean mathematics scores, are displayed in Table 6.3.

Table 6.3 *Mean Mathematics Achievement Scores, by Number of Siblings*

Siblings	N	%	Score	SE	Diff from '0 Siblings'	SED	95%CI	
0	421	10.5	236.3	5.66	-	-	-	-
1	1033	25.8	257.9	3.79	21.63	**5.46**	**-32.55**	**-10.72**
2	1300	32.4	255.9	2.12	19.62	**5.92**	**-31.45**	**-7.49**
3	731	18.3	254.7	2.98	18.40	**6.08**	**-30.55**	**-6.25**
4+	521	13.0	243.0	4.42	6.72	6.40	-19.51	6.07

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Pupils with no siblings had the lowest mean score, which differs significantly from the mean score of pupils with one, two, or three siblings, but not from the mean score of pupils with four or more siblings.

The ordinal position of a pupil in his/her family was not found to be associated with mathematics achievement (see e-appendix E6.3).

FAMILY SOCIOECONOMIC STATUS

In this section, the associations between parents' socioeconomic status (particularly employment status and educational attainment) and their children's mathematics achievement are considered.

Employment Status

The total breakdown by parents in paid employment and those not in paid employment is presented in Table 6.4. The vast majority of pupils (90.8%) came from families where at least one parent was in paid employment. Pupils whose parents were not in paid employment achieved a significantly lower mean score (219.9) than pupils with at least one parent in paid employment (256.2).

Table 6.4 *Mean Mathematics Achievement Scores, by Combined Parents' Employment Status*

Paid Employment?	N	%	Score	SE	Diff from 'paid'	SED	95%CI	
Yes	3550	90.8	256.2	2.47	-36.26	3.77	**28.72**	**43.79**
No	358	9.2	219.9	3.15				

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*
'Not in paid employment' = unemployed, students, those on full-time home duties, and those on state sponsored benefits. Figures based on the highest status of either the male or female parent/guardian.

Table 6.5 *Mean Mathematics Achievement Scores, by Nature of Parents' Employment*

Employment Status	N	%	Score	SE	Diff from FT work	SED	95% CI	
FT work	3210	82.2	258.1	2.36	-	-	-	-
PT work	340	8.7	237.6	4.68	-20.6	3.74	**13.09**	**28.02**
Not working	102	2.6	217.5	6.58	-40.6	6.85	**26.94**	**54.3**
Home duties	170	4.3	217.7	5.43	-40.4	5.56	**29.30**	**51.5**
Other	86	2.2	227.0	6.48	-31.1	7.08	**16.97**	**45.23**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference.*
Figures based on highest status of either male or female parent/guardian

The category 'paid employment' in Table 6.4 was disaggregated in Table 6.5 to include parents currently in part-time and full-time work, while the category 'not in paid employment' was disaggregated to include parents on home duties, the unemployed, and others (e.g. students, those on disability). Pupils with at least one parent in full-time employment had a significantly higher mean maths achievement score (258.1) than pupils whose parents' highest status was part-time work (237.6), working (217.5), or engaged in home duties (217.7). (Missing values can be found in e-appendix E6.5.)

Further analyses based on the employment status of male and female parents/guardians indicated that pupils whose mothers worked full-time (260.6; SE = 2.32) or part-time (257.1; SE = 3.75) achieved significantly higher mean scores than pupils whose mothers were involved solely in home duties (248.2; SE = 3.42; see e-appendix E6.6 and E6.7).

Based on the job title and description provided by parents, an ISEI (International Socioeconomic Scale) code was assigned to each parent. The distribution of parents' combined ISEI codes yielded three groups. Parents with ISEI codes from 16 to 43 (elementary to service workers) were designated low socio-economic group (SEG); parents with scores between 44 to 53 (clerks to technicians) middle SEG; and from 54 to 90 (management assistants to judges) upper SEG. For each analysis (unless otherwise stated), the SEG is based on the highest ISEI code of either parent/guardian (see e-appendix E6.8 for missing values).

Table 6.6 *Mean Mathematics Achievement Scores, by Parental Socioeconomic Group*

SEG	N	%	Score	SE	Diff from Upper	SED	95% CI	
High	1258	34.9	270.2	1.83	-	-	-	-
Middle	887	24.6	259.2	2.72	-11.0	2.51	**6.00**	**16.04**
Low	1456	40.4	240.6	3.70	-29.6	3.24	**23.09**	**36.03**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

The highest mean achievement score was obtained by children of parents in the high socioeconomic group (Table 6.6). Their score differs significantly from the mean scores of the children of parents in the middle and low groups. Analyses based on the mean achievement scores at key percentile points indicate that pupils from the upper socioeconomic group perform consistently and significantly higher at each percentile benchmark (Table 6.7). All of the differences between the upper and middle SEGs, and the upper and lower SEGs are significant (except upper-middle at the 90th percentile). The full table comparing differences at each benchmark can be viewed in e-appendix E6.9.

Table 6.7 *Mathematics Achievement Scores at Key Percentile Benchmarks, by SEG*

Percentile	Upper SEG		Middle SEG		Lower SEG	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
10th	216.5	4.4	202.8	5.0	176.2	4.3
25th	244.0	3.3	229.3	3.6	209.4	3.5
50th	273.5	2.2	261.2	4.3	243.4	3.5
75th	298.6	2.0	290.7	3.5	272.1	4.8
90th	323.3	3.7	313.8	4.2	301.2	4.7

In Table 6.8, mean scores are presented for mothers/female guardians only (the total percentage of males on full time home-duties was less than 0.5). For the upper and middle socioeconomic groups, pupils' mean achievement scores are significantly higher when the female parent/guardian was in paid employment than when engaging in full time home-duties. The difference is greatest for pupils in the middle socioeconomic group.

Table 6.8 *Mean Achievement Scores, by SEG and Work Status of Mother*

SEG	Status	%	Score	SE	Diff with 'Work'	SED	95%CI	
Upper	Work	64.1	274.0	3.15	-14.16	4.80	**4.57**	**23.75**
	Home	35.9	259.9	5.99				
Middle	Work	46.4	262.5	5.11	21.86	9.08	**3.73**	**39.99**
	Home	53.6	240.7	7.8				
Lower	Work	54.8	247.7	4.04	6.06	6.08	-18.21	6.08
	Home	45.2	253.8	7.13				

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*
'Work' = mothers who were in full- or part- time employment
'Home' = mothers on full-time home duties

Parents' Educational Attainment

Parents were presented with a list of educational qualifications (ranging from Primary Certificate to Third-Level post-graduate degree) and asked to specify which qualifications they had attained (see Table 6.9).

Table 6.9 *Mean Mathematics Achievement Scores, by Combined Parental Education*

Education level	%	Score	SE	Diff from 'Leaving'	SED	95% CI	
Primary Cert	3.5	216.9	4.78	-37.1	6.40	**24.36**	**49.9**
Group Cert	5.1	226.0	4.51	-28.0	5.51	**16.99**	**38.99**
Junior Cert	14.0	232.1	3.89	-21.9	4.09	**13.7**	**30.02**
Leaving Cert	22.3	254.0	4.47	-	-	-	-
Diploma	22.8	257.6	2.55	3.6	4.42	-12.43	5.22
Degree	17.1	276.0	2.46	22.0	5.08	**-32.14**	**-11.84**
Post-graduate	6.6	274.6	4.33	20.6	6.32	**-33.2**	**-7.97**
None/missing	8.6	215.1	3.38	-38.9	5.84	**27.27**	**50.58**

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*
Educational level = highest qualification of either parent/guardian.

Mean achievement scores increased for each successive level of parent education. Pupils of parents with a Junior Certificate or a lower qualification achieved significantly lower mean scores than pupils whose parents had a Leaving Certificate, while pupils whose parents had a degree or post-graduate third-level qualification achieved significantly higher mean achievement scores than pupils of parents with Leaving Certificate only.

PARENTAL INVOLVEMENT/SUPPORT

This section examines the involvement of parents in supporting their children's mathematics achievement, as well as associations between achievement and a number of variables, including involvement with the school, attitudes towards mathematics, and satisfaction with their child's progress.

Parental Involvement

The level of parental involvement in children's school life and mathematics development was assessed by asking several questions. Parents responding to the Parent Questionnaire were asked whether they had taken part in a parenting programme to aid in mathematics at home, whether the school offered formal parent-teacher meetings, and if so, whether they had attended the meetings. They were also asked about the frequency with which they had discussed their child's mathematics development with teachers (other than at regularly scheduled parent-teacher meetings).

Few parents (2.5%) had ever been involved in a parenting programme specific to mathematics (see Table 6.10, and e-appendix E6.10 for missing values). The mean achievement score of children whose parents had participated is significantly lower than the score of children of parents who had not participated, possibly because schools attended by lower-achieving pupils are more likely to offer a parenting programme.

Table 6.10 *Mean Mathematics Achievement Scores, by Parents' Involvement*

	N	%	Score	SE	Difference	SED	95% CI	
Participation in Parenting Prog.					**Diff from 'yes'**			
Yes	104	2.5	228.9	4.87	24.31	5.57	**-35.42**	**-13.19**
No	3881	93.0	253.2	2.43				
Attended a meeting this year					**Diff from 'yes'**			
Yes	3567	85.5	254.4	2.26	-	-	-	-
No	236	5.7	224.0	8.11	30.42	7.78	**14.9**	**45.94**
No meeting held	161	3.9	257.1	11.79	2.68	11.18	-25.01	19.66
Frequency of extra meetings attended					**Diff from 'none'**			
None	2914	69.9	263.0	2.04	-	-	-	-
Once/Twice	874	21.0	227.4	3.79	35.59	3.44	**28.73**	**42.46**
Three/Four	153	3.7	203.6	7.33	59.44	6.69	**46.07**	**72.81**
Five or more	37	0.9	213.7	10.13	49.26	10.85	**27.59**	**70.93**

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*

Only 4% of parents indicated that formal parent-teacher meetings were not held at their child's school. The mean score of pupils attending schools that held meetings did not differ from the mean score of pupils in schools that did not hold meetings. However, the mean score of children whose parents had not attended a parent-teacher meeting was significantly lower than the mean score of children whose parents had attended (Table 6.10).

Issues of parental involvement were also considered in the context of pupils' self-efficacy, motivation, and enjoyment of mathematics (see Chapter 5). Table 6.11 displays standardised mean factor scores and standard errors on the self-efficacy and enjoyment of mathematics scales, for each of the parental involvement questions (see e-appendix E6.11 for missing values). Values for the motivation scale were not included because there were no significant differences on this scale (differences, standard errors of the difference, and confidence intervals may be found in e-appendix E6.12 and E6.13).

Standardised scores on the pupil self-efficacy scale were higher for each item when parents actively participated in their child's education, and the difference is significant for attendance at Parent-Teacher meetings. The children of parents who had not attended a parent-teacher meeting during the year had less confidence in their mathematics ability than pupils whose parents had attended a meeting. However, children whose parents attended meetings other than formal parent-teacher meetings had a mean self-efficacy score that was almost a third of a standard deviation below the mean. The only significant difference on the enjoyment of mathematics scale related to pupils whose parents had participated in a parenting programme. These pupils reported a significantly higher level of enjoyment of mathematics than pupils whose parents had not participated.

Table 6.11 *Mean Self-efficacy and Enjoyment of Mathematics Scores, by Parents' Involvement*

	N	Self-efficacy		Enjoyment	
		Mean	**SE**	**Mean**	**SE**
Participate in Parenting Programme*					
Yes	104	.15	.11	.26	.17
No	3881	.00	.04	**-.02**	**.05**
Attend PT meeting this year*					
Yes	3567	.05	.04	-.03	.05
No	236	**-.39**	**.21**	.07	.13
No Meeting	161	-.3	.19	.32	.24
No. meetings attended (not formal P-T)**					
None	2914	.11	.04	-.02	.05
Once/Twice	874	**-.3**	**.09**	.01	.07
Three/Four	153	**-.3**	**.17**	.05	.17
Five or more	37	-.52	.4	.27	.31

Each scale had a mean of zero and standard deviation of one. Figures in ***bold*** *indicate significant difference from reference category. * Reference category = 'Yes'; ** Reference category = 'None'*

Parental Satisfaction

Parents' perceptions of, and satisfaction with, their child's progress were assessed on several items. The first asked how satisfied parents were with their child's performance in each of the key mathematics strands. Responses were on a Likert-type scale ranging from 4 to 1, where higher values represented a greater level of satisfaction. A summary of parents' satisfaction with each content area is presented in Table 6.12 (a full version of the table and missing values are available in e-appendix E6.14 and E6.15 respectively). Differences between the mean scores are small and non-significant.

Table 6.12 *Mean Scores on Scale of Parents' Satisfaction with their Child's Performance, by Mathematics Strand, and Percentages of Parents' Expressing Satisfaction/Dissatisfaction*

Strand	N	Mean	SE	Satisfied/ Very Satisfied	Dissatisfied/ Very Dissatisfied
Number Facts	3854	3.3	0.02	92.1	7.9
Computation	3825	3.3	0.02	92.9	7.1
Measures	3648	3.2	0.02	89.7	10.3
Problem Solving	3716	3.1	0.02	83.3	16.7
Shape & Space	3430	3.1	0.02	88.1	11.9
Data & Chance	2863	3.0	0.03	81.5	18.5

In computing mean satisfactory ratings, the 'Don't Know' option was excluded
4 = 'Very Satisfied', 3 = 'Satisfied', 2 = 'Dissatisfied', 1 = 'Very Dissatisfied'

A total satisfaction score was computed by summing responses across six content areas. This was then split into three categories by identifying the 33rd and 67th percentiles. Mean scores for achievement on the self-efficacy, enjoyment, and motivation scales were computed for high, medium, and low levels of parental satisfaction (Table 6.13; missing values are available in e-appendix E6.16).

Table 6.13 *Mean Mathematics Achievement Scores, Self-efficacy, and Motivation Scores, by Parents' Level of Satisfaction with their Child's Progress.*

Satisfaction	%	Mean	SE	Diff from 'high'	SED	95%CI	
				Mathematics Achievement			
High	32.1	274.4	2.08	-	-	-	-
Medium	30.1	251.8	2.41	22.6	2.26	**18.08**	**27.09**
Low	37.8	228.2	3.04	46.2	2.45	**41.28**	**51.08**
				Self-Efficacy			
High	32.1	.3	.05	-	-	-	-
Medium	30.1	-.07	.05	.37	.07	**.24**	**.50**
Low	37.8	-.29	.07	.59	.07	**.44**	**.73**
				Motivation			
High	32.1	.06	.06	-	-	-	-
Medium	30.1	-.07	.05	.13	.06	**.01**	**.24**
Low	37.8	-.01	.05	.07	.06	-.06	.19

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference; n = 3974*

Pupils' mean mathematics achievement scores were found to be associated with levels of parents' satisfaction. The mean score differences between the children of high- and medium-, and high- and low-satisfied parents are statistically significant. Self-efficacy is also positively associated with levels of parents' satisfaction. Levels of self-efficacy are significantly higher when parents were highly satisfied with their child's progress than when they expressed medium, or low levels of satisfaction. A significantly higher level of pupil motivation is also associated with a high level of parents' satisfaction with their children's progress. Scores on the 'enjoyment of mathematics' scale are not significantly related to parents' satisfaction.

Parents were asked whether they thought their child was in the top, middle, or bottom third of his/her class in mathematics achievement (see e-appendix E6.17 for missing values), and these perceptions were related to their children's mathematics achievement, self-efficacy, motivation, and enjoyment of mathematics.

While relatively few parents (9.5%) believed their child to be in the bottom third, 46.2% ranked their child in the top third. Pupils judged to be in the top third achieved significantly higher mathematics achievement scores than those ranked in the middle or the bottom third of the class. Pupils' levels of self-efficacy were also significantly higher for pupils whose parents perceived them to be in the top third of their class (Table 6.14). Perceived class position, however, was not found to be significantly related to either motivation or enjoyment of mathematics.

Table 6.14 *Mean Mathematics Achievement and Self-efficacy Scores, by Parents' Perceptions of their Child's Position in Mathematics Class*

					Mathematics Achievement			
Class Position	**n**	**%**	**Mean**	**SE**	**Diff from 'top'**	**SED**	**95%CI**	
Top	1827	46.2	279.8	2.34	-	-	-	-
Middle	1518	38.4	239.0	2.66	40.7	2.57	**36.60**	**45.86**
Bottom	375	9.5	194.0	6.02	85.8	5.52	**74.74**	**96.79**
Unsure	233	5.9	222.7	4.33	57.6	4.20	**49.22**	**66.00**
					Self-Efficacy			
Top	1827	46.2	.36	.04	-	-	-	-
Middle	1518	38.4	-.20	.05	.55	.04	**.49**	**.62**
Bottom	375	9.5	-.81	.14	1.17	.16	**.85**	**1.48**
Unsure	233	5.9	-.32	.13	.67	.14	**.40**	**.95**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

One item on the Pupil Rating Form asked each pupil's teacher to indicate how supportive the parent/guardian was of the pupil's development in mathematics. Options included 'Very Supportive', 'Somewhat Supportive', 'Not Supportive', and 'Unsure'. Almost two-thirds of parents were considered to be very supportive, and only 4.5% not supportive. A higher mean mathematics score was achieved by pupils with very supportive parents, and the differences in achievement between these pupils, and pupils of somewhat supportive, and of unsupportive parents, are statistically significant (Table 6.15). Missing values are available in e-appendix E6.18.

Table 6.15 *Mean Mathematics Achievement Scores, by Level of Parent Support*

Supportive	**N**	**%**	**Mean**	**SE**	**Diff from 'Very'**	**SED**	**95% CI**	
Very	2656	64.2	263.9	2.10	-	-	-	-
Somewhat	1142	27.6	231.1	3.66	-32.8	3.59	**25.62**	**39.97**
Not	188	4.5	201.1	3.76	-62.8	3.40	**56.03**	**69.60**
Unsure	148	3.6	230.4	9.68	-33.5	10.01	**13.52**	**53.50**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Engagement in Maths Related Activities

To examine the extent that parents integrated maths-related activities into their child's everyday life, they were presented with a list of activities, and asked how often they engaged in each. Pupils' mathematics achievement scores and comparisons (with 'never' engaging in the activity as a reference group) are presented in Table 6.16 by response category (see e-appendix E6.19 for missing values).

Table 6.16 *Mean Mathematics Achievement Scores, by Parents' Frequency of Engaging in Maths-related Activities*

Frequency	N	%	Mean	SE	Diff from 'never'	SED	95%CI	
					Games Involving Maths			
Very Often	533	14.3	261.0	5.57	20.35	4.16	**-28.66**	**-12.05**
Sometimes	2685	71.8	256.0	2.23	15.29	4.57	**-24.41**	**-6.16**
Never	522	14.0	240.7	4.24	-	-	-	-
					Estimating Cost & Change			
Very Often	1098	30.2	251.7	3.4	1.26	2.85	-6.95	4.43
Sometimes	2116	58.2	256.4	2.33	5.92	3.57	-13.05	1.22
Never	426	11.6	250.5	3.7	-	-	-	-
					Reading Timetables			
Very Often	501	14.8	239.7	5.62	21.44	5.51	**10.44**	**32.43**
Sometimes	1517	44.7	254.5	2.39	6.62	3.06	**.51**	**12.74**
Never	1376	40.8	261.1	3.17	-	-	-	-
					Reading Maps			
Very Often	234	7.0	270.2	3.75	24.92	4.41	**-33.72**	**-16.12**
Sometimes	1836	55.0	263.9	2.62	18.61	3.06	**-24.72**	**-12.49**
Never	1268	38.0	245.3	3.07	-	-	-	-
					Working with Quantities			
Very Often	335	9.9	262.9	4.37	14.63	4.85	**-24.31**	**-4.95**
Sometimes	2166	64.1	258.3	2.66	10.08	3.86	**-17.79**	**-2.37**
Never	879	26.0	248.2	3.44	-	-	-	-

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

The data indicate that parents most often engaged children by playing games involving maths, estimating the cost of items and the change to be given, and working with quantities. Fewer parents engaged children in reading timetables and maps very often, though the mean mathematics achievement scores of pupils whose parents did encourage these activities are significantly higher than the mean scores of pupils whose parents never encouraged the activities. For all other activities, with the exception of estimating cost and change, children of parents who engaged in the activity at least sometimes achieved a significantly higher mean score than the children of parents who never engaged in the activity.

HOME RESOURCES

Parents were asked about the resources available to pupils at home (Table 6.17; see e-appendix E6.20 for missing values). Pupils who, according to their parents, had access to the Internet, a suitable study area, or a calculator in their home achieved a significantly higher mean score than pupils who had not. The difference was greatest for Internet access (26.1 scale score points), closely followed by the use of a suitable study area (23.2 scale score points).

Table 6.17 *Percentages of Pupils with Access to Various Resources at Home and Mean Mathematics Achievement Scores*

	N	%	Score	SE	Diff with 'Yes'	SED	95%CI	
Internet Access								
Yes	2082	48.0	266.0	2.16	-	-	**-**	**-**
No	1922	52.0	239.9	2.6	26.04	2.22	**21.61**	**30.47**
Study Area								
Yes	3530	88.7	255.2	2.32	-	-	-	**-**
No	448	11.3	232.0	4.76	23.17	4.19	**14.80**	**31.54**
Calculator								
Yes	3081	79.0	255.5	2.45	-	-	-	-
No	818	21.0	243.2	3.6	12.27	3.17	**5.95**	**18.59**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Pupils were asked on the Pupil Questionnaire if they had any of several items in their home and/or in their bedroom (Table 6.18; full tables available in e-appendix E6.21 and E6.22). Only 17.4% did not have access to a home computer, and 11.2% did not have a games console. The vast majority of pupils had a television and video/DVD player. The only significant difference in the mean achievement scores of pupils who did and did not have this range of resources was for pupils who had access to a home computer. The mean mathematics achievement score was significantly higher for pupils who had access than for pupils who had not (difference = 24.12, SED = 3.67, 95%CI = 16.79 to 31.45).

Table 6.18 *Mean Mathematics Achievement Scores, by Availability of Resources in Pupils' Homes and in their Bedrooms*

	Resources in Home				Resource in Bedroom			
	N	%	Score	SE	N	%	Score	SE
Computer/PC								
Yes	3228	82.6	256.9	2.18	531	15.4	234.8	3.04
No	680	17.4	**232.7**	**4.19**	2919	84.6	**256.2**	**2.26**
Games Console								
Yes	3506	88.8	251.4	2.64	1850	48.8	242.7	3.25
No	442	11.2	255.5	2.77	1942	51.2	**260.5**	**2.32**
TV								
Yes	4012	99.7	251.6	2.43	2247	57.3	241.5	2.94
No	12	.3	262.6	21	1674	42.7	**264.8**	**2.25**
Video/DVD								
Yes	3887	97.7	252.1	2.48	1379	37.8	238.3	2.81
No	92	2.3	241.9	5.3	2268	62.2	**260.1**	**2.15**

*Significant differences in **bold**; All comparisons made with 'yes' group. See e-appendix for full tables.*

With the exception of a television, almost half of pupils did not have access to these resources in the bedroom. Levels of mathematics achievement are significantly lower for pupils who had a computer (27.2 points), a games console (24.6 points), a television (29.9 points), or a video/DVD player (27.11 points) in their bedroom than for pupils who had not (see e-appendix E6.22 for confidence intervals and standard errors).

Spending up to one hour on the majority of activities listed in Table 6.19 is not associated with a significant difference in mathematics achievement relative to spending no time (Table 6.19; missing values for each activity are available in e-appendix E6.23).

Table 6.19 *Mean Mathematics Achievement Scores, by Time Spent on Various Activities before and after School each Day*

	%	Score	SE	Diff with 'None'	SED	95%CI	
Television (n=4032)							
None	39.9	245.6	2.65	-	-	-	-
Up to 1 Hour	43.4	258.0	2.89	12.45	3.23	**-18.91**	**-6.00**
1 - 2 Hours	16.7	248	5.2	2.41	5.83	-14.05	9.23
2 - 3 Hours	0.0	-	-	-	-	-	-
Computer Games (n=4020)							
None	72.5	254.3	2.11	-	-	-	-
Up to 1 Hour	20.0	250.7	4.49	3.61	3.98	-4.33	11.56
1 - 2 Hours	7.5	227.0	4.37	27.34	4.17	**19.02**	**35.67**
2 - 3 Hours	0.0	-	-	-	-	-	-
Home Chores (n=4014)							
None	11.7	238.2	4.71	-	-	-	-
Up to 1 Hour	60.0	256.9	2.45	18.69	3.67	**-26.03**	**-11.36**
1 - 2 Hours	22.8	250.0	3.99	11.80	5.38	**-22.55**	**-1.04**
2 - 3 Hours	5.5	228.1	3.01	10.07	7.16	-4.23	24.37
Maths Study (n=4039)							
None	2.2	189.5	13.9	-	-	-	-
Up to 1 Hour	88.0	255.6	2.20	66.10	13.78	**-93.61**	**-38.59**
1 - 2 Hours	9.1	228.6	4.25	39.12	15.84	**-70.75**	**-7.5**
2 - 3 Hours	0.7	209.6	7.85	-20.04	16.11	-52.21	12.14
Other Study (n=4020)							
None	2.4	210.9	11.34	-	-	-	-
Up to 1 Hour	72.0	255.3	2.43	44.37	10.98	**-66.30**	**-22.45**
1 - 2 Hours	23.8	244.7	2.71	33.81	11.12	**-56.03**	**-11.60**
2 - 3 Hours	1.8	234.4	14.47	23.48	20.98	-65.37	18.42
Sport (n=3992)							
None	5.9	238.2	6.67	-	-	-	-
Up to 1 Hour	20.4	250.9	4.14	12.69	6.08	**-24.82**	**-.560**
1 - 2 Hours	43.3	259.4	2.36	21.15	6.84	**-34.81**	**-7.50**
2 - 3 Hours	30.4	242.7	2.94	4.45	6.85	-18.12	9.22
Reading (n=4023)							
None	19.9	233.1	3.97	-	-	-	-
Up to 1 Hour	52.3	255.8	2.32	22.75	3.43	**-29.61**	**-15.90**
1 - 2 Hours	22.1	256.9	3.25	23.86	4.30	**-32.44**	**-15.27**
2 - 3 Hours	5.7	252.7	7.06	19.65	8.89	**-37.40**	**-1.89**
Extra Classes (n=3980)							
None	39.9	247.8	2.97	-	-	-	-
Up to 1 Hour	17.9	248.5	4.23	.66	4.04	-8.72	7.40
1 - 2 Hours	33.2	258.1	2.49	10.27	3.4	**-17.06**	**-3.48**
2 - 3 Hours	8.9	251.0	6.22	3.22	6.0	-15.20	8.76

Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference
Comparisons for each made using 'none' as the reference group.

For television viewing and playing games consoles, however, more than one hour is associated with a lower mean achievement score. For the other activities (chores, study, sport, extra classes), up to two hours of activity is associated with a significantly higher mathematics achievement score (compared to no time per activity). However, more than two hours per night of any one activity is associated with a lower achievement score.

Pupils who spent no time on maths study had the lowest achievement mean scores, followed by pupils who spent no time reading. Pupils who spent one to two hours engaged in sport achieved the highest mean score. Pupils who watched only one hour of television achieved a significantly higher mathematics achievement mean than pupils who watched two hours or more, while pupils who spent no time playing computer games achieved a significantly higher mean than pupils who spent one to two hours on this activity. Pupils who spent up to two hours per day playing computer games had the lowest mean score (27.3 scale points lower).

Contrary to expectations, more time expended on mathematics study was not associated with greater achievement. While the mean score of pupils who spent more than two hours on study was higher than that of pupils who did not study, it was significantly lower (by almost 21 scale points) than the mean score of pupils who studied for up to one hour. A similar trend is discernible for study in subjects other than maths. Although scores are significantly higher than when no study transpired, mathematics achievement levels are highest for ‘up to one hour’ of study.

Levels of achievement were consistently higher for pupils who read books for enjoyment, for one hour or more a day. Pupils who attended extra classes (such as music, dance, art, or language) for one to two hours had a significantly higher mean mathematics achievement score than pupils who did not attend extra classes at all.

MATHEMATICS HOMEWORK

Data on homework was obtained from both pupils (e.g., the frequency with which homework was assigned) and parents (e.g., time spent on homework and amount of assistance provided). Information was obtained on the specific aspects of mathematics with which pupils needed most help.

Pupils were asked how often they were given maths homework. Their responses are summarised in Table 6.20 (see e-appendix E6.24 for missing values).

Table 6.20 *Mean Mathematics Achievement Scores, by Frequency of Homework*

Freq. of Homework	%	Score	SE	Diff from ‘Everyday’	SED	95% CI	
Hardly ever/never	2.3	247.3	18.05	3.25	17.81	-38.82	32.31
Once/twice/week	7.8	245.2	16.01	1.14	16.43	-33.95	31.67
Three/four/week	58.8	256.4	2.53	12.37	4.38	**-21.1**	**-3.63**
Every day	31.2	244.0	4.38	-	-	-	-

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference; n = 4044*

Over half of the pupils said that they received homework three or four times a week, while relatively few (2.3%) were hardly ever, or never, given maths homework. Pupils who were given homework three or four times a week had a mean mathematics achievement score that is significantly higher than the mean of pupils who were assigned homework every day. No other comparison (with homework everyday as the reference group) was significant. For example, pupils who were given homework every night did not achieve significantly better than pupils who hardly ever, or never, received maths homework.

Since the data in Table 6.20 suggest that the assignment of more homework is not necessarily associated with higher mathematics achievement, analyses were conducted to establish whether more time spent on homework was associated with higher achievement scores. Data were obtained by asking parents how long their child spent on maths homework each day. The options and responses are summarised in Table 6.21 (see e-appendix E6.25 for missing values).

Table 6.21 *Mean Mathematics Achievement Scores, by Time Spent on Homework*

Time Homework	%	Score	SE	Diff from '5 mins'	SED	95% CI	
Approx. 5 mins.	9.4	274.85	4.15	-	-	-	-
Approx. 15 mins.	62.1	258.27	2.42	-16.57	4	**8.59**	**24.55**
Approx. 30 mins.	23.5	234.83	3.10	-40.01	4.71	**30.62**	**49.41**
Approx.1 hour	4.3	230.58	8.97	-44.26	10.01	**24.14**	**64.39**
More than 1 hour	.8	218.65	9.01	-56.19	10.16	**35.89**	**76.49**

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference; N = 3952*

First, the majority of pupils spent approximately 15 minutes on their homework, and the number of pupils who spent in excess of one hour was very small. The distribution of scores suggests an inverse relationship between time spent on homework and achievement, with pupils who spend the least amount of time achieving the highest mean score. A comparison of mean scores (with 'approx. 5 minutes' as the reference category) shows that the difference between each time category and the reference category is significant. Pupils who spent longer on their maths homework achieved significantly lower mean scores than pupils who spent approximately five minutes. Potential explanations for these findings include the possibility that mathematically competent pupils have less difficulty with the subject and therefore can complete homework more quickly, or that excessive homework may be deleterious to performance.

Support for the former supposition comes from information regarding the amount of help pupils received with their maths homework. In a majority of cases (51.4%), help was provided by a mother or female guardian. According to parents, more than 7 out of 10 pupils received only a few or approximately 15 minutes help with their maths homework each night. Pupils who received no help from their parents with their homework had a significantly higher mean achievement score than pupils who required greater amounts of assistance daily. The statistical significance of all comparisons with the 'none' category support the supposition that pupils with greater mathematics ability have less difficulty with their work, and so can complete it with less parental assistance.

Table 6.22 *Percentages of Parents Spending Varying Amounts of Time Helping Children with Homework, and Mean Mathematics Achievement Scores*

Time Homework	%	Score	SE	Diff from 'None'	SED	95% CI	
None	10.9	287.2	4.37	-	-	-	-
A few mins.	43.3	266.3	2.22	20.94	5.32	**10.32**	**31.56**
Approx. 15 mins.	30.4	239.4	3.13	47.83	5.45	**36.95**	**58.72**
30 – 60 mins.	14.1	215.2	4.43	71.99	7.26	**57.49**	**86.49**
More than 1 hour	1.3	211.3	7.01	75.88	8.71	**58.48**	**93.28**

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference; N = 3961*

Parents were also asked to identify the areas in which they provided most help. These areas, as well as the scores based on whether or not the pupil receives help, and a series of comparisons (with 'no help received' as the reference category) are presented in Table 6.23 (see e-appendix E6.27 for missing values). The number of pupils who received help for homework involving word problems and memorising tables was greater than the number who were helped with computation and maths concepts. The relationship between help and achievement scores followed the trend noted above: pupils who received help achieved a significantly lower mathematics achievement score than pupils who received no help. The difference between mean overall mean achievement scores for pupils who received help and those who did not was greatest for homework involving computation, and smallest for memorising tables.

Table 6.23 *Mean Mathematics Achievement Scores, by Specific Homework Areas in which Parents Provided Assistance*

	n	%	Score	SE	Diff with 'Help'	SED	95%CI	
Memorising Tables								
Help	1707	55.3	251.3	2.61	1.87	2.29	-6.46	2.72
No Help	2110	44.7	253.2	2.91				
Computation								
Help	1691	45.4	240.0	3.23	21.16	2.99	**-27.13**	**-15.19**
No Help	2034	54.6	261.2	2.51				
Word Problems								
Help	2228	58.4	246.2	2.45	13.52	2.18	**-17.88**	**-9.16**
No Help	1588	41.6	259.7	3.09				
Maths Concepts								
Help	1634	44.0	247.4	3.18	8.11	2.82	**-13.75**	**-2.47**
No Help	2082	56.0	255.5	2.71				

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*

COMPARISON WITH THE 1999 STUDY

Due to a change in the format of some items on the parent questionnaire since the 1999 study, a direct item-by-item comparison could not be made. However, general comparisons are possible under the headings used in this chapter (family structure, family socioeconomic status, parental participation/support, home resources, and homework).

Comparisons revealed few differences in family structure between 1999 and 2004. The percentage of pupils from nuclear families and their mathematics achievement scores are largely similar (79.0%, score = 253.9, SE = 2.23 in 1999; 81.1%, score = 255.5, SE = 2.59 in 2004).

Few parents in the 1999 sample were involved with parenting programmes, and the mean achievement scores of children whose parents were/were not involved were largely identical in both years. Few differences were discernible for overall levels of satisfaction with pupil progress. Mean parental satisfaction ratings in the 1999 study were slightly higher than in the 2004 study for Number Facts, Computation, and Problem Solving, though differences are not statistically significant.

In keeping with the slightly lower mean satisfaction, parents' perception of their child's class rankings were also marginally lower in 2004. Fewer parents in the current study assigned their children to the middle achievement grouping in their mathematics class, and more assigned them to the bottom third of the class. The fact that parents expressed marginally lower levels of satisfaction with their child's achievement and ranked fewer pupils in the top third of their class, even though overall mean scores were not significantly lower, may indicate higher parental standards or expectations.

The percentage of parents who engaged in mathematics-related activities with their children was approximately the same in both years, though pupils who regularly played games involving maths, read maps, or worked with quantities achieved slightly higher mean scores in 2004. The number of children with access to a calculator at home was also similar, though considerably more children in 2004 (77.4%) than in 1999 (47.8%) had access to a home computer. In both years, pupils with access to a home computer performed significantly better in mathematics than pupils without access.

Fewer pupils in 2004 (30.2%) than in 1999 (61.2%) were given mathematics homework on a daily basis. The mean achievement scores of pupils in these groups does not differ significantly. Pupils who received maths homework once or twice per week in 1999 had the highest mean mathematics achievement score, while in 2004, pupils who were given maths homework three or four times a week scored highest.

In both years, the highest mean mathematics score was achieved by pupils who spent approximately five minutes a day on homework, and the lowest by pupils who spent over 60 minutes.

SUMMARY

Pupils who lived in a family with both parents/guardians (84.5%) achieved a mean mathematics achievement score that is significantly higher, by two-fifths of a standard deviation, than the mean score of pupils who lived in a lone-parent family (15.5%). Pupils with one, two, or three siblings outperformed pupils who had no siblings. A pupil's ordinal position in the family was not associated with mathematics achievement.

A number of socioeconomic status (SES) variables were linked to achievement. On a combined measure of parent employment, pupils with at least one parent in full-time employment outperformed pupils from families where combined employment status was described as part-time, not working or involvement in home duties. When pupils were assigned to socioeconomic groups based on their parents' employment, those in the high socioeconomic group significantly outperformed pupils in the medium- and low- socioeconomic groups. The difference in mean achievement between pupils in the high and low groups is almost three-fifths of a standard deviation. The mean achievement score of pupils at the 10th percentile in the low socioeconomic group is 1.5 standard deviations below the overall mean.

Pupils' mathematics achievement increased as combined educational attainment of their parents increased. Pupils whose parents had attained a first degree or a post-graduate degree outperformed the children of parents whose highest educational qualification was the Leaving Certificate (the reference group). The latter group, in turn, outperformed pupils whose parents had only completed the Junior/Intermediate Certificate, the Group Certificate, or Primary Education. Degree of parents' involvement in the school (with the exception of attendance at an annual parent-teacher meeting) was not associated with their children's mathematics achievement, but was linked to children's perceived self-efficacy in mathematics. Pupil self-efficacy also increased as parental satisfaction with their child's progress and the class ranking they assigned to their child increased.

Aspects of pupils' mathematics achievement with which parents were satisfied include knowledge of number facts, computation, and measurement. Achievement scores were higher for pupils whose parents said they integrated mathematics into everyday activities in the home. Pupils whose parents regularly engaged them in games involving maths, map reading, and activities requiring counting and measuring achieved significantly higher mean scores than pupils whose parents never engaged in these activities. Among the home educational resources associated with achievement were access to a computer, access to the internet, and availability of a place to study. For each, pupils with access to these resources achieved, on average, half a standard deviation higher than pupils who did not have access.

Pupil participation in a number of out-of-school activities including sports, reading, and other extra-curricular activities (such as music, dance, art, or language classes) was associated with mathematics achievement. Lowest mean mathematics achievement scores were attained by pupils who spent little time studying mathematics and by pupils who spent longer periods (up to two hours) playing computer games or on household chores. Pupils who spent more than an hour on mathematics homework also had low mean achievement, possibly indicating that pupils with more severe difficulties with mathematics spend considerably longer on home work.

7. Classroom Environment and Mathematics Achievement

In this chapter, classroom environments for teaching mathematics are considered with reference to demographic information on teachers; the composition and size of classes; teacher participation in in-career development; aspects of mathematics teaching, including planning and use of resources; teachers' perspectives on aspects of learning support and resource teaching in mathematics; the climate for mathematics teaching in schools; teachers' comments on the teaching of mathematics, in the context of implementation of the 1999 PSMC; and associations between teacher/classroom variables and mathematics achievement. Comparisons are drawn between the responses of teachers to questionnaire items common to the 1999 and 2004 assessments.

The data for analyses come from the responses of teachers to the Teacher Questionnaire. All but one teacher (194 of 195) returned a completed questionnaire. In many of the analyses, teachers' responses were linked to the pupil database (with each pupil being assigned the values corresponding to his/her teacher). Thus, many of the statistics in the chapter refer to percentages of pupils whose teachers or classes have certain characteristics rather than to percentages of teachers or classes.

TEACHERS' BACKGROUNDS

The majority of pupils (77.6%) were taught by a female teacher (Table 7.1). Over four-fifths of girls were taught by a female teacher, and one-sixth were taught by a male. Just over seven-tenths of boys were taught by a female teacher, and over one-quarter by a male.

Table 7.1 *Percentages of Pupils Taught by Male and Female Teachers, by Pupil Gender*

Gender	N of Pupils	Taught by Female Teachers	Taught by Male Teachers
Girls	2029	83.3	16.7
Boys	2112	72.2	27.8
All	4141	77.6	22.4

The average number of years of teaching experience was 14.8 years (SD = 11.48, SE =1.09). Almost one-third of pupils were taught by teachers with between 1 and 5 years experience (Table 7.2). Just under 12% were taught by teachers with more than 30 years experience (see e-appendix E7.2 for standard errors).

Table 7.2 *Percentages of Pupils Taught by Teachers with Varying Levels of Teaching Experience*

Years of Teaching Experience	Number of Pupils	Percent of Pupils
1-5 years	1341	32.6
6-10 years	530	12.9
11-15 years	354	8.6
16-20 years	600	14.6
21-25 years	398	9.7
26-30 years	410	10.0
More than 30 years	482	11.7
Total	4157	100.0

Almost 12% of pupils (11.7%, SE = 2.8) were taught by a temporary or substitute teacher, while the remainder (88.3%, SE = 2.86) were taught by a permanent teacher. Fewer than 1% of pupils were taught by a teacher who job-shared (see e-appendix E7.25). Almost 23% of pupils were taught by a teacher with a Diploma for National Teaching, while 65% were taught by a teacher with a B.Ed. degree and 24% by a teacher with a primary degree other than a B.Ed. (Table 7.3). Overall, 94% of pupils were taught by a teacher holding either a N.T. diploma, a B.Ed., and/or a primary degree other than a B.Ed. and a postgraduate diploma in Education.

Table 7.3 *Percentages of Pupils Taught by Teachers with Various Qualifications*

Qualification	No. of Pupils	Percent of Pupils
Diploma for National Teaching (NT)	954	22.9
B.Ed.	2687	64.6
Primary degree other than B.Ed.	985	23.7
Postgraduate Diploma in Education (primary) (or equivalent)	593	14.3
Higher Diploma in Education (H. Dip.) (post-primary)	470	11.3
Diploma in Remedial / Special Education / Learning Support	207	5.0
Masters in Education [e.g., M.A. (Education), M.Ed.].	225	5.4
Other qualification [e.g., diploma, certificate, post-graduate degree]	287	6.9
Recognised teaching qualification	3891	93.6

(N = 4157)

CLASSROOM COMPOSITION AND SIZE

Just over 61% of pupils were taught in single-grade classes, and almost one-quarter (23.3%) in classes with two grades (i.e., Fourth class and one other grade) (Table 7.4).

Table 7.4 *Percentages of Pupils Taught in Single and Multi-grade Classes*

Number of grade levels taught by teacher	Percent of Pupils
Single-grade	61.6
Two grades	23.3
Three grades	10.4
Four grades	3.3
Five grades	1.4
Multi-grade (total)	38.4

(N = 4171)

Average class size across all classes was 27.2 pupils. The average class size of single-grade Fourth classes was 27.3. In multi-grade classes, the average number of pupils was 27.0, with an average of 12.9 in Fourth class. In designated disadvantaged schools, the average number of pupils in a single-grade Fourth class was 22.7, while in non-designated schools, it was 28.6 (Table 7.5).

Table 7.5 *Mean Class Size in Single- and Multi-grade Classes: All Pupils and Pupils in Fourth Class, by School Designated Disadvantaged Status*

	N	Mean No. of Pupils	SD	Range
All schools				
Single-grade Fourth classes	2568	27.3	4.63	15-35
Fourth classes in multi-grade classes	1603	12.9	5.70	3-28
All pupils in multi-grade class	1603	27.0	5.42	13-37
All pupils – all classes in study	4171	27.2	4.95	13-37
Designated schools				
Single-grade Fourth classes	551	22.7	3.41	17-30
Fourth class pupils in multi-grade classes	18	13.9	3.37	6-16
All pupils in multi-grade classes	18	23.9	4.46	17-37
All pupils – all classes in study	559	22.7	3.45	17-30
Non-designated schools				
Single-grade Fourth classes	2017	28.6	4.06	3-35
Fourth classes in multi-grade classes	1585	12.9	5.72	3-2 8
All pupils in multi-grade classes	1585	27.1	5.42	13-37
All pupils – all classes in study	3602	27.9	4.77	13-37

IN-CAREER DEVELOPMENT

Teachers, when asked to indicate the number of days of in-career development (ICD) in mathematics they had attended, reported attending an average of 2.4 days (provided by the Primary Curriculum Support Programme) in the last 5 years, and 0.34 days in the past 12 months. Attendance at courses on mathematics provided by other groups (Education Centres, Universities etc.) was low.

Table 7.6 *Mean Number of Days of ICD in Mathematics Attended by Teachers*

	PCSP Courses		Other Courses	
	N	**Mean Days**	**N**	**Mean Days**
Attended in Past 5 Years*	3890	2.41	4141	0.59
Attended in Past 12 Months	3801	0.34	3835	0.20

**Excludes pupils taught by teachers with fewer than 5 years teaching experience*

Almost 8% of pupils were taught by teachers who had at least 5 years teaching experience but who had not attended any course days on mathematics offered by the PCSP in the preceding 5 years (Table 7.7). Almost 90% of pupils were taught by teachers who had not attended ICD courses offered by other providers in the same time period.

Table 7.7 *Percentages of Pupils Whose Teachers Did Not Attend ICD*

	PCSP Courses		Other Courses	
	N	**% Not Attending**	**N**	**% Not Attending**
In past 5 years*	2727	7.8	2846	87.9
In past 12 months	3801	75.9	3835	93.2

**Excludes pupils taught by teachers with fewer than 5 years teaching experience*

Teachers who had attended at least some ICD courses provided by the PCSP over the preceding 5 years were asked to rate their satisfaction with the overall amount and quality of ICD in mathematics available to them. In general, teachers seemed satisfied with the amount available; fewer than 20% of pupils were taught by teachers who were either dissatisfied or very dissatisfied. Over 90% of pupils were taught by teachers who were satisfied or very satisfied with the quality of the ICD. The Cuiditheoirí Service, which provides advice and support to schools/teachers on curriculum implementation in mathematics and in other subjects, was also well received. Over 90% of pupils whose teachers had availed of the service were taught by teachers who were either very satisfied or satisfied with the advice they had received (Table 7.8).

Table 7.8 *Percentages of Pupils whose Teachers Reported Varying Levels of Satisfaction with the Amount and Quality of PCSP ICD Courses*

	N	**Very Satisfied**	**Satisfied**	**Dissatisfied**	**Very dissatisfied**
Amount of PCSP ICD	3302	14.8	66.3	17.7	1.3
Quality of PCSCP ICD	3302	23.4	68.4	7.7	0.5
Cuiditheoirí Service	2183*	40.2	52.9	6.2	0.7

**Based on responses of teachers who had availed of the service.*

Teachers were asked to indicate their satisfaction with the amount of coverage of specific aspects of the Primary School Mathematics Curriculum in ICD courses provided by the PCSP. More than 9 in 10 pupils were taught by teachers who felt that adequate or sufficient coverage had been allocated to the Number strand. On the other hand, almost 3 in 10 of pupils were taught by teachers who felt that there had been too little coverage of Shape & Space. About one-fifth were taught by teachers who felt that there had been insufficient coverage of Data (Table 7.9).

Table 7.9 *Percentages of Pupils whose Teachers Reported Varying Degrees of Satisfaction with the Amount of ICD Provided on Various Mathematics Content Strands and Skills**

Strand/Skill	Adequate / Sufficient	Too Little	Too Much
Strand			
Number	91.0	8.7	0.3
Algebra	77.9	22.1	0.0
Shape & Space	71.2	28.8	0.0
Measures	79.9	19.8	0.4
Data	78.5	20.6	1.0
Skill			
Recalling	77.2	20.6	2.2
Implementing	73.8	26.2	0.0
Reasoning	62.7	36.9	0.4
Connecting	80.2	19.2	0.7
Applying & Problem Solving	62.0	37.1	0.9
Communicating & Expressing	60.0	38.7	1.3

**Refers to pupils of teachers who had attended at least some ICD provided by the PCSP; N = 3302*

Teachers were somewhat less satisfied with the emphasis on mathematics skills. For example, over one-third of pupils were taught by teachers who said that coverage of Implementing was too little. Similar proportions were taught by teachers who felt that coverage of Applying & Problem Solving and Communicating & Expressing had been insufficient (Table 7.9).

Teachers who had attended courses in mathematics provided by the PCSP were also asked about the adequacy of coverage of a number of selected topics. While it is recognised that ICD provided by the PCSP may not have been designed to address these topics specifically, the responses of teachers may be indicative of areas in need of attention in the future. Over four-fifths of pupils were taught by teachers who felt that at least adequate coverage had been given to the topic of engaging of pupils in group activities, while just over three-quarters were taught by teachers who felt that at least adequate coverage had been given to the use of calculators in teaching mathematics. On the other hand, almost three-fifths of pupils were taught by teachers who felt that the topics of identifying learning difficulties in mathematics and interpreting standardised test scores in mathematics had not received sufficient coverage. Over three-quarters of pupils were taught by teachers who felt that not enough attention had been given to using Information and Communications Technologies (ICTs) to teach mathematics.

Table 7.10 *Percentages of Pupils whose Teachers Indicated Varying Levels of Satisfaction with the Coverage of Selected Topics in ICD Provided by the PCSP*

Topic	N	Too little	Adequate / Sufficient	Too much
Classroom-based assessment of mathematics	3165	45.5	54.1	0.4
Identifying learning difficulties in maths	3181	59.9	40.1	0.0
Interpreting standardised test scores in maths	3165	59.5	40.5	0.0
Engaging pupils in group activities	3155	17.0	79.7	3.3
Approaches to teaching mathematics	3172	15.6	83.2	1.2
Using ICTs to teach mathematics	3195	77.3	20.2	2.5
Grouping children for mathematics	3195	52.1	47.5	0.3
Use of calculators to teach mathematics	3195	24.3	74.9	0.8

Total N (before missingness) = 3302

Finally, teachers were asked to indicate their overall satisfaction with ICD and pre-service training in mathematics. Four out of five pupils were taught by teachers who were at least fairly satisfied with the ICD in mathematics that they had attended (Table 7.11). Just 7% of pupils were taught by teachers who were either dissatisfied or very dissatisfied. The data on pre-service training should be interpreted with caution as no data were available for the teachers of about one-third of pupils. Nevertheless, among those who responded, 18% of pupils were taught by teachers who were either dissatisfied or very dissatisfied.

Table 7.11 *Percentages of Pupils whose Teachers Indicated Varying Degrees of Satisfaction with ICD and Pre-service Training in Mathematics*

	In-career Development			Pre-service Training		
	N	%	SE)	N	%	(SE)
Very Satisfied	314	9.6	4.26	395	14.1	4.88
Satisfied	1106	33.8	5.78	931	33.1	4.59
Fairly Satisfied	1607	49.2	6.46	977	34.7	6.17
Dissatisfied	213	6.5	2.30	348	12.4	4.65
Very Dissatisfied	28	0.8	0.59	163	5.8	2.32

TEACHING MATHEMATICS

In this section, aspects of the teaching of mathematics are described, including time allocated to lessons, activities and materials used in lessons, and grouping practices.

Time Allocated to Mathematics Lessons

On average, pupils received 216 minutes (3 hours, 36 minutes) of mathematics instruction per week (Table 7.12). Pupils in single-grade classes received 12 minutes more than pupils in multi-grade classes. However, when standard errors around respective mean scores are taken into account, this difference is not large enough to reach statistical significance (see e-appendix, E7.12)[1].

Table 7.12 *Mean Number of Minutes Per Week Spent on Teaching Mathematics in Fourth Class in Single- and Multi-grade Classes*

	N	Mean Minutes	SD	Range
Single Grade Class	2535	220.7	41.85	120 – 300
Multi-Grade Class	1543	209.3	73.17	60 – 330
All Fourth Classes	4078	216.4	56.07	60 – 330

The mean length of mathematics lessons was 44.6 minutes (SD = 8.48; SE =1.29). The majority of pupils (87%, SE = 3.03) participated in mathematics lessons every day, with 12% (SE = 2.87) participating four times a week, and just over 1% participating three days a week.

Across all Fourth classes, an average of 83% of class time was allocated to instruction, with the remainder allocated to management (8.7%) and administration (8.3%) (Table 7.13). Small differences between single- and multi-grade classes, and between classes in disadvantaged and non-disadvantaged schools, are not statistically significant (see standard errors in e-appendix, E7.13).

Table 7.13 *Percentages of Time Allocated to Various Activities in Mathematics Lessons, by Class Type and School Designated Disadvantaged Status*

	N	Management	Administration	Instruction
All Classes	3917	8.7	8.3	83.0
Single grade classes	2356	9.0	8.3	82.7
Multi-grade classes	1560	8.2	8.3	83.5
Classes in disadvantaged schools	470	12.6	8.9	78.6
Classes in non-disadvantaged schools	3446	8.2	8.2	83.6

Use of Instructional Resources

Teachers were asked to rate the frequency with which they used various resources to teach mathematics, using a 4-point scale: every day/almost every day; once or twice a week; once or twice a month; hardly ever/never. The most commonly-used resources were textbooks (used by almost all pupils on a daily basis) and tablebooks (used by 45% of pupils on a daily basis) (Table 7.14).

[1] This is because the 95% confidence intervals around the mean number of minutes (mean ±1.96* the standard error) overlap.

Table 7.14 *Mean Frequency of Using Resources for Teaching Mathematics, and Percentages of Pupils whose Teachers Report Using Resources with Various Frequencies*

	N	Mean Usage**	Daily Usage	Once/Twice a Week	Once/Twice a Month	Hardly Ever or Never
Textbooks	4140	4.0	95.5	4.0	0.4	0.0
Tablebooks	4079	3.1	45.0	32.3	11.5	11.1
Workbooks/sheets	4084	2.8	20.4	47.3	26.6	5.8
Concrete materials	4104	2.6	8.7	42.8	44.4	4.1
Calculators	4085	1.9	4.7	17.4	44.5	33.4
Computers	4018	1.6	2.7	15.2	26.4	55.7
Other	4140	1.2	2.7	20.8	23.7	26.7

**Based on 4-point scale: 4 – every day/almost every day; 3 – once or twice a week; 2 – once or twice a month; 1 –hardly ever/never.*

Concrete materials were used relatively infrequently (just 9% of pupils used them on a daily basis while a further 42.8% did so once or twice a week). Just 5% of pupils used a calculator every day, while about one-third (33.4%) never used one. The ‘other’ resources identified by teachers included the school environment (e.g., for identification of mathematics shapes) and various mathematics games (see e-appendix E7.14 for standard errors).

Teachers were asked to indicate the types of software used by pupils. Almost one-half of pupils had received at least some instruction with software designed to provide practice on mathematics facts and skills, while 2 in 5 (41.8%) had encountered software designed to tutor mathematics concepts such as number, space and time (Table 7.15). Almost a third (31.6%) of pupils had encountered adventure games that involved mathematics, while a fifth (22.7%) had worked with software that provided practice in data handling (see e-appendix E7.15 for standard errors).

Table 7.15 *Percentages of Pupils whose Teachers Reported that Various Types of Software Had Been Encountered during Mathematics Classes*

ICT Resource	N	Percent of Pupils
Software to provide practice on mathematics facts/skills	4157	49.9
Software that tutors mathematics concepts	4157	41.8
Software that engages pupils in higher-level thinking	4157	7.2
Software that provides practice in data handling	4157	22.7
Adventure games that involve mathematics	4157	31.6
Internet resources for learning mathematics	4157	16.1

Teachers indicated the types of activities that pupils engaged in as they used their calculators in class. The activities for which calculators were used most often were routine computation and checking answers. Forty-eight percent of pupils engaged in routine computation with a calculator at least once a month, while almost 59% engaged in checking answers with the same frequency (Table 7.16). Calculators were used less frequently for solving problems, and for exploring number concepts. The vast majority of pupils (91.7%) hardly ever or never used a calculator in a test or exam (see e-appendix E7.16 for standard errors).

Table 7.16 *Percentages of Pupils whose Teachers Reported that Calculators Had Been Used for Various Purposes in Mathematics Classes*

Calculator Activity	N	Mean*	Daily	Weekly	Monthly	H. Ever/Never
Routine computation	4157	1.7	3.3	10.5	34.1	52.2
Checking answers	4157	1.9	5.5	16.7	36.5	41.3
Exploring number concepts	4157	1.5	0.5	3.9	40.0	55.6
Solving one-/two-step problems	4157	1.5	1.0	10.4	30.7	57.9
Tests and exams	4157	1.1	0.0	2.7	5.5	91.7

**Based on 4-point scale: 4 – every day/almost every day; 3 – once or twice a week; 2 – once or twice a month; 1 –hardly ever/never.*

Planning for Mathematics Lessons

Almost 9 in 10 pupils were taught by teachers who prepared short-term plans fortnightly or more often (Table 7.17). Almost half were taught by teachers who prepared long-term plans on a term-by-term basis, while 35% were taught by teachers who did so on an annual basis (see e-appendix E7.17 for standard errors).

Table 7.17 *Percentages of Pupils whose Teachers Reported Engaging in Short- and Long-term Planning with Varying Degrees of Frequency*

	N	Weekly or more often	Fortnightly	Monthly	Less often
Short-term scheme	4140	40.0	46.9	11.8	1.3
		Monthly or more often	**Term-by-term**	**Annually**	**Less Often**
Long-term scheme	4107	13.8	48.2	35.0	3.0

Teachers reported drawing on a broad range of resources in their planning. Thirty-one percent of pupils were taught by teachers who used the pupil edition of the class text as their main source in deciding which topics to teach, while a further 20% drew on the teacher manual accompanying the class text for this purpose (Table 7.18). Other sources, such as the 1999 PSMC and the Plean Scoile, were used less frequently. The teacher edition of the class text was the most commonly used resource for deciding how to present a topic (35% of pupils), though some teachers also drew on the pupil edition of the class text (22%) and the Teacher Guidelines accompanying the PSMC (22%). Over four-fifths of pupils were taught by teachers who drew on the class text (whether teacher or pupil edition) as their main source in selecting problems and applications for classwork and homework. While almost one-quarter of pupils were taught by teachers who used the class text to select problems and applications for assessment, almost 2 in 5 pupils were taught by teachers who identified problems and applications for this purpose in ‘other’ (unspecified) sources.

Just over 70% of pupils were taught by teachers who met once or twice a year to plan mathematics activities with other teachers in their school or cluster; 16.5% of pupils were taught by teachers who met once a month or more often; and teachers of the remaining pupils never met to discuss curriculum or teaching approaches in mathematics (see e-appendix E7.26).

Table 7.18 *Percentages of Pupils whose Teachers Reported Using Various Sources as the Main Resource for Planning Mathematics Lessons*

Topic	N	1999 PSMC Content Statement	1999 PSMC Teacher Guidelines	Plean Scoile	Teacher's Manual for Textbook	Pupil Edition of Textbook	Other Sources
Deciding on topics (objectives)	4131	16.5	20.1	12.9	19.5	30.8	0.2
Deciding how to present a topic	4131	3.5	21.7	4.3	35.0	22.1	13.4
Selecting probs/ applications for class/homework	4131	0.8	4.8	1.7	17.3	66.3	9.2
Selecting probs/ applications for assessment	4131	1.6	7.9	4.2	23.6	23.1	39.7

Grouping for Mathematics Instruction

Teachers were asked to indicate if pupils in Fourth class were grouped for mathematics instruction, and, if so, whether they stayed in the same groups whenever there was group teaching. Just 16.8% of pupils in Fourth class were not grouped for instruction (Table 7.19). This percentage did not vary much across single- and multi-grade classes. According to teachers, 7.5% of all pupils in Fourth class always stayed in the same group for instruction, while 69% sometimes stayed in it.

Table 7.19 *Percentages of Pupils in Fourth Class whose Teachers Indicated that They Stayed in the Same Groups for Mathematics Lessons*

	N	Always	Sometimes	Never	Not grouped
Pupils in single-grade classes	2535	7.3	66.1	10.0	16.6
Pupils in multi-grade classes	1459	7.7	74.2	0.9	17.2
Pupils in all Fourth-grade classes	3995	7.5	69.0	6.7	16.8

When asked about the basis of grouping, teachers reported that 20.9% of pupils were placed into similar ability groups, while almost two-thirds were placed in mixed-ability groups, in those lessons in which grouping occurred (Table 7.20). Fourth class pupils in multi-grade classes were less likely to find themselves in similar ability groups than pupils in single-grade Fourth classes.

Table 7.20 *Percentages of Pupils in Fourth Class whose Teachers Indicated Allocating Them to Groups for Mathematics in Various Ways*

	N	Similar ability groups	Mixed ability groups	Similar/ Mixed	Not grouped
Pupils in single-grade classes	2520	29.7	50.5	4.2	15.6
Pupils in multi-grade classes	1456	5.5	70.9	5.1	18.4
All Fourth classes	3976	20.9	58.0	4.6	16.6

Although over 80% of pupils in Fourth class were grouped for instruction at some time or other, it appears that this did not occur frequently. For example, 84% of pupils were in classes in which teachers taught all pupils together in most lessons (Table 7.21). Group work and paired work were each offered to fewer than 5% of pupils in most lessons, and to two-thirds in some lessons. Conferencing between teacher and pupil occurred frequently, with almost 90% of pupils participating in conferences in at least some lessons.

Table 7.21 *Percentages of Pupils Involved in Whole-class Instruction, Paired Work, and Conferencing with their Teacher, with Varying Levels of Frequency*

	N	Most lessons	Some lessons	Hardly ever	Never
Whole 4th class engaged in same lesson/activity	4103	84.0	13.2	2.0	0.6
Large/Small groups of 4th class pupils work together	3987	3.2	67.3	24.6	4.9
Pairs of 4th class pupils work together	3870	5.5	68.1	23.3	3.2
Conferencing between teacher and pupil for individual instruction.	4024	43.0	45.3	10.7	0.9

Finally, teachers of multi-grade classes were asked about how often they grouped Fourth class pupils with children from other class levels. Over one-third (37%) of pupils in multi-grade classes were grouped in this way ‘sometimes’. For the remaining pupils, however, such grouping ‘never’ occurred (see e-appendix 7.27).

Assessment of Mathematics

Almost 80% of pupils were taught by teachers who administered standardised tests once a year, while 5% were taught by teachers who administered them twice. Almost 15% were in classes in which standardised tests were not administered. Teacher-made tests were also frequently administered. Just over one-quarter of pupils were in classes in which such tests were administered once a term, just under one-third in classes in which they were administered once a month, and almost one-quarter in classes where they were administered on a weekly basis (Table 7.22).

Table 7.22 *Percentages of Pupils whose Teachers Engaged Them in Various Types of Mathematics Assessment, by Frequency*

Type of Assessment	Once a Year	Twice a Year	Once a Term	Once a Month	Once a Week	Not Used
Standardised tests	79.4	5.1	0.0	0.0	0.0	14.9
Teacher-made tests	2.4	3.8	26.6	32.9	23.5	10.8
Teacher-made checklists	2.2	1.2	16.2	26.8	14.9	38.7
Structured teacher observations	2.2	0.9	10.4	19.8	39.4	27.3
Diagnostic tests	4.3	2.8	1.6	1.3	2.4	87.6
Progress tests	2.8	0.6	28.5	28.1	7.1	32.9

N (each row) = 4157

Just 11% of pupils were in classes in which teacher-made tests were not used. Progress tests (typically those accompanying mathematics textbooks) were administered relatively frequently; 57% of pupils were in classes in which such tests were administered either once a term or once a month. On the other hand, just under one-third of pupils were in classes in which such tests were not used at all. Almost 90% of pupils were in classes in which diagnostic tests (test designed to pinpoint pupils' strengths and learning needs in mathematics in some detail) were not administered (Table 7.22).

LEARNING SUPPORT AND RESOURCE TEACHING

Teachers were asked about the support they provided for children in receipt of learning support/resource teaching that focused on mathematics. First, they were asked about their familiarity with the DES *Learning Support Guidelines* as they relate to provision in mathematics. Sixteen percent of pupils were taught by teachers who indicated that they were very familiar with the *Guidelines*, over one-quarter (25.9%) were taught by teachers who were unfamiliar with them, and the remainder by teachers who were somewhat familiar with them (e-appendix E7.28). The relatively large proportion of pupils taught by teachers who were not familiar, or only somewhat familiar, with the *Guidelines* (83.6%) may simply reflect the low level of learning support in mathematics that is available in some schools (i.e., teachers may not have read the sections of the *Guidelines* dealing with mathematics because learning support in mathematics was not provided in their school).

Teachers were asked whether they had contributed to the development of school policy on the provision of learning support in mathematics. Thirty-eight percent of pupils were taught by teachers who had, while 62% were taught by teachers who had not (e-appendix E7.29).

Finally, teachers were asked about the extent of integration between teaching in mathematics classes and learning support/resource classes (see Table 7.23).

Table 7.23 *Percentages of Pupils whose Teachers Indicated Varying Levels of Integration between Class and Learning Support/Resource Teaching in Mathematics*

Teacher Ratings of Integration	N	Percent of Pupils (1)	Percent of Pupils (2)
Complete integration	685	16.6	24.0
Some integration	1756	42.6	61.4
A little integration	331	8.0	11.6
No integration	88	2.1	3.1
Not applicable	1261	30.6	---

Pupils (1) – includes all pupils whose teachers responded, including teachers for whom the question was not applicable (i.e., they had no pupils in receipt of learning support/resource teaching in mathematics). Pupils (2) – excludes pupils of teachers with no pupils in receipt of learning support / resource teaching for mathematics

In classes to which the question was applicable (last column in Table 7.23), almost one-quarter of pupils were taught by teachers who felt that there was full integration between class teaching and learning support/resource teaching. Sixty-one percent of pupils were taught by teachers who stated that there was some integration, while just 3% were taught by teachers who reported no integration.

SCHOOL CLIMATE AND MATHEMATICS

Over 90% of pupils were taught by teachers who agreed or strongly agreed that the attitude towards the 1999 PSMC in their school was positive (Table 7.24). Almost 90% of pupils were taught by teachers who agreed or strongly agreed that their school had a clear set of goals and priorities for teaching mathematics. On the other hand, almost one-quarter of pupils were taught by teachers who disagreed or strongly disagreed that their school had a clear set of goals and priorities for staff development.

Table 7.24 *Percentages of Pupils whose Teachers Indicated Varying Levels of Agreement with Statements about School Climate as It Relates to Mathematics*

Statement	N	Mean**	Strongly Agree	Agree	Disagree	Strongly Disagree
There is positive attitude towards methodology of 1999 PSMC	3943	3.3	33.2	61.6	4.5	0.6
School has clear set of goals and priorities for teaching maths	3920	3.1	23.0	66.2	10.1	0.8
School resources are used effectively for teaching of maths	3925	3.0	18.5	67.7	13.2	0.6
School has clear set of goals and priorities for staff development*	3786	2.9	16.7	57.8	23.1	2.3

**Missingness on this item: 9.2%; **Based on the following scale: 4 = strongly agree; 3 =agree; 2 = disagree; 1 = strongly disagree.*

TEACHERS' COMMENTS ON THE PRIMARY SCHOOL MATHEMATICS CURRICULUM

At the end of the Teacher Questionnaire, teachers were invited to make any comments they felt were relevant to implementation of the 1999 PSMC or the teaching and assessment of mathematics. A total of 66 comments were made by 46 teachers (almost one-quarter of the teachers who completed the questionnaire). A table outlining the main themes identified can be found in e-appendix E7.30.

Just over 12% of comments represented expressions of satisfaction with the PSMC. Almost 11% referred to class size as an impediment to implementing the PSMC, while 9.1% referred to aspects of the content of the curriculum, and the same percentage noted a lack of resources for implementing it.

Teachers' comments also referred to difficulties in teaching mathematics to certain subgroups, including pupils with learning support needs (3.0% of comments), newcomer pupils (3.0%), and pupils with varying levels of ability in mathematics (3.0%). Reference was also made to difficulties in teaching children in multi-grade classes (3%).

Comments relating to textbooks tended to be negative. One complained that there had been a 'dumbing down' of content, while another was critical of a lack of mathematics texts in Irish for senior classes. Comments on assessment included a criticism of continuous assessment (as recommended in the PSMC), and a need for standardised tests in Irish.

While comments about ICD and activities relating to planning to implement the PSMC were positive, one called for ICD that was specific to particular class levels, and another expressed disappointment at the lack of available time to review resources demonstrated by a facilitator during ICD.

Taken together, teachers' comments suggest that they experience some difficulty in attending to the needs of pupils with varying abilities (e.g., children with learning difficulties, children whose first language is not the language of instruction). Such difficulties seem to be compounded by a perceived pressure to complete the full mathematics curriculum with all pupils, and by a shortage of resources (at least among those teachers who provided written comments).

ASSOCIATIONS BETWEEN TEACHER VARIABLES AND ACHIEVEMENT

In this section, correlations between several variables described in this chapter and pupils' mathematics achievement are considered. Some caution should be exercised in their interpretation. First, it should be noted that they are based on cross-sectional data, describing variables associated with performance at one point in time. Second, a significant correlation between a given variable and achievement does not imply causation. For example, a negative association between use of concrete materials and performance may reflect a practice among teachers of using such materials more frequently with low achievers, not a negative effect on performance of the use of such materials. Third, for some variables, such as average length of mathematics lessons, there may be insufficient variation in the data to induce a significant correlation (e.g., most mathematics classes may be of broadly similar length), and an experimental study would be necessary to ascertain if varying lesson time would increase or reduce performance. Fourth, a small but statistically significant relationship between two variables does not imply that the relationship is a substantive one.

Of the correlation coefficients reported in Table 7.25, only four have statistically significant relationships with achievement. Two relate to class size: the total number of pupils in a class (including pupils not in Fourth class), and, in the case of single-grade Fourth classes, the number of pupils in the class. In both cases, the relationship with achievement is negative, indicating a tendency for larger classes to be associated with higher achievement. The other significant correlations concern frequency of use of computers and satisfaction with ICD. More frequent use of computers/ICT, and greater satisfaction with ICD on the part of teachers, are weakly associated with higher achievement in mathematics.

Table 7.25 *Correlations between Selected Classroom/Teacher Variables and Pupils' Mathematics Achievement*

Variable	N	r	t	p
Teacher Characteristics				
Teaching experience (years)	4115	.048	0.864	0.391
Teacher gender	4157	- .033	0.703	0.484
Class Composition				
Single vs. multi-grade	4171	- .631	1.435	0.156
Class size (all pupils)	4171	**.110**	**2.237**	**0.029**
Class size (pupils in fourth class)	4171	.017	0.421	0.675
Class size (single grade classes)	2568	**.219**	**4.096**	**0.000**
Allocation of Teaching Time				
Minutes per week teaching maths	4078	.014	0.374	0.709
Average mathematics lesson	4147	.003	0.070	0.944
Frequency of Using Resources				
Textbooks	4140	-.047	-0.362	0.719
Computers	4018	**.100**	**3.406**	**0.019**
Tablebooks	4064	.010	0.233	0.817
Calculators	4085	.007	0123	0.903
Worksheets	4084	-.002	-0.041	0.067
Concrete mats.	4084	-.028	-0.591	0.557
In-career Development - Mathematics				
Days PCSP Courses attended (last 5 years)	3890	.069	0.592	0.116
Days PCSP courses attended (last year)	3835	.041	.0879	.0383
Satisfaction with amount of PSCP courses	3538	-.068	-1.938	0.057
Satisfaction with quality of PCSP courses	3500	-.059	-1.929	0.059
Satisfaction with ICD generally	3577	**.068**	**2.616**	**0.011**
Satisfaction with pre-service training	2814	.042	0.884	0.380

*Statistically significant correlation coefficients in **bold***

COMPARISON WITH THE 1999 STUDY

In comparisons between key variables derived from responses to items on the Teacher Questionnaire in 1999 and 2004, five topics are addressed: teacher demographics, class size, time allocated to teaching mathematics, use of calculators and computers, and attendance at in-career development courses.

Teacher Demographics

In 1999, teachers were asked to indicate the range into which their age fell (under 25, 25 to 29 years, etc.), and in 2004, they were asked to indicate the number of years during which they had been teaching. In 1999, just under 17% of pupils were taught by teachers under 30 years of age, while in the current study, 46% of pupils were taught by teachers with fewer than 10 years teaching experience (Table 7.26). Although recognising that the two sets of responses are not directly comparable, it can be inferred that more pupils in Fourth class were taught by younger, less-experienced teachers in 2004, than in 1999.

Table 7.26 *Age Range of Teachers (1999) and Years of Teaching Experience (2004)*

1999			2004		
Age Range	**% of Pupils**	**SE**	**Teaching Experience**	**% of Pupils**	**SE**
Under 25 years	9.7	2.52	1-5 years	32.6	4.73
25-29 years	6.9	2.07	6-10 years	12.9	3.30
30-39 years	30.2	3.97	11-15 years	8.6	2.02
40-49 years	36.2	4.1	16-20 years	14.6	4.51
50-59 years	14.4	2.85	21-25 years	9.7	2.11
60 or more	2.70	2.70	26-30 years	10.0	2.39
			More than 30 years	11.7	3.59

Class Size

Average class size in single-grade Fourth classes was 30.0 pupils in 1999, and 27.3 pupils in 2004. This difference (2.7 pupils) is statistically significant (Table 7.27). Average class size across all classes (including pupils not in Fourth class) was 28.6 in 1999 and 27.2 in 2004. Again, the reduction (1.4 pupils) is statistically significant. The average number of pupils in Fourth class in multi-grade classes and the overall average number of pupils in multi-grade classes did not change to a significant degree between 1999 and 2004. Hence, the overall improvement in class size seems to be limited to a reduction in the size of single-grade classes.

Table 7.27 *Mean Class Sizes of Single- and Multi-grade Classes, 1999 and 2004*

	1999			2004			Diff	SED	95% CI	
	N	Mean	SE	N	Mean	SE				
Single-grade Fourth classes	2485	30.0	0.53	2568	27.3	0.52	-2.7	0.74	**-4.18**	**-1.22**
Fourth Class in Multi-grade Class	2097	13.0	0.66	1603	12.9	0.97	-0.1	1.17	-2.44	2.24
All pupils in Multi-grade class	2097	26.9	0.52	1603	27.0	1.07	0.1	1.19	-2.28	2.48
All pupils – all classes in study	4582	28.6	0.37	4171	27.2	0.52	-1.4	0.64	**-2.67**	**-0.13**

Time Allocated to Teaching Mathematics

In 1999, the average amount of time allocated to teaching mathematics to pupils in Fourth class each week in single-grade classes was 268.2 minutes, while, in multi-grade classes, it was 229.0 (Table 7.28). In 2004, the corresponding average times were 220.7 minutes and 209.3 minutes. Across the two years, there was a significant decline in the amount of time allocated to teaching mathematics, a decline that was larger in single-grade (47.5 minutes) than in multi-grade classes (19.7 minutes).

Table 7.28 *Average Weekly Time (Minutes) Allocated to Teaching Mathematics in Fourth Class, by Class Type, 1999 and 2004*

Class	1999*			2004			Diff	SED	95% CI	
	N	Mean Mins.	SE	N	Mean Mins.	SE				
Single-grade	2463	268.2	3.68	2535	220.7	5.04	-47.5	6.24	**-59.96**	**-35.04**
Multi-grade	2130	229.0	2.56	1543	209.3	8.34	-19.7	8.72	**-37.12**	**-2.28**
All classes	4593	250.0	5.80	4078	216.4	7.43	-33.6	9.43	**-52.4**	**-14.8**

Use of Calculators and Computers

In both 1999 and 2004, teachers were asked if their pupils used a calculator and/or computer in mathematics classes. In 1999, teachers responded by indicating yes or no, while in 2004, they indicated the frequency with which pupils used calculators and computers. If teachers in 2004 indicated that their pupils used calculators/computers at last once or twice a month, their response was interpreted as indicating usage, whereas if they indicated that these tools were 'hardly ever or never' used, their response was interpreted as indicating non-usage.

Not surprisingly, given the introduction of calculators in the 1999 PSMC (implemented from 2001 onwards), calculator usage increased from just under 5% of pupils in 1999 to 67% in 2004 (Table 7.29). The increase, however, hides the fact that, among pupils using calculators in 2004, two-thirds did so no more than once or twice a month (see Table 7.14).

Table 7.29 *Percentages of Pupils Who Used Calculators and Computers in Mathematics Classes, according to their Teachers, 1999 and 2004*

	1999			2004			Diff	SED	95% CI	
	N*	%**	SE	N*	%**	SE				
Calculator	4697	4.7	1.68	4085	66.6	4.04	61.9	4.38	**53.16**	**70.64**
Computer	4693	35.9	3.96	4018	44.3	5.74	8.4	6.97	-5.53	22.33

**Total number of valid cases; **Uses calculator or computer at least once or twice a month*

The percentage of pupils whose teachers indicated that they used a computer in mathematics classes increased from 35.9% in 1999 to 44.3% in 2004. This increase is not statistically significant. On the other hand, there was a statistically significant increases in the percentages of pupils using software that provides practice on mathematics facts/skills, software that tutors mathematics concepts, adventure games that involve mathematics, and Internet resources for learning mathematics (Table 7.30).

Table 7.30 *Percentages of Pupils Who Had Encountered Various Types of Software in Mathematics Classes, 1999 and 2004*

ICT Resource	% 1999	SE 1999	% 2004	SE 2004	Diff	SED	95%CI	
Software for practice on maths facts/skills	34.1	0.72	49.9	5.22	15.8	5.27	**5.28**	**36.32**
Software that tutors maths concepts	28.4	3.61	41.8	5.11	13.4	6.26	**0.91**	**25.89**
Software to engage higher-level thinking	8.3	2.32	7.2	2.24	-1.1	3.2	-7.54	5.34
Software to practice in data handling	27.2	3.52	6.9	4.87	-20.3	6.0	**-32.30**	**-8.30**
Adventure games that involve maths	6.9	1.84	31.6	4.69	24.7	5.04	**14.64**	**34.76**
Internet resources for learning maths	0.5	0.49	16.1	4.47	15.6	4.50	**6.62**	**24.58**

N (1999) = 4713; N (2004) = 4157

Attendance at In-career Development Courses

In 1999, just 16% of pupils were taught by teachers who had attended an in-career development course in the previous five years, while in 2004, 92.2% of pupils were taught by teachers who had attended an in-career development course in mathematics offered by the PCSP or other providers studying the same time period. Furthermore, in 2004, almost 30% of pupils were taught by a teacher who had attended at least one day of in-career development in the previous 12 months – up from 3.3% in 1999. In both 1999 and 2004, teachers of about 10% of pupils did not respond to the item on in-career development in the previous 12 months, suggesting that the figures in Table 7.31 may overestimate attendance at ICD.

Table 7.31 *Percentages of Pupils whose Teachers Had Attended In-career Development in Mathematics in the 5 Years and the 12 Months Prior to the Study, 1999 and 2004*

	1999			2004*		
	N	**% Attending**	**SE**	**N**	**% Attending**	**SE**
In past 5 years	2861	16.4	2.97	2640	93.8	3.37
In past 12 months	3801	3.3	1.09	3753**	29.7	5.00

**Based on attendance at PCSP and/or other courses; **10% of cases were missing*

SUMMARY

In 2004, 77.6% of pupils in Fourth class were taught by female teachers. Almost one-third were taught by teachers with fewer than five years teaching experience.

Average class size across all classes was 27.2 pupils. The average class size for single-grade Fourth classes was 27.3, while, in multi-grade classes, the average was 27.0 pupils.

Almost 8% of pupils were taught by teachers who had not attended ICD in mathematics offered by the PCSP in the five years prior to the study, and almost three-quarters by teachers who had not attended a PCSP course in mathematics in the 12 months prior to the study. The majority of pupils were taught by teachers who were very satisfied or satisfied with the amount and quality of PCSP ICD relating to the PCSP. Teachers did, however, identify specific content strands and skills in the revised curriculum which, they felt, had not been addressed adequately. These included Shape & Space (29% indicated that 'too little' ICD had been provided), Implementing (26%), Reasoning (37%), Applying & Problem-Solving (38%), and Communicating & Expressing (39%). Teachers identified several additional topics about which they wished to learn more, including classroom-based assessment of mathematics, the identification of learning difficulties, the interpretation of standardised test scores, the use of ICT for teaching mathematics, and approaches to grouping pupils.

Teachers in single-grade Fourth classes allocated 220.7 minutes per week to teaching mathematics, while teachers in multi-grade classes allocated an average of 209 minutes mathematics in Fourth class. Both times are in excess of the recommended 180 minutes in the Introduction to the Primary School Curriculum (DES/NCCA, 1999a), though teachers can supplement this with discretionary time (by two hours per week).

Eighty-seven percent of pupils were taught by teachers who said that they developed short-term schemes for teaching mathematics, on a weekly or fortnightly basis. Over 60% were taught by teachers who engaged in long-term planning on either a monthly or term-by-term basis, while a further one-third were taught by teachers who prepared long-terms plans on an annual basis. Teachers said that they used published mathematics schemes more often than other sources, including the Primary

School Mathematics Curriculum, as their main source of information in planning mathematics lessons.

The tools that teachers used most often to assess mathematics were standardised tests (typically administered once a year), teacher-made tests, and progress tests accompanying mathematics textbooks. Almost 90% of pupils were in mathematics classes in which diagnostic tests of mathematics were never used.

The majority of pupils were taught by teachers who indicated at least some familiarity with the DES *Learning Support Guidelines* as they relate to mathematics. Where learning support and/or resource teaching in mathematics was provided, 85% of pupils were in classes whose teachers indicated at least 'some' integration between class and support programmes in mathematics.

In general, teachers expressed satisfaction with the learning climate for mathematics in their school. Ninety-five percent of pupils were taught by teachers who 'strongly agreed' or 'agreed' that there was a positive attitude in the school towards the 1999 Primary School Mathematics Curriculum, while almost 90% were taught by teachers who indicated the same levels of agreement with the view that their school had a clear set of goals and priorities for teaching mathematics. On the other hand, one-quarter of pupils attended schools where the teachers 'disagreed' or 'strongly disagreed' that the school had a clear set of goals and priorities for staff development.

Teachers' comments about the implementation of the 1999 Primary School Mathematics Curriculum covered a variety of topics, including satisfaction with the curriculum, the effect of large class sizes on implementation, lack of teaching resources, insufficient time for teaching mathematics, and difficulty with curriculum implementation in multi-grade classes.

A comparison between the responses of teachers to questions on the Teacher Questionnaire in the 1999 and 2004 surveys indicated a significant decline in class size since 1999 in single-grade Fourth classes, and a reduction in the number of minutes per week allocated to teaching mathematics in Fourth class in both single- and multi-grade classes. The percentage of pupils using calculators increased significantly between 1999 and 2004, though, in 2004, of pupils who used calculators, two-thirds did so no more than once or twice a month. Overall use of computers in mathematics classes did not increase to a significant degree between 1999 and 2004. However, more pupils in 2004 had worked with software designed to provide practice on mathematics facts/skills, software designed to tutor mathematics concepts, and Internet resources for learning mathematics. The proportions of pupils whose teachers had attended in-career development in the five years prior to the survey, and in the 12 months prior to the survey, increased significantly between 1999 and 2004.

8. School Variables and Mathematics Achievement

School-level variables relevant to performance in mathematics considered in this chapter are school structure and related characteristics, including size, gender composition, socioeconomic status and attendance; the provision by schools of learning support and resource teaching to pupils with learning difficulties; issues identified by principal teachers as affecting the teaching of mathematics; home-school links; and aspects of curriculum implementation. Comments of principal teachers about teaching and learning mathematics are also considered.

While most variables are derived from the School Questionnaire (e.g., geographic location) or from the DES database of primary schools (e.g., gender composition, disadvantaged status), a few (such as mean school-level socioeconomic status) are derived from pupil-level data, by taking an average value for all pupils in Fourth class in the school and assigning that value to all pupils. Unless otherwise specified, analyses are based on 4171 pupils.

SCHOOL STRUCTURE AND COMPOSITION

School Size

As reported in Chapter 3, all schools on the primary school database were stratified according to whether they were large (defined as 35 or more pupils in Fifth class), medium (21-34 pupils), or small (fewer than 21 pupils)[1]. The measure of school size in this chapter employs the same parameters. The mean achievement scores of pupils attending small, medium, and large schools are presented in Table 8.1 (see e-appendix E8.1 for missing values).

Table 8.1 *Mean Mathematics Achievement Scores, by School Size*

	N	Score	SE	Diff with Large	SED	95%CI	
Large	1510	248.8	2.78	-	-	-	-
Medium	1059	251.9	4.25	3.04	5.14	-13.30	7.22
Small	1602	251.7	4.88	2.73	5.61	-8.38	13.83

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Pupils attending medium and small schools achieved mean scores that were about three points higher than the mean score of pupils attending large schools (Table 8.1). However, these differences are not statistically significant.

[1] School size was based on the number of pupils in Fifth Class since this was used as a stratifying variable in sampling schools.

Size of Community Served

Principals were asked to indicate whether their school was located in the city/suburbs of Dublin, Cork, Galway, Limerick, or Waterford (referred to as a city); a town with a population greater than 10,000 (a large town); a town with a population between 1,500 and 10,000 (a small town); or a rural area (fewer than 1500 people). Pupils attending schools which served rural areas achieved a significantly higher mean achievement score (by 15.3 points) than pupils attending schools located in cities. The mean scores of pupils attending schools in large and small towns, although higher than the mean of pupils attending schools in cities, are not statistically significantly different from that of cities (Table 8.2; missing values can be found in e-appendix E8.2).

Table 8.2 *Mean Mathematics Achievement Scores, by Size of Community in which the School was Located*

	N	Score	SE	Diff with City	SED	95%CI	
City	1531	242.6	3.94	-	-	-	-
Large town	584	253.9	5.23	11.37	6.53	-24.42	1.68
Small town	542	251.8	3.59	9.21	5.320	-19.80	1.39
Rural area	1514	257.9	3.49	15.34	5.17	**-25.67**	**-5.01**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Gender Composition

Using information from the DES schools database, schools were categorised on the basis of whether their enrolment was all-boys, all-girls, or mixed. The mean mathematics score of pupils attending all-boys schools, although marginally higher, was not significantly different from that of pupils attending all-girls or mixed schools (Table 8.3; additional information on gender composition of schools can be found in e-appendix E8.3).

Table 8.3 *Mean Mathematics Achievement Scores, by Gender Composition of School*

	N	Score	SE	Diff with Mixed	SED	95%CI	
All Boys	663	252.1	5.85	1.29	6.52	-14.30	11.72
All Girls	542	248.8	4.30	2.08	5.46	-8.82	12.98
Mixed	2966	250.8	3.04	-	-	-	-

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Languages Spoken in Schools

The vast majority of pupils (95.7%) attended schools in which the main language of instruction was English, while 4.3% attended schools in which the main language was Irish. Just over 4 out of 5 pupils (81.2%) attended schools where fewer than 5%

spoke a language (mother tongue) other than the language of instruction, and only 2% attended schools where 40% or more of pupils spoke a first language other than English or Irish (see e-appendices E8.4 and E8.5 for full breakdown). There was no statistical association between the percentage of pupils in a school who spoke a first language other than English or Irish and mathematics achievement.

Designated Disadvantaged Status

Almost 14% of pupils attended schools designated as disadvantaged. The mean achievement score of pupils in these schools was 36 points lower than the mean score of pupils in non-designated schools (Table 8.4).

Table 8.4 *Mean Mathematics Achievement Scores, by School Designated Disadvantaged Status*

	N	Mean	SE	Difference	SED	95%CI	
Designated	569	219.73	5.89	35.94	6.47	**-48.86**	**-23.0**
Not Designated	3602	255.67	2.35				

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

A quarter (25.6%) of pupils attending designated schools scored at or below the 10th percentile (Table 8.5). The corresponding estimate for pupils attending schools that were not designated was 7.6%. Just 5.2% of pupils attending designated schools achieved a score that was at or above the 90th percentile, compared to 10.7% for non-designated schools.

Table 8.5 *Percentages of Pupils with Very Low and Very High Achievement in Mathematics, by School Designated Disadvantaged Status*

Percentile	Designated		Non-designated		Total	
	%	SE	%	SE	%	SE
At/Below 10th	25.6	3.11	7.6	.86	10.1	.93
At/Above 90th	5.2	2.45	10.7	1.16	10.0	1.06

A similar picture emerges when the percentage of pupils achieving at each proficiency level in designated and non-designated schools is considered (Table 8.6). A significantly higher percentage of pupils in designated (35.4%) than in non-designated schools (11.6%) achieved at proficiency Level 1 or below. Conversely, significantly lower percentages of pupils in designated schools achieved Levels 3 (18.6%) and 4 (11.4%) than pupils in non-designated schools (27.2% and 28% respectively).

Table 8.6 *Percentage of Pupils Performing at Each Proficiency Level, by School Designated Disadvantage Status*

Level	Designated	N	%	SE	Diff	SED	95%CI	
5	Yes	39	6.9	3.02	5.6	3.25	-0.89	12.09
	No	449	12.5	1.20				
4	Yes	65	11.4	1.97	16.6	2.56	**11.49**	**21.71**
	No	1008	28.0	1.63				
3	Yes	105	18.6	2.18	8.6	2.63	**3.35**	**13.85**
	No	982	27.2	1.47				
2	Yes	157	27.8	4.15	-7.0	4.44	-15.86	1.86
	No	749	20.8	1.57				
1	Yes	156	27.6	2.83	-17.7	3.02	**-23.72**	**-11.68**
	No	356	9.9	1.04				
<1	Yes	44	7.8	2.05	-6.1	2.13	**-10.35**	**-1.85**
	No	63	1.7	0.57				

Note: Level 5 = Most advanced; Level 1= Minimum level; Level 0 = Mathematics knowledge not assessed by this test

Book Grant Scheme

Principals were asked to specify the number the pupils in each class who were included in the 'School Books for Needy Pupils' scheme. The total mean percentage of pupils in Fourth class in the scheme was 26.6, and the total percentage for all classes in the school was 30.4. Based on whole school data, the percentage of pupils included in the book grant scheme was considerably higher in designated (75.4%, SE = 4.89) than in non-designated schools (22.5%, SE = 2.23), a difference that is statistically significant at the .05 level (SED = 5.41, 95%CI = 42.10 to 63.72). Additional information, including missing values, can be found in e-appendix Tables E8.7 and E8.8.

Almost 85% of pupils in designated disadvantaged schools attended schools where more than half of pupils were participating in the book grant scheme, compared to 12.4% of pupils in non-designated schools (Table 8.7). Disregarding cells with small sample sizes (e.g., <3.2%), an increase in the percentage of pupils in the book grant scheme in either school type was associated with a lower mean mathematics achievement score. This was corroborated by a moderate negative correlation between the percentage of pupils in the scheme in a school and mean mathematics achievement ($r = -.25$, $t = 4.92$, $p < .01$).

Table 8.7 *Mean Achievement Scores of Pupils in Receipt of Book Grant, by School Designated Disadvantage Status*

% on Grant	Designated*			Non-designated**			Total***		
	%	Mean	SE	%	Mean	SE	%	Mean	SE
0-24	3.2	204.5	13.54	55.9	258.6	1.14	47.1	258.0	2.90
25-49	12.7	264.0	6.37	31.7	247.6	1.54	28.5	248.9	3.64
50-74	16.3	220.0	4.67	9.9	244.7	2.63	11.0	238.6	7.26
75-100	67.9	212.1	2.59	2.5	282.6	5.78	13.5	222.9	10.88

** N = 569; ** N = 2820; *** N = 3389*

Socioeconomic Status

A measure of school-level socioeconomic status was computed by obtaining the mean SES score for each school, using the highest ISEI score (described in Chapter 5) for either parent. Each pupil was categorised as attending a high, medium, or low SES school, depending on whether the mean SES score for the pupil's school was below the 33rd percentile on the distribution of school-level SES scores (<44.1), between the 33rd and 67th percentiles (44.1 to 50.1), or above the 67th percentile (>50.1). Pupils in high-SES schools had a mean achievement score (262.7) that is significantly higher than the mean scores of pupils in medium-SES (251.1) and in low-SES schools (238.9) (Table 8.8). The correlation between school-level socioeconomic status and mean achievement scores is also significant and positive ($r = .23$, $t = 4.79$, $p < .01$).

Table 8.8 *Mean Mathematics Achievement Scores, by School-level SES*

School SES	%	Mean	SE	Diff from High	SED	95%CI	
High SES	33.0	262.7	2.41	-	-	-	-
Medium SES	33.7	251.1	3.15	11.58	3.91	**3.77**	**19.39**
Low SES	33.3	238.6	4.67	24.15	5.19	**13.79**	**34.50**

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference*

Attendance

Attendance data were ascertained by aggregating mean rates of individual pupils in Fourth class, as provided by their teachers, to give a mean school-level attendance figure. The mean school-level attendance rate was 94.97% (SE = .20).

Three attendance categories were created by dividing the distribution of school attendance values at the 33rd and 67th percentile. Students were then classified according to whether the attendance level for their school was low, medium or high (using the cut-points at these percentile ranks). The lower category included attendance rates of 94% or lower, the medium category between 94.1% and 95.5%, and the higher category, attendance rates higher than 95.6%.

Table 8.9 *Mean Mathematics Achievement Scores, by Attendance Category of School*

Attendance	%	Score	SE	Diff with Higher	SED	95%CI	
Lower	32.3	242.6	4.42	15.70	5.65	**4.41**	**26.99**
Medium	28.6	250.0	4.77	8.32	5.70	-3.06	19.71
Higher	39.1	258.3	3.28	-	-	-	-

*Significant differences in **bold**; SE = Standard Error; SED = Standard Error of the Difference; n = 4117*

Pupils attending schools that had a higher rate of attendance had a significantly higher mean achievement score (258.3) than pupils attending schools that had a lower mean attendance rate (242.6) (Table 8.9). The correlation between mathematics scores and school-level attendance is weak and non-significant ($r = .16$, $t = 1.88$, $p > .05$).

PROVISION OF LEARNING SUPPORT AND RESOURCE TEACHING IN MATHEMATICS

Information on the provision of learning support and resource teaching at school-level is presented in this section. Additional information relating to learning support is provided in Chapter 9.

Learning Support and Resource Teaching

The percentages of pupils who needed and received learning support and resource teaching in mathematics are presented in Table 8.10. Based on the figures provided by principal teachers, a significantly higher percentage of pupils in designated (23.4%) than in non-designated (14.39%) schools were judged to require learning support (difference = 9.1%; SED = 3.792; 95%CI = 1.51 to 16.65). Despite the greater need in designated schools, the percentages of pupils in receipt in each school type were broadly similar (6.6% and 6.8% respectively). The total mean percentage of pupils in receipt of learning support across school types indicates that fewer than half of pupils who were considered to be in need of additional support in mathematics were actually receiving it.

Table 8.10 *Percentages of Pupils in Need and in Receipt of Learning Support or Resource Teaching for Mathematics, by School Designated Disadvantaged Status (All Class Levels Combined)*

	Designated *		Non-Designated**		Total***	
	Mean %	SE	Mean %	SE	Mean %	SE
Learning Support						
Need LS	23.4	3.55	14.3	1.03	15.6	.95
Receiving LS	6.6	3.60	6.8	.99	6.8	.91
Resource Teaching						
Need RT because of learning disability	18.7	6.43	8.5	2.02	9.8	1.99
Receiving RT	7.5	2.11	5.3	1.70	5.6	1.50

** N = 569; ** N = 3062; *** N = 4171*

The total mean percentage of pupils perceived to be in need of resource teaching for mathematics (across all class levels) because of a diagnosed learning disability in mathematics was 9.8% (SE = 1.99), while the percentage who received it was 5.6% (SE = 1.50). The difference between designated and non-designated schools for either of these values is not significant.

Principals also provided information on the total number of pupils in ordinary classes in receipt of learning support for mathematics (Junior and Senior infants, First and Second, Third and Fourth, and Fifth and Sixth classes). The lowest levels of support were provided to pupils in Junior and Senior infant classes and the highest at the upper end of the school (Third to Sixth class), though even at these class levels more than 6 in 10 pupils attended schools in which no learning support in mathematics was provided. Almost all pupils (96.1%) attended schools in which no-one from Junior or Senior infants received learning support, and almost three-quarters attended schools in which no pupils in First and Second classes received support (Table 8.11; additional information, including mean values and missingness, can be found in e-appendices E8.9 and E8.10).

Table 8.11 *Percentages of Pupils Attending Schools with Varying Levels of Learning Support Provision for Mathematics, by Grade-Level*

		None	1– 5%	6– 10%	11–15%	16–20%	+20%	n
Junior/ Senior Infants	%	96.1	2.8	1.1	0	0	0	3853
	SE	1.59	1.40	0.75				
First/ Second Class	%	74.7	10.5	5.5	7.6	1.7	0	3742
	SE	4.11	2.88	2.09	3.20	1.05		
Third/ Fourth Class	%	62.9	17.8	11.0	2.9	3.6	1.8	3760
	SE	5.08	3.51	3.20	1.40	1.70	1.54	
Fifth/ Sixth Class	%	68.7	16.1	7.5	6.9	0.4	0.4	3534
	SE	4.31	3.54	2.69	2.72	0.29	0.43	

ISSUES AFFECTING THE TEACHING OF MATHEMATICS IN SCHOOLS

Difficulties encountered by school principals in providing for the teaching and learning of mathematics in schools are considered in this section.

Prioritisation of Issues

Principal teachers were presented with a list of 21 problems that might affect the teaching of mathematics in their school, and were asked to indicate the extent of each one using a 3-point scale (‘3’ a serious problem; ‘2’ a problem; ‘1’ no problem). A mean score was computed for each problem and 21 items were rank ordered by this score. The top 5 (most problematic) and the bottom 5 (least problematic) issues identified are presented in Table 8.12.

Most principals (61%) identified a shortage of learning support teachers for mathematics as a serious impediment to effective mathematics teaching. Other issues identified included large classes (34%), a shortage of substitute teachers (25%), inadequate classroom accommodation (19%), and multi-grade classes (18%).

Table 8.12 *Mean Scores on Scales Measuring Problems Identified by School Principals as Affecting Teaching of Mathematics in Schools*

Problem	Mean	SE	%	SE
Most Serious Issues				
Shortage of LS teaching time for mathematics	2.51	.05	61.02	3.57
Large classes	2.12	.09	34.30	5.24
Shortage of substitute teachers	1.99	.08	24.56	5.16
Inadequate classroom accommodation	1.68	.08	18.77	3.80
Multi-grade class arrangements	1.66	.08	18.13	4.66
Least Serious Issues				
Shortage of calculators	1.14	.04	84.24	4.31
Availability of appropriate textbooks	1.19	.05	82.43	3.97
High teacher turnover	1.2	.06	82.08	4.38
Difficulty in implementing 1999 Primary Curriculum	1.32	.07	67.97	5.52
Inadequate teacher in-career development	1.39	.05	61.91	4.40

Calculator availability, implementation of the 1999 PSMC, and the provision of in-career development were not regarded as serious problems. The issues identified as problematic by principals of designated and non-designated schools were broadly similar. While principal teachers in both types of school identified learning support and class size among their most serious problems, pupils' lack of interest was also identified in disadvantaged schools (see e-appendix E8.12).

To consider potential differences between designated and non-designated schools further, a factor analysis was conducted of all 21 items. Using Varimax rotation, identifying Eigen values greater than 1, and suppressing factor loadings lower than .04, four main factors were discernible (see e-appendix E8.13). The factors were labelled 'Pupil/parent disinterest' (with higher scores denoting greater lack of interest), 'Learning resources' (referring to the availability of maths equipment and software), 'Staff development' (which included variables relating to inadequate teacher training or support), and 'Staffing and Accommodation' (referring to shortage of teachers/substitute teachers, and classroom accommodation). Each had a mean of zero and a standard deviation of one.

Significant differences between the mean scores of designated and non-designated schools were found for two factors. Levels of pupil and parental disinterest are significantly higher in designated than in non-designated schools, while 'Problems with Staffing and Accommodation' are significantly lower in designated than in non-designated schools (Table 8.13).

Table 8.13 *Standardised Mean Scores for School Resources, by School Designated Disadvantaged Status*

	Designated	Mean	SE	Diff with 'Designated'	SED	95%CI	
Pupil/Parent Disinterest	Yes	1.31	.41	-1.59	.44	**.71**	**2.46**
	No	-.28	.11				
Availability of Learning Resources	Yes	.44	.28	-.55	.30	-.05	1.14
	No	-.10	.11				
Difficulty with Staff Training	Yes	-.18	.36	.19	.38	-.96	.58
	No	.01	.10				
Problems with Staffing & Accommodation	Yes	.01	.16	.49	.21	**-.90**	**-.07**
	No	.50	.15				

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*
N 'Designated' = 569; N 'Non-Designated' = 3602

HOME-SCHOOL LINKS

Parental Support

Principals were asked if their school had a programme to support parents in helping their children with mathematics at home. Only 20% of pupils attended schools which had such a programme. Designated disadvantaged schools were more likely to offer such a programme (Table 8.14; missing values in e-appendix E8.14).

Table 8.14 *Percentages of Pupils Attending Schools with/without Parent Support Programmes for Mathematics, by School Designated Disadvantaged Status*

	N	Parent Programme		No Parent Programme	
		%	SE	%	SE
Designated	777	7.4	2.80	5.2	1.80
Non-Designated	3103	12.6	3.68	74.8	4.70
All schools	3880	20.0	4.64	80.0	4.64

The mean achievement scores of pupils who attended schools which had, and did not have, a programme to support parents in helping their children with maths at home did not differ significantly.

Principals were presented with four types of programme and asked to identify any which applied to their school. The most common type was a class for parents on methods taught in the school, and the least common a basic maths skills programme for parents (Table 8.15; missing values in e-appendix E8.15).

Table 8.15 *Percentages of Schools Offering Various Parent Programmes for Mathematics, and Pupils' Mean Mathematics Achievement Scores*

	N	Yes			No		
		%	Score	SE	%	Score	SE
Class for parents on methods taught	4102	12.0	241.5	8.15	88.0	252.2	2.54
Presentation on the maths curriculum	4102	8.7	252.6	6.34	91.3	250.8	6.34
Promotion of paired/shared mathematics	4102	5.6	241.4	16.7	94.4	251.5	2.32
Basic skills maths programme for parents	4102	3.6	211.7	-	96.4	252.4	2.41

Parents' Associations

Over 84% of pupils attended schools that had a parents' association, and almost one-third attended schools in which teachers attended such meetings in their capacity as teachers. Significant differences in the mean mathematics achievement scores of pupils are not associated with attendance at a school with an active parents' association (SED = 7.0, 95%CI = –8.04 to 19.97), or with teacher attendance at Parent Association meetings (SED = 4.4, 95%CI = –8.53 to 9.04) (Table 8.16; missing values in e-appendix E8.16).

Table 8.16 *Percentages of Pupils Attending Schools with a Parents' Association, Attendance of Teachers at Meetings, and Pupils' Mean Mathematics Achievement Scores*

	N	%	Mean Score	SE
Does the school have a Parents' Association?				
Yes	3463	84.4	251.9	2.44
No	639	15.6	245.9	6.92
Do teachers attend in their capacity as teachers?				
Yes	1301	32.7	251.5	3.45
No	2683	67.3	251.3	3.31

The most common activity organised by parents' associations was fundraising for literacy materials for schools, followed by book fairs. Activities relating to mathematics appeared to receive less attention, from both parents' associations and school staff. The most common activities organised by school staff were book fairs and visits from authors, with maths-related activities receiving considerably less emphasis (Table 8.17; see Tables E8.17 and E8.18 in the e-appendix for standard errors and missing values respectively). In schools in which there was a parents' association, 81.9% (SE = 4.1) of parents had attended a meeting of the association in the year in which the survey was carried out, though the correlation between attendance at such meetings and mathematics achievement is not significant.

Table 8.17 *Percentages of Pupils in Schools in which Various Activities Were Organised by Parents' Association or School Staff to Promote Learning*

	N	Parent's Association %	School Staff %
Book fairs	3984	25.3	63.7
Fundraising for literacy materials for school	3984	58.7	34.4
Fundraising for maths equipment for school	3984	15.3	21.4
School visits by authors	3984	6.96	64.5
Other activities related to literacy	3984	7.51	52.9
Other activities related to maths	3984	4.3	26.0

CURRICULUM IMPLEMENTATION

Implementation

The general positive attitude of principal teachers to the 1999 PSMC is evident in their responses to a number of general statements about the curriculum (Table 8.18).

Table 8.18 *Teachers' Mean Levels of Agreement with Statements Relating to the 1999 PSMC*

Statement	Mean	SE
Teachers are receptive towards the curriculum	3.44	.06
Has resulted in pupils engaging in more frequent practical maths activities	3.28	.07
The curriculum has been implemented successfully	3.13	.05
The use of calculators is an important component of the curriculum	3.08	.06
The curriculum has increased pupils' motivation to learn maths	3.03	.06
The curriculum has increased the development of problem solving skills	2.90	.06
The curriculum has improved pupils' mathematics achievement	2.80	.06
The use of calculators in 4th to 6th class has improved problem solving	2.80	.07

4 = Strongly Agree; 3 = Agree; 2 = Disagree; 1 = Strongly Disagree

The lowest mean level of agreement was 2.8 (where 3 indicates 'agree' and 2 'disagree') indicating that, on average, pupils attended schools where there was at least some agreement with most of the statements. The strongest level of agreement was evident for the statement that teachers are receptive to the mathematics curriculum, and for the belief that the mathematics curriculum has resulted in a more practical emphasis in teaching. Statements for which there was least agreement concerned the impact of the curriculum on pupils' problem solving skills and mathematics achievement, and the role of calculators in improving pupils' problem solving (a full breakdown is available in e-appendix E8.19).

School Planning

The great majority (94.4%) of pupils attended schools that had plans which included written statements based on the 1999 Primary School Curriculum in relation to the teaching of mathematics. Designated and non-designated schools did not differ significantly in this regard (see e-appendix E8.20).

Principals were presented with a list of 15 statements relating to mathematics and were asked whether each was included in their School Development Plan. The frequency of inclusion of each is presented in Table 8.19 (the mean mathematics achievement scores of pupils in schools where the statement is and is not included can be found in e-appendix E8.21).

Table 8.19 *Percentages of Pupils Attending Schools that Included Various Statements in the School Development Plan Relating to Mathematics*

Statement	N	Included (%)	Not Included (%)
Assessment of pupils' achievement	4049	97.1	2.9
Maintaining records on achievement	4073	91.7	8.3
Engaging pupils in practical maths activities	3994	90.9	9.1
Common terminology for teaching	4031	90.3	9.7
Inventory of equipment/materials	4008	90.2	9.8
Methodology for teaching across classes	4008	88.7	11.3
Communicating progress to parents	4073	86.6	13.4
Procurement of equipment/materials	3996	85.5	14.5
Organisation of teaching	3977	78.3	21.7
Strategies for teaching problem solving	4011	78.1	21.9
Provision for pupils with learning difficulties	3865	71.8	28.2
Distribution of material across classes	4008	66.6	33.4
Tracking system for locating equipment	3892	60.7	39.3
Replacement of defective equipment	3941	45.2	54.8
Provision for advanced pupils in maths	3889	43.6	56.4

While the majority of pupils attended schools that included in their plan provision for tasks such as the assessment (97.1%) and maintenance of pupils' achievement records (91.7%), fewer attended schools where the plans included statements relating to the organisation of teaching (78.3%) or the teaching of problem-solving strategies (78.1%). Fewer pupils still attended schools that had explicit statements about provision for pupils with learning difficulties in mathematics (71.8%), though this figure was still considerably higher than that for providing for enrichment activities for more advanced pupils (43.6%).

Staff Meetings

In response to a question which asked how many hours had been spent at staff meetings since the beginning of the school year, principals indicated that, on average, the time was 8.53 hours (SE = 0.47). The mean for designated disadvantaged schools

(11.2 hours; SE = 1.05) is significantly greater than the mean for non-designated schools (8.1 hours; SE = 0.52) (SED = 54.87, 95%CI = -105.57 to -4.18).

Information was obtained from principal teachers about the content of staff meetings, including the amount of time spent discussing the teaching and assessment of English and mathematics. Similar amounts of time were spent discussing the assessment of English and mathematics. However, marginally more time was spent discussing the teaching of English than the teaching of mathematics (Table 8.20).

Table 8.20 *Mean Percentages of Time Spent Discussing Aspects of English and Mathematics at School Staff Meetings*

Aspect	% of Time	SE
Teaching English	12.7	1.08
Teaching Mathematics	10.9	0.88
Assessing English	7.1	0.69
Assessing Mathematics	7.1	0.72
All Other Topics	58.4	3.03

Assessment of Mathematics

Questions to principals regarding the practice of schools with respect to standardised testing of mathematics revealed that a large majority (89.2%; SE = 3.69) of pupils attended schools that administered standardised tests once a year, while 3.4% (SE = 2.54) attended schools that administered them twice a year, 4.1% (SE = 1.62) attended schools that administered them once every two years, and 3.4% (SE = 2.27) attended schools that never administered standardised tests (N = 4088). The frequency of using standardised tests was not associated with pupils' mean achievement.

Pupils at all grade levels sat standardised maths tests at least once a year. In general, more pupils in Third to Fifth classes were tested once a year (approximately 90% for each) than pupils in Senior Infants (13%), First class (68%), or Sixth class (72%) (see e-appendices E8.22 and E8.23 for missing values and standard errors).

Many more pupils attended schools in which progress tests (such as the mastery tests accompanying some mathematics schemes) were administered on a more regular basis. While 3.4% (SE = 2.54) of pupils attended schools that administered standardised tests twice a year, the equivalent value for progress tests was 14.6% (SE = 3.26). Almost two-thirds of pupils (64.3%; SE = 5.13) attended schools in which progress tests were administered more often than this.

COMMENTS FROM PRINCIPALS

Comments relating to the teaching or assessment of mathematics were provided by 41 of the 136 principal teachers who completed the School Questionnaire. Altogether, 60 separate comments were classified under seven main headings: positive aspects of the mathematics curriculum (15%), negative aspects of the mathematics curriculum

(13.3%), teaching resources (18.3%), learning support issues (18.3%), standardised testing (6.7%), calculator usage (5%), and other issues (23.4%).

Positive Aspects of the Mathematics Curriculum

Comments reflected a general level of satisfaction with the implementation of the mathematics curriculum. The clearly delineated strands were identified as useful tools for planning lessons, and school curriculum statements were considered beneficial for teaching. The reduction of content in the curriculum was perceived by several school principals to be advantageous in developing an understanding of the strands and skills, and in allowing teachers and pupils to deviate from the repeat practice approach. This facilitated greater opportunities for group work and hands-on learning, providing more enjoyment and greater practical experience of mathematics, particularly for weaker students.

Negative Aspects of the Mathematics Curriculum

While the current curriculum was believed to be more favourable than its predecessor to weaker students, a perceived decrease in difficulty level was thought to result in fewer challenges for average and above average pupils. This concern was shared by several principals, who thought that less demanding mathematics and the introduction of more concrete materials in senior classes reflected a ‘dumbing-down’ of the curriculum.

Teaching Resources

The lack of revised textbooks, particularly in Irish, was regarded by several principals as inhibiting implementation of the revised curriculum in mathematics. Inadequate provision of physical resources and a requirement to share mathematics equipment were also identified as barriers to learning. Greater access to materials and smaller class sizes were seen as important in facilitating more concrete activities and better understanding of the concepts and practical uses of mathematics. These difficulties were perceived to be further compounded by multi-grade class arrangements, which were seen as adding to principal teachers’ frustration and workload.

Learning Support Issues

Concerns over the provision of time, resources, and teachers for learning support for mathematics were expressed by several principals, all of whom believed current arrangements to be inadequate (especially when compared with those for learning support in English). Greater co-ordination between class teachers and learning support teachers, and the subsequent development of joint strategies, were seen as deserving more attention, as was a need for greater flexibility in applying criteria for accessing learning support.

Standardised Testing

In the view of principals, provision for learning support could be improved by updating current standardised and diagnostic measures. The current cut-off point

($\leq$10th percentile score) on standardised measures such as the DPMT or SIGMA-T was considered too low.

Calculator Usage

A small number of comments expressed scepticism about calculators. While some principals said that calculators had been beneficial to weaker students, there was concern that they had induced laziness in more able pupils. The general consensus was that calculator use should be monitored to prevent over-reliance on calculators.

Other issues

One-sixth of principals' expressed the view that it was still too early to comment on the current mathematics curriculum, and that more time would be required before any firm conclusions about its effectiveness could be drawn. Other issues raised included the relationship between lack of parental support and lower pupil interest in mathematics, areas of the curriculum that were being neglected due to the large volume of work, and the possible impact of the curriculum on post-primary mathematics.

COMPARISON WITH THE 1999 STUDY

A comparison of the performance of pupils in schools designated as disadvantaged shows that although there was a decline in mean performance between 1999 and 2004, the difference is not statistically significant (Diff = -8.1, SED = 7.69; 95%CI = -23.45 to 7.25; full table available in e-appendix E8.24). Again, although scores were lower in 2004 than in 1999 at each percentile rank (see e-appendix E8.25 for table), none of the differences are statistically significant.

Some issues considered to be very serious by principals in 1999 were regarded as less serious in 2004 (teacher in-career development, problems with equipment and materials, and multi-grade classroom arrangements). Similarities between comments expressed in 1999 and 2004 include concern about inadequate learning support provision, dissatisfaction with the relevance of the curriculum, and a desire for greater emphasis on more practical activities and group work in mathematics lessons.

SUMMARY

Pupils attending schools in rural areas had a significantly higher mean mathematics achievement score than pupils attending schools in cities.

Pupils who attended schools designated as disadvantaged achieved a significantly lower mean achievement score than pupils in non-designated schools, were over-represented at and below the 10th percentile, and under-represented at and above the 90th percentile.

The percentage of pupils in designated and non-designated schools who were receiving learning support in mathematics did not differ significantly, though significantly more pupils in designated schools were judged to be in need of learning support.

A shortage of learning support teaching time and large class sizes were identified as the two most problematic issues encountered by principal teachers in delivering effective mathematics teaching. Lack of provision for learning support and inadequate teaching resources and intervention strategies for pupils with learning difficulties were also raised as matters of particular concern. Although school development plans were available in most schools, many plans did not address provision for pupils with learning difficulties in mathematics or enrichment programmes for advanced pupils. Comments from principal teachers suggest a general satisfaction with the implementation of the mathematics curriculum, but a concern that it fails to challenge high-achieving pupils.

Comparison with the 1999 study shows many similarities as well as improvements in some areas. In 2004, fewer principals expressed concerns about teacher in-career development or multi-grade class arrangements.

9. Learning Support for Mathematics

In this chapter, issues relating to learning support for mathematics are considered: provision of learning support in schools; background information on learning support teachers; the work of learning support teachers; the teachers' perceptions of learning support provision in schools, and their comments. Comparisons are made with the 1999 study. With the exception of the first section (provision of learning support), data in the chapter are unweighted (hence no standard errors are reported), and are not directly linked to mathematics achievement. Data for the chapter are based on responses to the School and Learning Support Teacher Questionnaires and to the Pupil Rating Forms.

Some items in the Learning Support Teacher Questionnaire related to the provision of learning support in general, while others related specifically to English or mathematics. Of the 172 respondents who completed the questionnaire, 35.8% provided learning support for English only, 2.9% provided learning support for Mathematics only, and 61.6% provided learning support for both mathematics and English. Unless otherwise stated, analyses in this chapter were conducted using information from respondents who provided learning support for mathematics (n=111, representing 73 schools).

PROVISION OF LEARNING SUPPORT FOR MATHEMATICS

Based on responses to the School Questionnaire, just over half (50.6%) of pupils attended schools in which learning support was provided for mathematics. Provision was more extensive in large schools than in small schools. Almost two-thirds of pupils who attended large schools (64.3%) had access to learning support for mathematics, compared to 37.6% in small schools. The percentage of pupils attending schools in which learning support for mathematics was provided was almost twice as large in non-designated (54.2%) as in designated disadvantaged (26.0%) schools (Table 9.1).

Table 9.1 *Numbers and Percentages of Pupils Attending Schools in which Learning Support for Mathematics Was Provided, by School Size and Designated Disadvantaged Status (All Class Levels Combined)*

School Size/Status	Provides LS		
	N	%	SE
Large	926	64.3	6.50
Medium	508	50.7	7.22
Small	575	37.6	7.41
Designated	133	26.0	9.53
Non-Designated	1877	54.2	5.01
Total	2010	50.6	4.3

On the basis of data provided by teachers on the Pupil Rating Form, it was estimated that 14.4% (SE = 1.06) of pupils in Fourth class were in need of learning support, 6.5% (SE = .89) were receiving it, and 2.9% (SE = .61) had received it in the past but were not receiving it at the time of the study. A very small percentage (0.3%) of pupils had discontinued learning support in mathematics but still needed it, while 2.6% of pupils had discontinued and were no longer considered to be in need (Table 9.2).

Table 9.2 *Percentage of Pupils in Receipt of Learning Support for Mathematics, and Percentage Discontinued, by Need (Fourth Class)*

		In Receipt of LS				LS Discontinued			
		Yes		No		Yes		No	
		N	%	N	%	N	%	N	%
In Need of LS	Yes	272	6.5	328	7.9	14	0.3	585	14.0
	No	0	0	3566	85.6	107	2.6	3459	83.0

Pupils who were in need, and in receipt, of learning support achieved a mean score of 186.6. Pupils who were perceived to be in need, but not in receipt of learning support achieved a mean score of 199.0. Both scores are significantly lower than the mean score of pupils who were not in need or in receipt of learning support (260.4) (Table 9.3).

Table 9.3 *Mean Mathematics Achievement Scores of Pupils in Need of, in Receipt of, or Discontinued from, Learning Support for Mathematics (Fourth Class)*

Learning support	Yes			Diff with 'Not in Receipt/Not in Need'	SED	95%CI	
	N	Mean	SE				
Not in need & not in receipt	3566	260.4	2.42	-	-	**-**	**-**
In need & in receipt	272	186.6	4.91	73.84	5.47	**62.91**	**84.77**
In need & not in receipt	328	199.0	3.98	61.44	4.66	**52.14**	**70.74**

Significant differences in ***bold****; SE = Standard Error; SED = Standard Error of the Difference*

In Fourth class, 3.1% (SE = 0.41) of pupils were also in receipt of resource teaching (RT) in which instruction in mathematics was provided because of a diagnosed mild or moderate general learning disability, while 0.8% (SE = 0.23) were in receipt of RT in which instruction in maths was provided because of a diagnosed specific learning disability. The mean score of pupils in receipt of RT in mathematics due to a mild or moderate general learning disability was 180.1 (SE = 5.72), while, for pupils in receipt for a specific learning disability, it was 185.4 (SE = 10.6).

BACKGROUNDS OF LEARNING SUPPORT TEACHERS

The data in this section are based on the responses of teachers who provided learning support for mathematics.

Teaching Experience and Course Work

Almost two-thirds of learning support teachers (61.6%) provided support in one school only, while a cumulative total of 90% provided support for three schools or less.

Teaching experience among learning support teachers ranged from 1 to 44 years, with a mean of 23.8 years (SD = 9.31). Teachers had been engaged in learning support for between 1 and 30 years, with a mean of 6.4 years (SD = 6.23). The large standard deviation indicates considerable variation in the number of years spent providing learning support.

Over two-fifths (43.2%) of teachers who provided learning support in mathematics had not completed the one-year, part-time, in-service course in learning support. Just under half of respondents (47.7%) had completed the course, and 9% were in the process of completing it at the time of the study.

Satisfaction with Learning Support Courses

Teachers were asked to indicate their level of satisfaction with various topics that could be covered on PCSP courses and on the one-year part-time course for learning support teachers (a summary of levels of satisfaction with topics on other in-career development courses are available in e-appendix E9.2). Responses relating to PCSP courses in Table 9.4 are based on all teachers who provided learning support for mathematics, while those relating to the one-year part-time course are based only on those who had completed, or were attending, the course.

The majority of learning support teachers were satisfied with the coverage of topics in the PCSP courses relating to the curriculum, such as implementation (63.0%) and the underpinning framework (61.1%)[1]. Just over half (51.3%) were satisfied with ICD on the implementation of the *Learning Support Guidelines* for mathematics (Table 9.4).

Levels of dissatisfaction with topic coverage on PSCP courses were relatively low. The topics with which the greatest number of respondents expressed dissatisfaction were addressing pupils' learning difficulties in mathematics (42.7%), planning learning programmes for pupils receiving learning support (39.7%), and recording pupil progress (36.8%). Working effectively with parents (33.3%) and with class teachers (32.9%) were not satisfactorily covered, or were not covered at all (38.7% and 27.6% respectively). Other topics that respondents said were not covered include management of time (39.2%) and interpreting the outcomes of standardised tests (27.6%).

Most learning support teachers expressed satisfaction with the more practical aspects of the one-year, part-time course for learning support teachers, including assessing pupils' learning difficulties in mathematics (80.0%), implementing the *Learning Support Guidelines* as they relate to mathematics (66.7%), and planning

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[1] Teachers reporting levels of satisfaction/dissatisfaction (Table 9.4) could indicate that a topic had not been covered. If the responses of teachers reporting that a topic had not been covered had been treated as missing, the percentages reporting satisfaction would have been greater, and the percentages reporting dissatisfaction smaller.

learning programmes for pupils in receipt of learning support (65.0%). As with PCSP courses, respondents expressed dissatisfaction with topics pertaining to working effectively with parents (35.0%) and class teachers (35.0%), and addressing pupils' learning difficulties in mathematics (29.3%). Sizeable proportions of teachers indicated that management of time (35.9%) and working effectively with parents (27.5%) had not been covered (Table 9.4).

Table 9.4 *Numbers and Percentages of Learning Support Teachers Expressing Varying Degrees of Satisfaction with Coverage of Topics in In-career Development Courses*

Topic	PCSP				One-Year part-time course*			
	n	S	NS	NC	n	S	NS	NC
Implementing LS Guidelines for maths	78	51.3	29.5	19.2	39	66.7	20.5	12.8
Assessing pupil's learning difficulties in maths	78	42.3	30.8	26.9	40	80.0	15.0	5.0
Developing/reviewing school policy on LS	77	48.1	31.2	20.8	38	36.8	34.2	28.9
Planning learning programmes for pupils receiving LS in maths	78	37.2	39.7	23.1	40	65.0	25.0	10.0
Recording progress by pupils receiving LS in maths	76	38.2	36.8	25.0	39	59.0	28.2	12.8
Framework underpinning 1999 PSMC	72	61.1	22.2	16.7	34	52.9	14.7	32.4
Implementing the 1999 PSMC	73	63.0	27.4	9.6	33	54.5	18.2	27.3
Interpreting outcomes of standardised tests	76	43.4	28.9	27.6	40	70.0	22.5	7.5
Management of time	74	27.0	33.8	39.2	39	35.9	28.2	35.9
Working effectively with class teachers	76	39.5	32.9	27.6	40	47.5	35.0	17.5
Working effectively with parents	75	28.0	33.3	38.7	40	37.5	35.0	27.5
Addressing pupils' learning difficulties in maths	75	40.0	42.7	17.3	41	61.0	29.3	9.8

** Responses based on those who had completed or were currently completing the one-year part-time course*
n = number; S = satisfied; NS = Not Satisfied; NC = Not Covered

Teachers were asked to express their level of satisfaction with the coverage of an additional number of topics on the one-year, part-time course. The highest level of satisfaction was expressed for the identification of pupils with learning difficulties; the lowest with planning/reviewing learning support programmes for mathematics (Table 9.5).

Table 9.5 *Teachers' Mean Satisfaction Ratings (and Associated Percentages) for Coverage of Topics on the One Year, Part-time Course for Learning Support Teachers*

	N	Mean	SD	% V Satisfied / Satisfied	% Dissatisfied / V Dissatisfied
Identifying pupils with learning difficulties in maths	40	3.28	.68	87.5	12.5
Teaching pupils with learning difficulties in maths	40	3.08	.73	77.5	22.5
Assessing LS pupils' progress in maths	40	2.83	.78	60.0	40.0
Planning/reviewing LS programmes for maths	40	2.80	.79	62.5	37.5

'4' = Very Satisfied, '3'= Satisfied, '2' Dissatisfied, '1' Very Dissatisfied.

A comparison of the mean levels of satisfaction expressed by teachers in schools designated as disadvantaged and non-designated schools on these topics revealed a statistically significant difference for the topic 'teaching pupils with learning difficulties in maths' [$t(38) = 2.19$, $p < .05$]. Learning support teachers in designated schools expressed a significantly lower mean level of satisfaction (2.5, SD = .55) than teachers in non-designated schools (3.2, SD = .72).

WORK OF LEARNING SUPPORT TEACHERS

In responding to questions about their work, teachers who provided learning support to pupils in more than one school were asked to use the school in which they received the questionnaire as their reference point, unless otherwise stated.

Time Management

Data on the proportion of time spent by learning support teachers on various activities are presented in Table 9.6. Teachers spent just over a quarter of their time providing pupils with learning support for mathematics, compared to over half their time providing learning support for English.[2] Just 2% of time was spent working with class teachers on issues related to learning support for mathematics.

Table 9.6 *Percentage of Time Spent by Learning Support Teachers in Contact with Various Personnel*

Contact time with:	%	SD
Pupils (English)	56.3	24.95
Pupils (Maths)	27.8	23.44
Teachers (English)	3.1	2.85
Teachers (Maths)	2.0	2.18
Parents	2.7	3.44
Principal	2.3	2.04
Other	5.3	4.93

(N = 101 teachers)

[2] Data in Table 9.6 are based on responses of teachers who provided learning support for mathematics only, or for both mathematics and English

The distribution of learning support provision for mathematics was considered in more detail by grade level. The first row in Table 9.7 gives the number of pupils at each level who were receiving learning support in mathematics from teachers in the survey. Just 7 pupils in Junior Infants were in receipt of learning support in mathematics, compared to 144 pupils in Sixth class. This illustrates the relatively low level of provision in the infant classes relative to the senior classes.

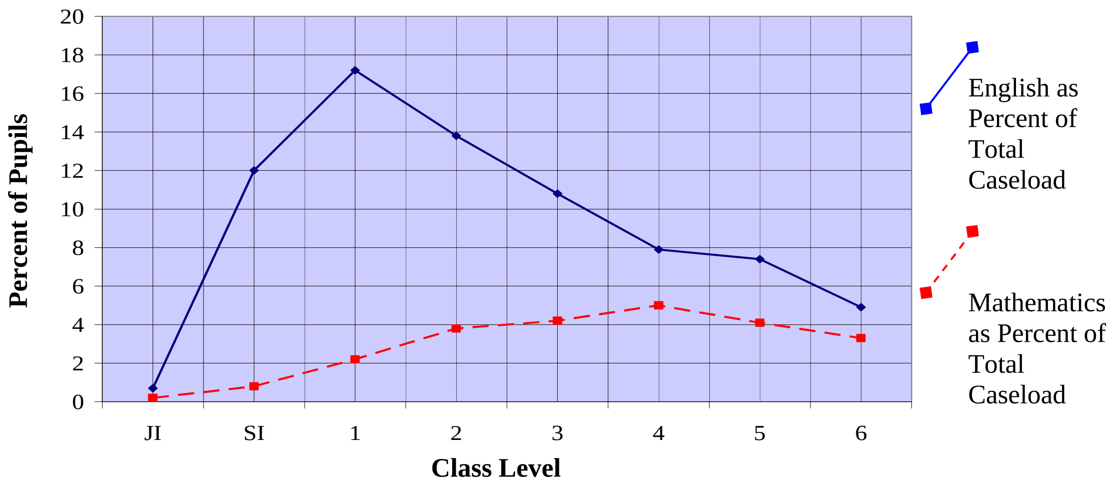
The second row in Table 9.7 expresses the number in receipt of learning support in mathematics at each grade level as a percentage of the total number of pupils in receipt of learning support in mathematics. Only 0.7% of pupils in receipt of learning support were in Junior Infants, while 14.0% were in Sixth class. The third row expresses the number of pupils in receipt of learning support in mathematics at each grade level as a percentage of the total number of pupils in receipt of learning support in English and mathematics combined (4377 pupils). This shows that total learning support provision for mathematics comprised less than one-quarter (23.6%) of all learning support provided by learning support teachers who taught mathematics.

Table 9.7 *Numbers and Percentages of Pupils in Receipt of Learning Support for Mathematics, by Grade Level*

	Grade Level								Total
	JI	SI	1	2	3	4	5	6	
No. of Pupils in receipt of LS for Mathematics	7	33	97	166	183	221	181	144	1032
Percentage of all Pupils in receipt of LS for mathematics	0.7	3.2	9.4	16.1	17.1	21.4	17.5	14.0	100
Percentage of pupils in receipt of LS for mathematics as % of all pupils in receipt of LS	0.2	0.8	2.2	3.8	4.2	5.0	4.1	3.3	23.6

In a graphical presentation of these data (Figure 9.1) two patterns are discernible (data relating to learning support for English can be found in e-appendix E9.4). The first is that teachers who provide learning support for mathematics have larger

Figure 9.1 *Comparison of Distributions of Learning Support Caseloads for English and Mathematics (among Learning Support Teachers of Mathematics), by Class Level*



caseloads in English than in mathematics. The second is that provision of learning support in English peaks at an earlier stage (First class) than learning support in mathematics (Fourth).

Role of the Learning Support Teacher

Questions regarding the involvement of learning support teachers in various aspects of provision, planning and policy in their school were accompanied by 4 options: greatly involved; somewhat involved; involved a little; and not involved. Mean levels of involvement are based on all four points. Levels of involvement were very high. Virtually all respondents felt greatly or somewhat involved in the maintenance of regular plans and progress reports for pupils. Large majorities also felt involved in implementing procedures for selecting pupils for learning support and contributing to the development of policy on learning support. The lowest degree of involvement related to the provision of supplementary teaching in mathematics and implementing strategies for early learning to prevent learning difficulties (Table 9.8).

Table 9.8 *Mean Ratings (and Associated Percentages) of Learning Support Teachers' Involvement in Various Activities Referred to in the Learning Support Guidelines*

	n	Mean	SD	Greatly/Somewhat Involved (%)	Involved a little/ Not Involved (%)
Maintaining regular planning/progress reports for pupils in receipt of LS	111	3.86	3.8	99.1	0.9
Implementing procedures for selecting pupils for learning support	111	3.68	.71	91.0	9.0
Providing supplementary teaching in English	106	3.59	.93	87.7	12.2
Contributing to development of policy on LS in present school	111	3.52	.85	89.2	10.8
Contributing to decision making regarding purchase of learning resources	111	3.47	.81	87.4	12.6
Advising teachers on assessment/ teaching of pupils in receipt of LS	110	3.31	.79	85.8	14.5
Providing supplementary teaching in Mathematics	105	3.11	1.05	71.5	28.6
Implementing strategies for early learning to prevent learning difficulties	109	3.07	.98	76.2	23.9
(If shared post) Performing defined role in co-ordinating LS in schools	51	3.20	1.13	80.4	19.6

'4' = Greatly Involved, '3' = Somewhat Involved, '2' = Involved a Little, and '1' = Not Involved

Content of Learning Support Lessons in Mathematics

Learning support teachers indicated the level of emphasis they placed on core content strands and mathematical skills during learning support classes. The greatest emphasis was placed on Number (with all teachers emphasising it a lot or sometimes). The least emphasis was on Data, with over a half of teachers (53.8%) reporting that they placed little or no emphasis on the area (Table 9.9).

Table 9.9 *Mean Ratings and Percentages of Teachers Placing Varying Degrees of Emphasis on Mathematics Content Strands in Learning Support Lessons*

Strand	Total			Emphasis (%)	
	n	Mean*	Sd	A lot/ Some	Little/ None
Number	81	3.95	.21	100.0	0.0
Algebra	80	3.28	.68	90.0	10.0
Shape & Space	79	2.71	.68	63.3	36.7
Measures	79	2.96	.65	79.7	20.3
Data	78	2.38	.71	46.2	53.8

**‘4’ = Lot of Emphasis, ‘3’ = Some Emphasis, ‘2’ = Little Emphasis, ‘1’ = No Emphasis.*
See e-appendix Tables E9.6 for full breakdown.

Most learning support teachers reported placing either a lot or some emphasis on Implementing (98.8%), and Integrating & Connecting (96.3%). Fewer respondents reported placing these levels of emphasis on higher-order processes, such as Applying & Problem Solving (77.8%), Reasoning (75.6%), or Communicating & Expressing (71.6%) (Table 9.10).

Table 9.10 *Mean Ratings and Percentages of Teachers Placing Varying Degrees of Emphasis on Mathematics Skills in Learning Support Lessons*

Skill	Total			Emphasis (%)	
	n	Mean	Sd	A lot/ Some	Little/ None
Implementing	81	3.67	.50	98.8	1.2
Integrating & Connecting	82	3.62	.56	96.3	3.7
Understanding & Recalling	82	3.43	.77	87.8	12.2
Applying & Problem Solving	81	3.12	.81	77.8	22.2
Communicating & Expressing	81	3.01	.86	71.6	28.4
Reasoning	82	2.99	.76	75.6	24.4

**‘4’ = Lot of Emphasis, ‘3’ = Some Emphasis, ‘2’ = Little Emphasis, ‘1’ = No Emphasis.*
See e-appendix Tables E9.7 for full breakdown.

Selection of Pupils for Learning Support

Learning support teachers were asked to indicate the criteria used to identify and select pupils for learning support for mathematics in their schools. The most frequently-used criterion was the outcome of a standardised test (97.9% ‘always’ or ‘sometimes’ used this criterion). Large percentages of learning support teachers also drew on advice from other professionals (80.6%), parental concerns (80.4%), and teacher checklists (79.8%), while about two-thirds (68.2%) used diagnostic tests a 'always' or 'sometimes' (Table 9.11).

Table 9.11 *Mean Frequency Ratings (and Associated Percentages) of Criteria Used to Identify and Select Pupils for Learning Support in Mathematics*

Criteria	n	Mean*	Sd	Always/ Sometimes (%)	Rarely/ Never (%)
Outcome of standardised test	94	3.85	0.41	97.9	2.1
Structured teacher observations	92	3.33	0.63	95.7	4.3
Advice from other professionals	93	3.09	0.90	80.6	19.4
Parental concerns/feedback	92	2.97	0.64	80.4	19.6
Teacher checklists	89	2.90	0.89	79.8	20.2
Diagnostic tests	85	2.69	1.02	68.2	31.8
Progress tests (from text books)	83	2.61	0.88	61.4	38.6

'4' = Always, '3' = Sometimes, '2' Rarely, '1' = 'Never'.
See Appendix Table E9.8 for additional details

Where standardised tests were used to identify and select pupils for learning support in maths, respondents were asked to indicate the percentile rank used as the cut-off point at each class level (where relevant). The mean cut-off point was highest in Second class (15th percentile) and lowest in Sixth class (13th).

Almost half (45.6%) of the 90 teachers who responded reported that the main criterion for organising pupils in learning support classes was their current class level, 26.7% reported organising pupils mainly according to learning needs in mathematics, and 22% according to general achievement in mathematics (5.6% used some other criterion).

Learning Support Guidelines for Mathematics

Almost three-quarters (73.7%) of learning support teachers for mathematics agreed 'very much' or 'somewhat' that the *Learning Support Guidelines*, as they relate to mathematics, were being implemented in their school. Just 11.6% of respondents indicated that *Guidelines* were not being implemented, while 14.7% were 'unsure' (see e-appendix Table E9.9).

The majority of respondents found the *Guidelines* as the relate to mathematics to be useful in their work as learning support teachers of mathematics, with 69.5% finding them either 'very useful' or 'somewhat useful'. Just 18.1% found the *Guidelines* not to be very useful, or not useful at all, and 10.8% of respondents were unsure (see E-Appendix Table E9.9).

Just 14.9% of learning support teachers believed that class teachers were 'very familiar' with the *Guidelines* as they relate to mathematics. Over half (58.6%) thought that teachers were 'somewhat familiar' with them, and over a quarter (26.6%) believed that they were 'not familiar' with them (N = 74).

Resources for Learning Support

Learning support teachers were asked to provide information on availability of, and their satisfaction with, resources for providing learning support in mathematics. Eighty-six percent of teachers were either ‘very satisfied’ or ‘satisfied’ with the availability of structured materials (for example, fraction strips), while 84% expressed similar levels of satisfaction with the availability of environmental materials. Almost 30% were dissatisfied with the availability of diagnostic tests (Table 9.12) (See Appendix Table E9.10 for additional details).

Over three-quarters of respondents expressed satisfaction with the availability of computer hardware (78.7%) and computer software (76.4%) (Table 9.12). However, in responding to a separate question, 10.8% said that they did not have access to a computer with a CD-ROM drive, and 36.9% did not have access to a computer with an internet connection (N = 111). The majority of learning support teachers reported having a secure system for storing pupil records (83.8%), and a suitable room in which to provide learning support (89.2%).

Table 9.12 *Percentages of Learning Support Teachers Expressing Varying Degrees of Satisfaction with the Availability of Resources for Learning Support for Mathematics, and Mean Satisfaction Ratings*

Resources	n	Mean	Sd	Very Satisfied / Satisfied	Very Dissatisfied / Dissatisfied
Structured materials	93	3.15	.71	86.0	14.0
Environmental materials	92	3.11	.70	84.8	15.2
Computer hardware	89	2.99	.81	78.7	21.3
Diagnostic tests	91	2.95	.95	70.3	29.7
Computer software	89	2.92	.79	76.4	23.6
Books about maths for teachers	90	2.74	.91	63.3	36.7

PERCEPTIONS OF LEARNING SUPPORT PROVISION IN SCHOOLS

Learning support teachers indicated a general satisfaction with learning support provision in the schools in which they taught. Most respondents (94.4%) expressed agreement with the view that their school was supportive in accessing in-career development for them. Almost 4 in 5 (78.3%) agreed that class and learning support teachers jointly shared responsibility for the progress in mathematics of pupils in receipt of learning support, while almost three-quarters (73.9%) agreed that there was a team approach to learning support that involved all teachers in place in the school. Just under half (44.9%) agreed that learning support was meeting the needs of pupils with learning problems in mathematics in their schools. A large percentage of respondents (78.0%) disagreed with the view that there was a lack of support from class teachers in implementing learning support programmes for mathematics. Sixty percent of teachers disagreed with the view that there was a clear policy for learning support in mathematics in the school, while almost one-third (32.6%) disagreed with the view that learning support was meeting the needs of pupils with learning problems in mathematics (Table 9.13).

Table 9.13 *Teachers' Mean Levels and Percentages of Agreement with Statements Relating to Learning Support for Mathematics at School Level*

	n	Mean	Sd	Strongly/ Agree	Un-sure	Strongly/ Disagree
The school supports me in accessing in-career development opportunities	90	4.28	0.60	94.4	4.4	1.1
Responsibility for pupils' progress is shared between the class & LS teachers	92	3.90	0.85	78.3	12.0	9.8
There is a satisfactory level of cooperation between class & LS programmes	91	3.84	0.91	72.5	17.6	9.9
The approach to LS teaching is a team approach involving all teachers	92	3.84	0.99	73.9	12.0	14.1
The class teacher assumes primary responsibility for development of LS pupils	92	3.77	0.94	68.5	21.7	9.8
The area provided for LS teaching is unsatisfactory	92	3.68	1.38	22.8	4.3	72.8
There is lack of support from class teachers in implementing LS programmes for maths	91	3.89	0.89	9.9	12.1	78.0
There is a lack of support from parents of pupils receiving LS for maths	92	3.50	1.09	23.9	12.0	64.1
There is a lack of clear policy on provision of LS for maths	90	3.39	1.23	28.9	11.1	60.0
There is a shortage of suitable books & other materials for LS for maths	93	3.20	1.37	36.6	9.7	53.8
LS is meeting the needs of pupils with learning problems in maths	89	3.16	1.21	44.9	22.5	32.6

'5' = Strongly Agree, '4' = Agree, '3' = Unsure, '2' = Disagree, '1' = Strongly Disagree

LEARNING SUPPORT TEACHERS' COMMENTS

Learning support teachers were invited to provide additional comments on the provision of learning support for mathematics. Sixty-four comments were provided by 34 teachers. The comments were categorised under the headings: learning support provision for mathematics relative to English (23.4% of comments); under-provision of learning support in mathematics (35.9%); teaching resources and materials (14.1%); standardised testing in the selection of pupils (14.1%); and 'other' (12.5%).

Learning Support Provision for Mathematics Relative to English

A frequently recurring issue raised by teachers was what they viewed as the current inadequate levels of learning support provision for mathematics. Several respondents believed that although the same structural needs, guidelines, and support were required for mathematics as were available for English, there was considerable disparity in provision between the subjects. Teachers claimed that provision for

English was frequently prioritised, and provision for mathematics marginalised. Consequently, they felt that positive results from learning support intervention tended to be more apparent in English than in mathematics, reinforcing the emphasis that schools placed on English.

Under-Provision of Learning Support in Mathematics

Several comments noted that teachers providing learning support for mathematics needed greater support in their work, and advocated increasing the current number of learning support teachers. Respondents reported wasting time travelling from school to school, or working in their own personal time to attempt to tackle their excessive caseloads. According to the teachers, this lack of time has negative consequences, not only for the time apportioned to each child/class, but also for planning and communication with class teachers or other learning support teachers. Again, reference was made to the slower progress of pupils receiving learning support for mathematics, compared to English.

Teachers asked for more in-career development courses, and more relevant modules in existing courses, for mathematics. Greater training for class teachers was advocated to enable class teachers to differentiate between pupils' ability and learning capabilities, rather than "pulling everyone through the same programme, whether they're capable or not".

Teaching Resources and Materials

Teachers reported a discrepancy between the availability of teaching resources and materials for learning support in English and mathematics. A small number stated that resources and equipment for mathematics were very limited, and in a few cases, virtually non-existent. This, they said, resulted in teachers spending time searching for materials, with suitable resources and progress tests difficult to source. It was suggested that criterion-referenced tests should be updated in line with the 1999 PSMC, and that diagnostic tests based on Irish norms should be established and made available, to assist learning support teachers in clarifying targets and progress.

Use of Standardised Tests in the Selection of Pupils

Many respondents expressed concern over the cut-off points used in identifying and selecting pupils for learning support. It was argued that the 12th percentile (referred to in the *Learning Support Guidelines*) as a cut-off point was too low, and that this should be raised to the 20th percentile. One rationale for this was that the large number pupils currently performing at or around the 12th percentile were in constant danger of slipping below the cut-off point, and, rather than seeking to raise their achievement in a substantive way, the system focused on maintaining them above this cut-off point. A few teachers believed that greater emphasis should be placed on structured teacher observations during selection since they perceived cut-off points to be arbitrary.

Other Issues

Other comments referred to a lack of time for learning support in mathematics and the impact this had had on interactions with pupils and class teachers, a lack of time for recording and monitoring progress, and an absence, in some contexts, of appropriate early intervention strategies.

COMPARISON WITH THE 1999 STUDY

Although the issue of learning support was not considered in detail in the 1999 study, information was provided on a number of key topics. This permitted comparisons between the provision of learning support in mathematics by school size and disadvantaged status, the percentages of pupils who needed, were in receipt of, and had discontinued learning support, the mean number of years pupils were in receipt of learning support, and the criteria used to identify pupils with learning difficulties in mathematics.

In 1999, 44.4% of pupils attended schools in which learning support for mathematics was provided. By 2004, this had increased to 50.6%. Pupils in larger schools were more likely in both years to have access to support. Whereas in 1999, 47.9% of designated schools provided learning support in mathematics, by 2004 this had decreased to 26% (Table 9.14). None of the differences between the two years is statistically significant (see e-appendix Table E9.13 for confidence intervals).

Table 9.14 *Percentage of Pupils Attending Schools in which Learning Support for Mathematics Was Provided, by School Size and Designated Disadvantaged Status, 1999 and 2004*

School Size/Status	1999 Study		2004 Study	
	%	SE	%	SE
Large	51.9	6.21	64.3	6.50
Medium	44.4	10.30	50.7	7.22
Small	35.7	8.38	37.6	7.41
Designated	47.9	11.70	26.0	9.53
Non- Designated	43.8	4.77	54.2	5.01
Total	44.4	4.60	50.6	4.29

There were significant increases in the number of learning support posts in large, medium, and small schools between 1999 and 2004. However, neither overall numbers nor numbers in designated or non-designated schools changed significantly between the two years (Table 9.15).

Table 9.15 *Mean Numbers of Learning Support Posts in Schools, by Size and Designated Disadvantaged Status, 1999 and 2004*

School Size/Status	1999		2004		Diff	SED	95%CI	
	Mean	SE	Mean	SE				
Large	1.18	.06	1.62	.13	.44	.14	**-.73**	**-.15**
Medium	.73	.09	.97	.05	.24	.10	**-.45**	**-.03**
Small	.33	.03	.70	.13	.37	.13	**-.64**	**-.10**
Designated	1.26	.15	1.09	.10	.17	.18	-.19	.53
Non- Designated	.67	.04	.84	.09	.17	.10	-.37	.03
Total	.77	.04	.88	.08	.11	.90	-.29	.07

The percentage of pupils in need of learning support for mathematics in 2004 (14.4%) was significantly lower than the percentage in need in 1999 (20.5%) (difference = 6.1, SED = 1.39, 95%CI = 3.32 to 8.88). However, this difference may be accounted for by the percentage of pupils in receipt of resource teaching that included mathematics in 2004 (3.9%). Data were not gathered on this in 1999, since resource teaching was not widely available in schools at the time. The percentage of pupils in receipt of learning support for mathematics (6.5%) was marginally lower in 2004 than in 1999 (7.7%). However, the difference was not statistically significant (Table 9.16, see e-appendix Table E9.14 for confidence intervals).

Table 9.16 *Percentages of Pupils in Fourth Class Who Needed and Were Receiving Learning Support for Mathematics, 1999 and 2004*

	1999			2004		
	N	%	SE	N	%	SE
% Need Learning Support	4691	20.5	.90	4166	14.4	1.06
% Receiving Learning Support	4663	7.7	1.23	4166	6.5	.89
% Received in Past but Discontinued	4423	3.2	.68	4166	2.9	.61

In both 1999 and 2004, teachers indicated, in respect of individual pupils, the number of years during which they had attended learning support for mathematics. In both years, almost three-quarters of pupils had received one or two years of support by the end of Fourth class. While the percentages of pupils in receipt for four years and for six years were marginally higher in 1999 than in 2004, differences were not statistically significant (Table, 9.17; see e-appendix Table E9.15 for standard errors of the difference and confidence intervals).

Table 9.17 *Percentages of Pupils in Fourth Class Who Were in Receipt of Learning Support for Mathematics for Varying Numbers of Years, 1999 and 2004*

	1999 Study		2004 Study	
Years	**%**	**SE**	**%**	**SE**
1	47.5	6.11	44.3	6.01
2	23.5	4.39	33.0	5.93
3	9.8	1.91	10.5	2.55
4	14.8	5.89	7.8	3.05
5	2.7	1.66	3.4	1.40
6	1.7	1.31	1.1	0.74

In the 1999 study, teacher recommendations were rated the most important criterion for selecting pupils for learning support for mathematics (66.6%), while standardised test scores were considered as the primary method of selection by just over a quarter of respondents (27.9%). In 2004, structured teacher observations and teacher checklists were still used, but most teachers considered the outcomes of standardised tests to be the most important criterion (97.9%).

SUMMARY

Just over half (50.6%) of pupils attended schools in which learning support for mathematics was provided. Six and a half percent of pupils were in receipt of learning support for mathematics, and 7.9% were in need, but not in receipt at the time of the survey. Just under 4% of pupils were receiving resource teaching for mathematics, arising from a mild general or specific learning disability. Mean mathematics achievement scores were significantly lower for pupils in receipt of learning support or resource teaching for mathematics than for pupils not in receipt.

The mean number of years experience for learning support teachers (6.4 years) was low relative to that for overall teaching experience (23.8 years), and just over half of learning support teachers for mathematics (56.7%) had completed or were completing the one-year part-time, in-service learning support course. Teachers were more satisfied with the coverage of the topic of addressing pupils' learning difficulties in mathematics in the one-year part-time course than in PCSP courses. Satisfaction with the coverage of topics on PSCP courses was greatest for those relating to the implementation of the 1999 curriculum, and lowest for those dealing with learning difficulties in mathematics.

Teachers provided more learning support in mathematics to pupils in Fourth and Fifth classes than to pupils at other levels. Learning support classes focused primarily on the strands of Number, Algebra, and Measures, and on the skills of Implementing, and Integrating & Connecting.

Only 15% of respondents believed class teachers were 'very familiar' with the *Learning Support Guidelines* as they relate to mathematics, and less than one-fifth (18%) did not find them useful. Respondents were generally satisfied with the availability of structured and environmental materials, but were less satisfied with the availability of books about mathematics for teachers.

Differences in provision of learning support for English and mathematics were identified frequently in the additional comments provided by learning support teachers. Comments also referred to a need to update mastery tests in line with the PSMC, to update criterion referenced standardised tests, and to consider revising the cut-off point for selecting pupils for learning support in mathematics.

Although more pupils (7.7%) in Fourth class were in receipt of learning support for mathematics in 1999 than in 2004 (6.5%), the difference is not statistically significant. Moreover, it is likely that any decline has been offset by the increased availability of resource teaching in mathematics for pupils with both general and specific learning difficulties. The use of standardised tests as the main criterion used to select pupils for learning support increased substantially between 1999 and 2004.

10. Inspectors’ Views on Teaching and Learning Mathematic

Fifty inspectors, who had observed the teaching of mathematics in Fourth class in schools in the two years prior to the survey, completed a Questionnaire that asked about the teaching of English in First and Fifth classes, and the teaching of mathematics in Fourth class. This chapter discusses responses dealing with the teaching of mathematics in Fourth class relating to: the backgrounds of responding inspectors; inspectors’ views on planning, grouping pupils for instruction; aspects of the teaching of mathematics, including the teaching of the strands and skills embedded in the 1999 Primary School Mathematics Curriculum (PSMC); assessment of mathematics achievement; provision for learning difficulties and individual differences in mathematics; the availability and use of resources for teaching mathematics; professional development for teaching mathematics; and comments on the teaching of mathematics.

BACKGROUNDS OF INSPECTORS

The 50 responding inspectors had worked in that role for an average of 10.2 years (SD =10.7). While 36% had one or two years experience as inspectors, 32% had more than 20 years. In the two years prior to the survey, the inspectors had each observed an average of 30 mathematics lessons involving pupils in Fourth class (n = 48; SD = 27.0; range = 1 to 150). During the same period, the inspectors conducted an average of 16 school inspections (*Tuairiscí Scoile*) that included mathematics in Fourth class (n = 49; SD = 12.9; range = 2 to 70). In the two years prior to the survey, they each had carried out an average of 45 general inspections (*Mórfhiosraithe*) on the work of probationary teachers leading to the award of the DES Diploma (n = 40; SD = 24.9; range = 2 to 98).

Ninety-eight percent of respondents indicated that they were either ‘very familiar’ or ‘familiar’ with the results of the OECD Programme for International Student Assessment (PISA). Corresponding percentages for the Third International Study of Mathematics and Science (TIMSS, 1995) and the NAMA 1999 in Fourth Class were 69% and 90% respectively.

Inspectors were asked to indicate their views on the effectiveness of a range of approaches to teaching mathematics in terms of their potential to develop the mathematical competence of pupils in Fourth class. While 40.8% of respondents considered having pupils in similar ability groups to be a very effective strategy, just 24.0% considered mixed ability grouping to be very effective (Table 10.1).

Table 10.1 *Percentages of Inspectors Rating the Potential of Various Approaches to Teaching Mathematics to Develop Pupils' Competence*

Activity	N	Very Effective	Effective	In-effective	Very In-effective
Grouping pupils in similar ability groups	49	40.8	49.0	10.2	0.0
Grouping pupils in mixed ability groups	50	24.0	62.0	14.0	0.0
Using ICT to teach mathematics	49	22.4	67.3	10.2	0.0
Using calculators to teach mathematics	50	20.0	78.0	2.0	0.0
Daily use of workbooks/worksheets	50	4.0	28.0	56.0	12.0
Class discussion about word problems before pupils solve them independently	49	81.6	18.4	0.0	0.0
Teaching pupils problem solving strategies	50	90.0	10.0	0.0	0.0
Using concrete materials	50	86.0	14.0	0.0	0.0

Large majorities of inspectors said that ICT (89.7%) and calculators (98.0%) had the potential to develop pupils' competence in mathematics. On the other hand, over two-thirds considered the daily use of workbooks/worksheets to be ineffective or very ineffective. All inspectors indicated that teaching problem solving strategies to pupils and using concrete materials to teach mathematics to be effective.

PLANNING AND GROUPING FOR INSTRUCTION

Inspectors were asked to indicate their satisfaction with aspects of teachers' planning for mathematics teaching and grouping for instruction. A large majority expressed satisfaction[1] with the quality of both short- and long-term aspects of planning; just 12.0% expressed dissatisfaction with short-term plans, and 18.0% with long-term plans (Table 10.2).

Table 10.2 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with Aspects of Teachers' Planning for Mathematics*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Quality of short-term schemes	50	6.0	82.0	12.0	0.0
Quality of long-term schemes	50	6.0	76.0	16.0	2.0

Greater dissatisfaction was expressed with the balance between whole-class work, group work and individual work in single-grade than in multi-grade classes (Table 10.3).

[1] The term 'expressed satisfaction' here and elsewhere indicates the percentage of respondents indicating that they were either 'very satisfied' or 'satisfied'. Similarly 'expressed dissatisfaction' means that respondents were either 'dissatisfied' or 'very dissatisfied'.

Table 10.3 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with the Balance between Whole Class Work, Group Work and Individual Work in Mathematics in Single- and Multi-grade Fourth Classes*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Single-grade 4th classes	50	4.0	40.0	54.0	2.0
Multi-grade 4th classes	49	0.0	57.1	42.9	0.0

All but 15% of inspectors expressed satisfaction with the amount of mathematics homework assigned to pupils.

TEACHING OF MATHEMATICS

Inspectors indicated their satisfaction with the teaching of various elements of the 1999 Primary School Mathematics Curriculum (PSMC). Highest levels of satisfaction were recorded for Number (86.0% very satisfied or satisfied), Measures (82.0%), and Shape & Space (70.0%). Highest levels of dissatisfaction were expressed for Data (64.0% dissatisfied or very dissatisfied) and Algebra (46.0%) (Table 10.4).

Table 10.4 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with Teaching of Key Content Strands and Skills in the Primary School Mathematics Curriculum*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Strand					
Number	50	18.0	68.0	14.0	0.0
Algebra	50	0.0	54.0	46.0	0.0
Shape & Space	50	8.0	62.0	28.0	2.0
Measures	50	14.0	68.0	16.0	2.0
Data	50	0.0	36.0	60.0	4.0
Skill					
Understanding & Recalling	50	16.0	72.0	12.0	0.0
Implementing	50	8.0	56.0	36.0	0.0
Reasoning	50	2.0	20.0	74.0	4.0
Integrating & Connecting	50	6.0	56.0	38.0	0.0
Applying & Problem Solving	50	0.0	24.0	66.0	10.0
Communicating & Expressing	50	0.0	18.0	72.0	10.0

In assessing the teaching of mathematics skills, inspectors expressed most satisfaction with Understanding & Recalling (84.0% were very satisfied or satisfied), Implementing (64.0%), and Integrating & Connecting (62.0%) (Table 10.4). However, majorities were dissatisfied with Communicating & Expressing (82.0%

dissatisfied or very dissatisfied), Reasoning (78.0%), and Applying & Problem-Solving (76.0%) (Table 10.4).

Just 42.0% of inspectors expressed satisfaction with the approaches to teach mathematics, while 40.0% expressed satisfaction with the use of calculators (Table 10.6). Satisfaction levels were quite low for grouping children for mathematics (24.5%), engaging pupils in mathematical activities (20.0%), and using ICTs to teach mathematics (16.0%) (Table 10.5).

Table 10.5 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with Key Teaching Activities Related to Implementation of the Primary Schools Mathematics Curriculum*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Approaches to teaching maths	50	2.0	40.0	58.0	0.0
Using ICTs to teach maths	50	0.0	16.0	72.0	12.0
Grouping children for maths	49	0.0	24.5	63.3	12.2
Use of calculators to teach maths	50	0.0	40.0	52.0	8.0
Engaging pupils in practical maths activities	50	2.0	18.0	72.0	8.0

ASSESSMENT OF MATHEMATICS

In a series of questions which focused on assessment strategies recommended in the 1999 PSMC, inspectors were asked about the use and interpretation of standardised tests and informal classroom assessments, and the use of diagnostic tests. They were also asked about the quality of feedback offered to pupils.

A strong majority (86.0%) expressed satisfaction with the feedback given to pupils during class work, while 62.0% expressed satisfaction with the feedback offered to pupils on independent work completed in class. Inspectors were fairly evenly divided in their view of the feedback given to pupils on homework. Half were satisfied, and half dissatisfied (Table 10.6).

Although 4 out of 5 inspectors expressed satisfaction with the administration of standardised tests of mathematics, only half that number were satisfied with the interpretation of test results (Table 10.6), suggesting that teachers may not be deriving maximum benefit from the use of standardised tests as they plan learning activities for pupils.

Inspectors tended to be more dissatisfied than satisfied with the use of informal assessments of mathematics in classrooms. Although 73.4% expressed satisfaction with the use of teacher-made tests, just 22.4% expressed satisfaction with the use of structured observations, 36.7% with teacher-made checklists, and 44.9% with the use of informal assessments (Table 10.6).

Table 10.6 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with the Work of Teachers on Key Aspects of Assessment*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Feedback					
Feedback given to pupils during classwork/discussion	50	6.0	80.0	14.0	0.0
Feedback given to pupils on independent work completed in class	50	2.0	60.0	36.0	2.0
Feedback given to pupils on homework	48	2.1	47.9	43.8	6.3
Standardised Tests					
Administration of standardised tests of mathematics	49	8.0	72.0	18.0	2.0
Interpretation of results of standardised tests of mathematics	50	4.0	36.0	54.0	6.0
Informal Assessments					
Use of informal assessment procedures (*e.g., keeping records)*	49	2.0	42.9	51.0	4.1
Teacher-made tests	49	2.0	71.4	24.5	2.0
Teacher-made checklists	49	2.0	34.7	57.1	6.1
Structured observations	49	0.0	22.4	69.4	8.2
Progress tests or checklists accompanying mathematics texts	47	0.0	68.1	29.8	2.1
Diagnostic Tests					
Administration of diagnostic tests of mathematics	48	2.1	37.5	52.1	8.3
Interpretation of results of diagnostic tests of mathematics	48	2.1	22.9	64.6	10.4

Just over 60.0% of inspectors expressed dissatisfaction with the administration of diagnostic tests of mathematics (Table 10.6). This figure is difficult to interpret to the extent that many teachers said that they did not use diagnostic tests (Chapter 7). It may be that inspectors' levels of dissatisfaction reflect low usage levels.

DEALING WITH INDIVIDUAL DIFFERENCES BETWEEN PUPILS IN MATHEMATICS

When asked to indicate their satisfaction with the ways in which class teachers dealt with individual differences between pupils in mathematics classes, the vast majority of inspectors (84.0%) were either very satisfied or satisfied with teachers' work in identifying and addressing pupils' common errors. However, over half (51%) were dissatisfied with the ways in which pupils' misconceptions and learning difficulties in mathematics were identified and addressed (Table 10.7).

Table 10.7 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with the Work of Class Teachers in Dealing with Learning Differences in Mathematics*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Identifying and addressing pupils' common mathematical errors	50	6.0	78.0	16.0	0.0
Identifying and addressing pupils' misconceptions about mathematics	49	0.0	49.0	51.0	0.0
Identifying pupils' learning difficulties in mathematics	50	2.0	42.0	54.0	2.0
Addressing the needs of pupils with learning difficulties in mathematics	50	0.0	16.0	78.0	6.0
Teaching mathematics to pupils with low achievement	49	0.0	18.4	69.4	12.2
Teaching pupils with high ability in mathematics	49	2.0	57.1	36.7	4.1
Integrating class and learning-support programmes for pupils with learning difficulties (where applicable)	50	0.0	16.0	72.0	12.0

Over four-fifths of inspectors expressed dissatisfaction with the teaching of mathematics to low-achieving pupils. Only 16.0% were satisfied with the integration of class and learning support programmes for pupils with learning difficulties in schools where learning support programmes in mathematics were provided (Table 10.7).

When asked to indicate their satisfaction with the implementation of a number of recommendations made in the *Learning Support Guidelines*, just over 40% of inspectors expressed satisfaction with the identification and selection of pupils for learning support in mathematics, while only a quarter expressed satisfaction with the co-ordination of the work of class and learning support teachers. Almost 18% expressed satisfaction with the involvement of parents/guardians in the learning support programmes of pupils, while just over a quarter expressed satisfaction with the duration of learning support programmes for mathematics (Table 10.8).

Table 10.8 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with Implementation of Learning Support Guidelines as They Relate to Mathematics*

	N*	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Identification and selection of pupils in 4th class for LS	45	6.7	33.3	42.2	17.8
Co-ordination of class teachers and LS teachers (4th class)	44	0.0	25.0	65.9	9.1
Involvement of parents in LS programmes of 4th class pupils	45	0.0	17.8	66.7	15.6
General duration of LS programmes for maths	47	4.3	21.3	59.6	14.9

**Cases for which the question was 'not applicable' (e.g., no learning supported in mathematics offered to pupils in 4th class) in schools visited by inspectors were not included in the analyses.*

RESOURCES FOR TEACHING MATHEMATICS

For each mathematics strand in the 1999 PSMC, inspectors were asked to indicate their level of satisfaction with the availability of resources, and with the extent of the use of resources. Most inspectors expressed satisfaction with availability for each of the five strands in the curriculum. However, the percentage of inspectors expressing dissatisfaction with the availability of resources for Algebra (38.0%) was sizeable (Table 10.9).

Table 10.9 *Percentages of Inspectors' Expressing Varying Degrees of Satisfaction with the Availability of Resources for Teaching Mathematics in Fourth Class, by Curriculum Content Strand*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Number	50	24.0	62.0	14.0	0.0
Algebra	50	12.0	50.0	38.0	0.0
Shape & Space	49	16.3	59.2	24.5	0.0
Measures	50	16.0	70.0	12.0	2.0
Data	50	10.0	64.0	24.0	2.0

Eight in ten inspectors were very satisfied or satisfied with the use of resources to teach Measures, while three-quarters expressed similar levels of satisfaction for Number, and 62% did so for Shape & Space. However, about 6 in 10 inspectors were dissatisfied or very dissatisfied with the use of resources to teach Data and Algebra (Table 10.10).

Table 10.10 *Percentages of Inspectors Expressing Varying Degrees of Satisfaction with the Extent of Use of Resources for Teaching Mathematics in Fourth Class, by Curriculum Content Strand*

	N	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Number	50	10.0	64.0	24.0	2.0
Algebra	50	2.0	38.0	60.0	0.0
Shape & Space	50	4.0	58.0	38.0	0.0
Measures	50	8.0	72.0	20.0	0.0
Data	50	4.0	32.0	60.0	4.0

PROFESSIONAL DEVELOPMENT IN MATHEMATICS

Inspectors were asked to evaluate teachers' knowledge of mathematical concepts and processes, their understanding of the 1999 PSMC, and their knowledge of methods for teaching mathematics.

Knowledge about Mathematics

Almost three-quarters of inspectors rated teachers' knowledge of mathematics concepts and processes as either very comprehensive or quite comprehensive, while just over three-quarters rated teachers' understanding of the 1999 PSMC in these ways (Table 10.11). On the other hand, 70% of inspectors described teachers' knowledge of methods of teaching mathematics as somewhat limited.

Table 10.11 *Percentages of Inspectors Allocating Varying Ratings to Teachers' Knowledge of Mathematics Content Strands and Skills, Curriculum, and Teaching Methods*

	Very comprehensive	Quite comprehensive	Somewhat limited	Very limited
Teachers' knowledge of maths concepts and processes	10.0	62.0	28.0	0.0
Teachers' understanding of the maths curriculum	2.0	74.0	24.0	0.0
Teachers' knowledge of methods of teaching maths	0.0	30.0	70.0	0.0

(N = 50)

Mathematics Strands

Almost 4 out of 5 inspectors indicated that Data should be emphasised more strongly in in-career development courses on mathematics, while almost two-thirds felt that it should be more strongly emphasised in pre-service courses. About a quarter of inspectors indicated that Number, Measures, and Shape & Space should be emphasised more in pre-service and in-career development courses. Two-thirds indicated that Algebra should be emphasised more (Table 10.12).

Table 10.12 *Percentages of Inspectors Indicating Mathematics Content Strands Requiring More Attention in Pre-service and In-career Professional Development Courses*

	N	Pre-Service Training	N	In-Career Development
Number	50	26.0	49	20.4
Algebra	50	62.0	49	65.3
Shape & Space	50	34.0	49	30.6
Measures	50	24.0	49	22.4
Data	50	66.0	49	79.6

Mathematics Skills

Reasoning and Applying & Problem Solving were the skills identified by the largest majorities of inspectors as most in need of attention in pre-service and in-career professional development. About one-half of inspectors indicated that Implementing required additional attention (Table 10.13).

Table 10.13 *Percentages of Inspectors Indicating Mathematics Skills Requiring More Attention in Pre-Service and In-Career Professional Development Courses*

	N	Pre-Service Training	N	In-Career Development
Understanding & Recalling	49	30.6	49	20.4
Implementing	50	48.0	50	52.0
Reasoning	50	62.0	50	72.0
Integrating & Connecting	50	54.0	50	64.0
Applying & Problem Solving	50	66.0	50	78.0

Teaching and Assessment Methods

Almost two-thirds of inspectors identified a need for greater attention to engaging pupils in practical mathematics activities in pre-service teacher education courses, while almost two-thirds felt that this topic should receive greater attention in in-career development courses. Other topics that inspectors felt should receive more emphasis in in-career development courses include interpreting the results of standardised tests in mathematics, approaches to teaching mathematics, using ICTs to teach mathematics, and grouping children for mathematics. Fewer than half of inspectors felt that the use of calculators to teach mathematics or classroom-based assessment of mathematics needed more emphasis in pre-service teacher education or in-career professional development courses (Table 10.14).

Table 10.14 *Percentages of Inspectors Identifying Teaching and Assessment Methods Requiring More Attention in Pre-service and In-career Professional Development Courses*

	N	Pre-Service Training	N	In-Career Development
Classroom-based assessment of maths	50	44.0	49	46.9
Identifying learning difficulties in maths	50	62.0	49	55.1
Interpreting results of standardised tests	49	55.1	49	61.2
Approaches to teaching maths	50	70.0	50	72.0
Using ICT to teach maths	50	66.0	50	76.0
Grouping children for maths	50	64.0	50	72.0
Use of calculators to teach maths	50	42.0	24	48.0
Engaging pupils in practical maths activities	50	62.0	50	78.0

INSPECTORS' COMMENTS

Inspectors were invited to comment on aspects of teaching mathematics at the end of their questionnaire. Nineteen respondents offered a total of 49 comments, which fell into 12 categories, including use of concrete materials (25% of all comments), problem solving (12%), use of textbooks (10%), language and mathematics (8%), differentiation (6%), grouping/whole class teaching (6%), teaching methods (6%), learning support (6%), and assessment (4%) (see e-appendix E10.1).

Comments on concrete materials referred to the good progress that had been made to date, including increased use following implementation of the 1999 PSMC. However, concern was expressed that materials were not as widely used as they should be, and differences in levels of use between Junior classes (high use) and Middle and Senior classes (lower use) were commented on.

A need was identified to accord greater attention to teaching problem solving strategies explicitly, and, especially in schools serving areas of designated disadvantage, to ensure that the language structures required for problem solving are in place. One comment referred to the benefits of co-operative learning in teaching problem solving.

Textbooks were considered to be overused in both planning and teaching. One comment referred to the overuse of textbooks, despite the fact that teachers themselves were knowledgeable about the curriculum, appropriate teaching methods, and use of concrete materials/equipment. Comments on differentiation noted a need to better meet individual pupils' needs. Comments on grouping noted the prevalence of whole-class instruction, and the fact that this model did not meet the needs of lower-achieving pupils, who often did not get a chance to participate.

The importance of teaching language in the context of mathematics instruction was emphasised. One comment referred to the importance of language for conceptual development in mathematics, and the key role of the teacher in presenting and reinforcing the use of mathematical language.

A need was expressed to provide more learning support in mathematics, and to ensure greater integration between class and learning support programmes.

Comments on teaching referred to good practice in teaching strand units in mathematics, although such practice was not considered universal, and was not seen to be used frequently. A lack of time in which to complete the mathematics curriculum was noted. As a result, teachers tended to cover a topic superficially in order to move on to the next topic.

SUMMARY

While 41% of inspectors considered having pupils in similar ability groups to be a very effective strategy, just 24% considered mixed ability grouping to be very effective. Almost all inspectors supported the use of ICT and calculators to teach mathematics. However, just 32% viewed daily use of workbooks/worksheets as potentially effective.

Inspectors were generally satisfied with the quality of teachers' short- and long-term schemes for mathematics. However, 12% were dissatisfied with the quality of short-term plans, and 18% with the quality of long-term plans. Forty-four percent expressed satisfaction with the balance between whole-class work, group work and individual work in single-grade classes, while 57% expressed satisfaction with this balance in multi-grade classes. Over half of inspectors expressed dissatisfaction with the feedback about homework that teachers provided to pupils.

More inspectors were satisfied with the teaching of Number, Measures and Shape & Space than with the teaching of Data and Algebra. More were also satisfied with the teaching of lower-order mathematics skills (Understanding & Recalling, Implementing) than with higher-level skills (Reasoning, Integrating & Connecting, Applying & Problem-Solving). A majority of inspectors expressed dissatisfaction with approaches to teaching mathematics in schools, with the use of ICT to teach mathematics, with the use of calculators, and with the engagement of pupils in practical mathematics activities.

While most inspectors were satisfied with the administration of standardised tests, 60% expressed dissatisfaction with the interpretation of the results of tests, and, by implication, with the use that teachers made of them to guide instruction. Fifty-five percent of inspectors were dissatisfied with the use of informal assessment procedures, including the maintenance of records. More inspectors were dissatisfied than satisfied with the administration and interpretation of diagnostic tests of mathematics. Over 85% expressed satisfaction with teachers' ability to identify and address common mathematics errors made by pupils. However, over half expressed dissatisfaction with the identification of learning difficulties in mathematics, and efforts to address them. The integration of class and learning support programmes was also deemed to be problematic. High dissatisfaction rates in relation to implementation of aspects of the *Learning Support Guidelines* as they relate to mathematics may have been due to a lack of learning support for mathematics in some schools.

While almost three-quarters of inspectors considered teachers' knowledge of mathematical concepts and processes to be either very or quite comprehensive, 70% felt that teachers' knowledge of methods of teaching mathematics was somewhat limited. Inspectors identified the mathematics strands of Algebra and Data, and the processes of Reasoning, Integrating & Connecting, and Applying & Problem Solving as dimensions of the 1999 PSMC in need of additional attention in pre-service teacher education and in-service professional development courses. Approaches to teaching mathematics, engagement of pupils in practical mathematics activities, interpretation of standardised test results, and use of ICTs to teach mathematics were also identified as areas that could be more strongly emphasised in coursework.

In their comments about the teaching of mathematics, inspectors made particular reference to the need to use concrete materials to a greater extent at middle-and senior class levels. They also advocated more systematic and explicit approaches to teaching problem solving, and less emphasis on textbooks in favour of activities designed to develop the language of mathematics and to apply mathematics concepts to real-life contexts.

11. Conclusions and Recommendations

In this chapter, the first three sections, *mathematics content strands*, *mathematics skills*, and *mathematics proficiency levels*, draw primarily on Chapter 4 and address the implications of findings on achievement outcomes. The fourth section, *pupils with low achievement in mathematics*, draws on information in Chapters 5 and 8, which describe the performance of various subgroups such as traveller children and pupils in designated disadvantaged schools. The fifth section, *gender differences*, draws on Chapter 5. The sixth, *home-school links*, draws on Chapter 6 to describe links between the home environment and scholastic performance, and ways in which parents can fruitfully support their children's mathematics development. The seventh and eighth sections, *planning for and organising mathematics*, and *use of resources in mathematics classrooms*, draw on Chapters 7, 8 and 10, to suggest ways in which planning for teaching mathematics and the use of selected teaching resources can be improved. The ninth section, *learning support for mathematics*, draws on Chapters 8 and 9, while the tenth, *teacher education in mathematics,* draws on Chapter 7, but also includes information from Chapters 8 and 10.

1. Mathematics Content Strands

The performance of pupils on Shape & Space items improved significantly (by 5%) between 1999 and 2004. However, the actual items on which pupils improved related to lower-order processes such as Implementing rather than items that called for Reasoning. Furthermore, the improvement was achieved from a relatively low base (49% correct in 1999). Reflecting this situation, almost 30% of pupils in 2004 were taught by teachers who believed that this area had received insufficient attention in in-career development linked to the 1999 PSMC, while one-quarter of inspectors identified a need for additional in-career development in the area.[1] It may be noted that Irish 15-year olds also did poorly on the Shape & Space component of PISA 2000 and PISA 2003 mathematics (Cosgrove et al., 2005). The findings from the current study, and from PISA, indicate that there may be need for a more meaningful and purposeful approach to teaching Shape & Space, that includes increased attention to visualising and analysing the properties of 2-D and 3-D shapes, particularly in real-life contexts.

The performance of pupils on the Data content strand also improved significantly (again, by 5%) between 1999 and 2004. Nevertheless, in the Inspectorate's evaluation of the implementation of the 1999 PSMC, it was suggested

[1]It should be noted that the only in-career development in mathematics that is currently available through the Primary Curriculum Support Service is that provided by a small number of *Cuiditheoirí* (support persons) who provide a Regional Curriculum Support Service in mathematics. They provide school visits, drop-in sessions and afternoon/evening workshops in Education Centres countrywide.

that aspects of data handling, including data collection, data analysis, and constructing and interpreting graphs, could be extended to subjects such as geography and science (DES, 2005b). The extension of data gathering and data interpretation techniques to other subjects, as well as their application to real-life questions, would undoubtedly be of benefit to pupils in that, among other things, it would heighten their awareness of mathematics across the curriculum. The extension of strands such as Number, Measures, and Shape & Space to other subjects and to real-life contexts also merits consideration.

On both the Number and Measures strands there was a non-significant decrease in percent correct scores between 1999 and 2004. Over 90% of pupils were taught by teachers who were satisfied with the level of attention allocated to Number in in-career development courses, while 86% of inspectors were satisfied with the availability of resources for teaching Number, and three-quarters were satisfied with the use of resources to teach this strand. It seems that, while Number is emphasised to a lesser extent in the 1999 PSMC than in the earlier 1971 curriculum, overall performance on the strand has not been adversely affected. Nevertheless, the development of estimation skills, which was identified as an area in need of improvement in the Inspectorate's evaluation of the implementation of the PSMC (DES, 2005b), should continue to receive attention, particularly in the context of wider availability of calculators in mathematics classes. The finding in the NCCA curriculum review that teachers at all class levels placed relatively little emphasis on teaching estimation strategies (NCCA, 2005) supports concerns about the teaching of estimation skills. In the current study, pupils did poorly on an item that asked them to estimate the sum of a series of decimal numbers (e.g., 2.5 + 4.9 + 1.3).

The relatively poor performance of pupils on Measures (49% correct) is worthy of note in the context of almost 80% of pupils being taught by teachers who were satisfied with the level of attention afforded to this strand in ICD courses linked to the 1999 PSMC and inspectors' satisfaction with the availability and use of resources in this strand. One possible explanation for the observed performance level is that, in NAMA 2004, about three-fifths of Measures items were presented as word problems and, despite their considerable experience with hands-on materials, pupils may not have been able to transfer mathematics knowledge acquired in practical situations to the more abstract situations presented in non-routine problems. If this is so, some pupils may need support in establishing stronger links between practical activities and the problems they are asked to solve in test contexts. It may also be that textbooks over-emphasise the computation aspects of Measures in the practice tasks they provide for pupils, at the expense of more substantive tasks that entail reading of text, estimation and problem solving, and communication of results.

Performance on Algebra was marginally (but not significantly) higher in 2004 than in 1999. Over one-fifth of pupils were taught by teachers who felt that insufficient attention had been paid to this strand in in-career development. Although Algebra represents a relatively small segment of the mathematics curriculum at Fourth class, and fewer than 5% of items administered in the current assessment were classified as Algebra, it is nonetheless important in terms of its links to problem solving. Indeed, if pupils are to be successful in solving problems, they need to 'think algebraically' as they make connections between problem situations and the number sentences and algorithms that might be used to solve them.

Recommendations for Mathematics Content Strands	
R1	Teachers should support pupils' development in Shape & Space by engaging them to a greater degree in tasks involving reasoning about shape and space in school and in other contexts.
R2	Teachers should extend work relating to data collection, data analysis, and constructing and interpreting graphs to subjects such as geography and science, as well as to real-world problem contexts. Opportunities to apply knowledge about Number, Measures, and Shape & Space strands in other subject areas and in real-life contexts should be sought.
R3	Teachers should accord greater emphasis to the Measures strand by providing opportunities for pupils to transfer the knowledge and skills acquired in practical activities to non-routine problems.

2. Mathematics Skills

In 2004, pupils consistently performed better on items assessing lower-order rather than higher-order skills. For example, the mean percent correct score for Understanding and Recalling (a lower-order skill) was some 14 percentage points higher than the mean for Applying & Problem Solving (48%). There was a significant improvement between 1999 and 2004 in performance on one mathematics skill area, Reasoning.[2]

Performance on Applying & Problem Solving is a matter of concern in terms of the relatively poor performance of pupils in 2004, and gaps in teacher education noted by teachers and inspectors. In 2004, 37% of pupils were taught by teachers who felt that this skill had not been sufficiently emphasised in ICD for the 1999 PSMC, while 66% of inspectors indicated that more attention should be given to this skill in pre-service teacher education, and 78% thought it should be more strongly emphasised in in-career development courses. In the Inspectorate's evaluation of the 1999 PSMC, weaknesses in teaching problem solving were found in almost one-third of classrooms across all class levels (DES, 2005b), while the NCCA review found that Integrating & Connecting, Applying & Problem Solving, and Reasoning were among the skills that children had least opportunities to develop (NCCA, 2005). Both the Inspectorate and the NCCA noted that teachers over-relied on traditional text-book problems when teaching problem solving.

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[2] Some care should be exercised in interpreting performance on mathematics skills in NAMA 2004 and elsewhere. As indicated in Chapter 2, the question of whether an item measures (and requires) lower- or higher-order thinking skills will depend on a pupil's prior experience, knowledge and level of mathematics development.

Concerns about performance on problem solving items and the teaching of problem solving strategies are not confined to primary level. In the 2003 PISA mathematics assessment, which places a strong emphasis on solving mathematics problems set in real-life contexts, just 11% of Irish 15-year olds, compared to an OECD country average of 15%, and 24% in Finland, were able to solve complex problems (those at Levels 5 and 6 on the PISA proficiency scales) (Cosgrove et al., 2005, Table 3.11, p. 63).

An issue that merits greater attention in current discourse on problem solving in mathematics is the approach (or approaches) that should be used with pupils. The *Teacher Guidelines* accompanying the 1999 Primary School Mathematics Curriculum (PSMC) (DES/NCCA, 1999c, p. 35-36) outline a general approach when they recommend that children should be introduced to a variety of strategies and be encouraged to experiment with applying the same strategy to different problems, and different strategies to the same problem. The *Guidelines* also recommend co-operative group work and class discussion of the results of a problem-solving exercise to encourage children to try different approaches and offer alternative solutions. Strategies such as constructing a model, drawing a diagram to illustrate a problem, looking for patterns in a problem, writing a number sentence for a problem, and solving a simpler version of a problem using smaller numbers are suggested. The development of appropriate language in the context of problem solving is stressed.

Teachers may not be using these suggestions because of a lack of confidence in using constructivist approaches in teaching problem solving.[3] Oldham and Close (2005) noted that teachers who experienced mathematics as a fixed body of knowledge during their own schooling may be reluctant to use mathematics problem solving in their teaching, preferring to use problem solving lessons to facilitate practice on number concepts and skills, while O'Shea (2005) observed that the mathematical experience of some teachers may be an obstacle to the use of problem solving in teaching. According to Petraglia (1998), teaching texts (such as the *Guidelines*) are likely to fail to convince teachers to make 'leap-of-faith' changes (such as those required to move to more constructivist practices), and ICD that demonstrates problem solving in action, while building on teachers' own problem solving strategies, may be needed (see section 10 below).

If greater emphasis is placed on teaching Applying & Problem Solving (and related skills such as Reasoning and Integrating & Connecting) using constructivist approaches such as those suggested in the *Guidelines*, pupils should have a better chance of developing important mathematical models of thinking such as hypothesising, inferring, and questioning. The complexity of the process should not be underestimated. For example, Travers (2005) noted that involving pupils in

[3] In response to the first phase of its primary curriculum review, where issues around the teaching of problem solving were also identified, the NCCA plans to provide on-line exemplars of methodologies-in-action to provide teachers with additional support for teaching and learning. Work by the NCCA on classroom assessment may also be expected to support the teaching of problem solving.

drawing a diagram to represent a problem can entail fostering conceptual understanding in making representational links, including spatial representations underlying the problem.

It would also seem important to ensure that adequate time is available for pupils to propose strategies for solving a problem, to discuss the mathematics involved, to implement selected strategies, to estimate and compute outcomes, and to reflect on the skills that have been applied. Moreover, as suggested in the *Guidelines*, such work should occur in collaborative groups as well as in whole-class discussion contexts.

Beyond this, there may be value in piloting approaches to teaching and learning mathematics that have an even stronger emphasis on problem solving than the 1999 PCMC. A recent review of international trends in mathematics education, carried out by Conway and Sloane (2005) examined the principles underlying Realistic Mathematics Education (RME). This approach to teaching mathematics was considered to represent a move away from solving traditional textbook problems (which are often designed to provide practice on procedural skills already taught) towards solving problems set in real-life contexts, that allow pupils to deduce general mathematics principles and develop specific mathematics skills, in the course of discussing, exploring and solving problems (problem-based learning). A pilot project, based on this, or a similar philosophy, would help to inform mathematics educators on alternative ways forward. Such a project might involve both primary- and post-primary teachers, given that similar issues in relation to teaching problem solving seem to arise at both levels.

Recommendations for Mathematics Skills	
R4	Schools and teachers should place a stronger emphasis on teaching higher-order mathematics skills, including Applying & Problem Solving, to all pupils by implementing in a systematic way the constructivist, discussion-based approaches outlined in the *Guidelines* accompanying the 1999 PSMC.
R5	The Department of Education and Science should support the implementation and evaluation of pilot projects linked to problem-based approaches to teaching mathematics such as Realistic Mathematics Education (RME).

3. Mathematics Proficiency Levels

Proficiency levels, which were used to describe the mathematics performance of groups of pupils in the current study, indicate the distribution of mathematics achievement (relative to the curriculum) and the process skills that pupils at each level can be expected to perform. Clearly, the observation that 2.6% of all pupils (and 7.6% of pupils in designated disadvantaged schools) are likely to be unsuccessful on Level 1 items such as recalling basic multiplication and division facts, identifying place value, and solving simple routine word problems, is a matter of concern. These pupils are unable to engage with test items based on the curriculum for pupils in Fourth class, and the test does not provide information on what they are capable of doing in mathematics. At the other extreme, it is noteworthy that just 11.7% of pupils are likely to succeed in answering the most difficult (Level 5) NAMA items, such as implementing procedures for estimating sums and quotients, connecting decimal and fraction notation in measure contexts, applying concepts of ratio and proportion in practical contexts, and extending complex number patterns. These pupils are competent on the most difficult items in NAMA 2004, although little is known about the upper limits of their achievement, as Level 5 is unbounded. The vast majority of pupils (71%) score at Levels 2, 3, and 4.

Since proficiency levels were not developed for NAMA 1999, the percentages of pupils scoring at each level in the current study can only be viewed as baseline data against which to compare performance in the future. An important question is whether proficiency levels (or an equivalent measure of levels of achievement) might be of use to teachers seeking to understand the outcomes of this study, or indeed, the performance of pupils in their own mathematics classes. It would be useful, therefore, to ascertain the views of teachers on the usefulness of proficiency levels for interpreting and reporting on mathematics achievement.

Recommendation for Proficiency Levels	
R6	The value to teachers of proficiency levels for interpreting and reporting the outcomes of mathematics tests should be examined and, if appropriate, their use should be extended.

4. Pupils with Low Achievement in Mathematics

Pupils at risk of low achievement in mathematics include those attending schools designated as disadvantaged and members of the traveller community. Although the current study was not designed to examine the performance of such subgroups in detail, it does provide some broad indicators of their performance.

Pupils attending designated disadvantaged schools in 2004 achieved a mean score that was two-thirds of a standard deviation below the mean score of pupils not attending such schools. Furthermore, 26% of pupils in designated schools achieved scores at or below the 10th percentile, compared to 8% in non-designated schools. While 7.8% of pupils in designated schools scored below Level 1 on the overall mathematics proficiency scale (indicating that NAMA 2004 did not assess their mathematics skills), just 1.7% in non-designated schools scored below Level 1.

Concern about standards in designated schools is not new. The recent report of the Inspectorate on literacy and numeracy in designated schools (LANDS) also noted that large numbers of pupils in such schools experienced low achievement in mathematics (DES, 2005d). The report focused on a range of issues that needed to be addressed to support teachers in enhancing achievement including the development of stronger links between whole-school plans and practices in classrooms, the creation of stronger mathematics environments in classrooms, and the establishment of linkages between the mathematics strands. It is significant that several of these recommendations go beyond resource provision, and focus on the quality of planning and teaching at school level. Both LANDS and the current study raise the issue of the engagement of parents of pupils in designated schools in their children's mathematics development, and the need to develop strategies to improve it. While such parents in the current study attended parent-teacher meetings more often than parents of pupils in non-designated schools, and had more opportunities to attend classes that dealt with aspects of mathematics, principal teachers in designated schools cited parent disinterest as one of the greatest challenges to improving the teaching of mathematics.

The DEIS Action Plan includes recommendations/proposals that can be expected to have an impact on mathematics achievement in designated schools (DES, 2005a). These include greater access to intervention programmes for children with learning difficulties and greater availability of literacy and numeracy advisers (*Cuiditheoirí*) to work in designated schools on whole-school planning, ongoing professional development of teachers, and the establishment of appropriate school, class and pupil targets. Taken together, the recommendations in the LANDS report and the proposals in the DEIS Action Plan have the potential to improve mathematics achievement in designated schools, but their effects on mathematics achievement should be carefully monitored, and adjustments made in line with need.

Children from the traveller community (2% of the sample in NAMA 2004) achieved a mean score that was 1.2 standard deviations lower than the mean score of pupils in the settled community. This is consistent with the outcomes of the Survey of Traveller Education Provision by the Inspectorate, in which it was found that 62% of traveller pupils in primary schools achieved in the bottom quintile (DES, 2006). These low performance levels suggest that much needs to be done to raise the mathematics achievement of traveller children. This is a particularly challenging task in light of the strong representation of traveller children in designated disadvantaged schools, where, as discussed above, overall performance in mathematics is already low.

Although the current study did not identify a difference in performance between pupils born in Ireland and those born in other countries, or between the children whose first language is English or Irish and children with a different first language, the mathematics development of pupils in these groups should continue to be closely monitored, both in national assessments, and in individual school contexts.

Recommendations for Pupils with Low Achievement in Mathematics	
R7	Schools and teachers with large numbers of pupils from disadvantaged backgrounds should implement the recommendations for the improvement of numeracy outlined in the LANDS report, including those related to school-level planning, the creation of suitable classroom environments for mathematics, the provision of extensive practice in developing mathematics skills in all curriculum strands, the development of stronger links between class and learning support teachers, and the analysis of standardised test results to inform planning.[4]
R8	The DES should pay particular attention to the development of numeracy skills in the context of implementing the DEIS Action Plan, by appointing advisors to work with schools, and by ensuring that other support systems, including in-career development for teachers and support programmes for pupils with learning difficulties, are put in place, and their effects are monitored in the short and medium terms.
R9	Designated disadvantaged schools should take appropriate steps to build on existing initiatives such as the participation of parents in parent-teacher meetings and in mathematics classes for parents, to ensure the ongoing involvement of parents in their children's mathematics development.
R10	The achievement in mathematics of pupils in various at-risk groups, including pupils in designated disadvantaged schools, traveller children, and newcomer pupils for whom the language of instruction is not their first language, should be monitored in future national assessments increasing the representation of pupils in these subgroups in the national sample if necessary.

5. Gender Differences in Mathematics Achievement

In the current study, the overall achievement of male and female pupils did not differ significantly. Male pupils achieved a significantly higher mean score on one content strand (Measures), while no significant differences were observed on any of the mathematics skill scales. Higher-achieving male pupils (scoring at the 75th and 90th percentiles) achieved significantly higher scores than their female counterparts. A broadly similar trend is observed when mathematics proficiency levels are considered, with significantly more males than females scoring at an Advanced level. In PISA 2003 mathematics involving 15-year olds, males in Ireland achieved significantly higher mean scores than females on the overall scale and on each of four subscales. A difference of over one-quarter of a standard deviation was observed on the Shape & Space subscale.

The patterns of gender differences observed in PISA contrast with those found in the Junior Certificate Examination in Mathematics. In 2003, at Higher and Ordinary levels, more females than males achieved grades A, B, and more males than

[4] Recommendations specific to numeracy are given in DES (2005d), pages 53-54.

females achieved grade E or lower. The reasons for these differences in performance are unclear, and may relate to the content presented (PISA focuses on problem solving in real-life contexts more than the Junior Certificate Mathematics Examination), or to students' perceptions of the relative importance of the assessments in terms of reward for effort invested.

In the current study, teachers rated male and female pupils differently for attentiveness in class, persistence in mathematics school work, and ability to work with limited supervision. In all cases, average ratings for females were higher than for males, but no difference was observed for general academic ability. Male pupils rated themselves significantly higher than females on self-efficacy (confidence) in mathematics while females rated themselves higher on enjoyment of mathematics. While the association between self-efficacy and achievement was significant, that between enjoyment of mathematics and mathematics achievement was not. It would be worth examining whether female pupils' self-efficacy could be enhanced in a substantive way in the course of mathematics instruction, and what effect this might have on achievement in the shorter and longer terms. Where learning strategies are concerned, the only difference observed in the current study was that females were significantly more likely than males to report that they asked for help from the teacher or from friends when confronted with difficult material.

Recommendations for Gender Differences	
R11	Research should be conducted to investigate the nature of emerging gender differences in performance in mathematics at primary-school level. Relevant aspects might include school composition, instructional practices, and pupil dispositions.

6. Home-School Links and Mathematics Achievement

In the current study, parents' satisfaction with their child's progress in mathematics was associated with pupil achievement and with pupil self-efficacy in mathematics. In general, children who were viewed by their parents as doing well in mathematics had higher achievement scores, and higher confidence in their ability to succeed on mathematics problems than children whose parents perceived them to be doing poorly. Parents were broadly happy with their children's progress, particularly where number facts, computation, and measures were concerned.[5] They identified problem solving and data as areas with which they were relatively less satisfied.[6]

Over 86% of parents had attended parent-teacher meetings at which their children's mathematics progress could be discussed at least once a year, although for many parents, especially those whose children were not experiencing difficulties, this

[5] Parents did not have access to the results of NAMA 2004 for their child in reaching this determination.

[6] Parents may not have interpreted terms such as 'Problem Solving' and 'Data' in the ways in which they are defined in the 1999 PSMC.

appears to have been the extent of formal contact between the child's home and the school. The mean mathematics achievement score of children whose parents attended more than one meeting a year was significantly lower than that of children whose parents attended just one meeting, suggesting that parents who meet with teachers more frequently do so because a problem has arisen.

The Inspectorate's evaluation of the 1999 PSMC and the NCCA review refer to the non-participation of parents in school-related activities, and raise issues about parents' familiarity with the 1999 PSMC (DES, 2005b; NCCA, 2005). In particular, it would be beneficial if more schools could provide information sessions for parents on mathematics development, and outline changes arising since the implementation of the 1999 PSMC and any implications for work on mathematics at home. In addition to providing information on approaches to teaching mathematics in schools, it would also be important to identify for parents resources in the home and the community, including the Internet, that could be used to develop children's mathematics proficiency. In this context, the materials (DVD, templates for schools to communicate information about the curriculum at different levels) being prepared by the NCCA to inform parents about the 1999 PSMC and the ways in which parents can support the work of schools in implementing the curriculum should be useful, particularly if they focus in a specific way on what can be done to develop children's mathematics knowledge at home. The launch of a study by the NCCA in September 2006 to improve the quality of reporting by schools to parents in mathematics and other subjects should also improve communication.

As in other studies, such as NAMA 1999 and PISA, the occupational status of parents and their educational attainment were associated with their children's achievement in mathematics, with children of parents with lower-status jobs and lower educational attainment doing less well, on average. Pupils in lone-parent families also did significantly less well than children in other family types. Although parents are relatively powerless to change their socioeconomic circumstances in the short term, there are aspects of the home environment related to mathematics achievement over which parents can exercise control. These include engaging children in mathematics-related activities on a regular basis (e.g., games involving mathematics, reading timetables and maps, and working with quantities, locating shapes in the environment), and ensuring access to relevant resources such as a calculator. Other findings of our study, such as the significantly lower achievement of pupils who had a television in their bedroom compared with those who had not, may also have relevance for parents.

In the current study, 15% of parents reported spending upwards of 30 minutes a day helping their child with mathematics homework, while, on average, children who received help for 30 minutes or longer did considerably less well than children who received less help. This finding indicates that some parents may need additional support from schools and teachers in identifying the amount of help with homework that should be provided, and in deciding the nature of that help.

Recommendations for Home-School Links	
R12	Schools and teachers should support parents in developing their child's proficiency in mathematics, through provision of information on changes in curriculum and teaching methodologies, advice on engaging children in mathematics-related activities at home, and guidance on using homework (including the amount of time to allocate to homework) to support learning.
R13	Parents should seek ways to support the development of children's mathematics proficiency at home, through engaging them in informal mathematics activities including games involving estimation, providing them with relevant resources, and giving them appropriate support in completing homework activities.

7. Planning for and Organising Mathematics in Schools and Classrooms

Most pupils in the current study attended schools whose principal teachers reported that the school development plan relating to mathematics included statements on assessment of pupils' achievements, maintenance of records on achievement, engagement of pupils in practical activities, an inventory of equipment/materials, and common mathematics terminology. However, plans were less likely to include statements relating to the organisation of teaching (e.g., grouping), strategies for teaching problem solving, provision for pupils with learning difficulties, or provision for advanced pupils in mathematics. Hence, in at least some schools, there are aspects of the school development plan for mathematics that may need to be extended.

Over half of pupils in the study were taught by class teachers who reported using a limited set of resources (typically the class text or the accompanying teacher manual) to plan for mathematics teaching and learning. This may arise from the fact that some textbooks present a programme for each class year, which is already organised by stands and strand units. Sources such as curriculum documents and the *Plean Scoile* were used relatively infrequently. Over four-fifths of pupils were taught by teachers who said that they met with colleagues no more than once or twice a year (if at all) to discuss teaching methodologies or issues of concern in the PSMC. These findings are consistent with those of the DES (2005b) evaluation of the implementation of the 1999 PSMC, and point to a need for more collaborative planning in schools, and for the establishment of stronger links between school plans, curriculum documents, and teacher schemes for mathematics.

Inspectors in the study identified collaborative group work as a potentially effective approach to teaching mathematics, while principal teachers noted that the 1999 PSMC offered greater opportunities for group work in classrooms. Nevertheless, teachers in this study reported that group or paired work was offered to less than 6% of pupils in most mathematics lessons, and that 25% of pupils were never grouped for mathematics lessons. Given the emphasis on practical activities and problem solving in the 1999 PSMC, including the role of discussion in developing mathematics skills, it is worrying that many children do not have an opportunity to engage more often in collaborative group work.

Pupils in Fourth class received an average of 30 minutes less direct mathematics instruction per week in 2004 than in 1999. The difference was over 45 minutes in single-grade classes, and 20 minutes in multi-grade classes. Most pupils received more than the minimum recommended time of 180 minutes per week. Although overall mean scores in mathematics achievement did not change significantly between 1999 and 2004, it cannot be concluded on the basis of this study that a reduction in time allocated has had no cumulative or long-term effects on mathematics achievement, particularly for pupils who started school after implementation of the 1999 PSMC in 2002. The associated reduction in the average length of mathematics lessons in Fourth class (over 10 minutes in single-grade classes) may reduce opportunities for pupils to engage in the substantive problem-solving activities and discussion envisaged in the 1999 PSMC. However, it has to be acknowledged that the reduction in time teaching mathematics can be offset to some degree by integrating the teaching of mathematics in other subject areas.

Recommendations for Planning for and Organising Mathematics	
R14	Schools should base their development plans for mathematics on the PSMC, and should ensure congruence between school plans and class plans for mathematics. Both types of plan should include arrangements for grouping pupils for mathematics teaching, strategies for teaching problem solving, provision for pupils with learning difficulties, and provision for high achievers.
R15	Teachers should ensure that there are links between school plans and class schemes in mathematics. Opportunities for collaborative planning and analysis should be organised by school management in order to facilitate class teachers and learning support teachers in jointly implementing programmes for children with learning difficulties in mathematics.
R16	Schools and teachers should ensure that adequate time is available during mathematics lessons to implement the approaches to developing problem solving skills outlined in the 1999 PSMC. These include making hypotheses, constructing mathematics models, drawing diagrams, looking for patterns, experimenting with strategies, and discussing outcomes in small-group and whole-class contexts.
R17	Future national assessments of mathematics should continue to monitor the effects of reduced dedicated teaching time on pupil achievement in mathematics, taking into account the integration of mathematics into other subject areas.

8. Use of Resources in Mathematics Classrooms

Almost all pupils in the current study were taught by teachers who reported that they used textbooks on a daily basis. Workbooks, worksheets and tablebooks were also used extensively. On the other hand, almost one-half of pupils were in classrooms in which concrete materials were used to teach mathematics no more often than once or twice a month. These outcomes may be contrasted with the recommendation in the 1999 PSMC that extensive use be made of concrete materials at all class levels, including Fourth class. The NCCA curriculum review cited the use of practical work as the most successful aspect of the 1999 PSMC from the perspective of teachers (NCCA, 2005), and ratings provided by inspectors in the current study suggest that relatively good use is made of concrete materials to teach Number and Measures. It is interesting, therefore, that self-reports of teachers in our study suggest a somewhat limited use of concrete materials. Cleary, there are still aspects of mathematics in which resources could be used more often and to better effect. For example, over one-third of inspectors in the current study were dissatisfied with the extent of the use of resources to teach Shape & Space. The recommendation by the Inspectorate (DES, 2005b) to extend the collection and interpretation of data to other subject areas such as geography and science is also consistent with efforts to increase the use of resources in teaching mathematics. The use of appropriate computer software (such as spreadsheets) by pupils as they engage in data-related activities should also be considered.

The current study shows that 78% of pupils were in classrooms in which calculators were used no more than once or twice a month. The PSMC refers to the importance of calculators in the development of estimation and problem solving skills from Fourth class onwards. For example, it is stated that ‘calculators can make problem solving more accessible for lower-achieving children. . . ’ and ‘the skills of estimation and trial-and-error methods of problem solving can be developed’ (NCCA, 1999c, p. 50). It is surprising, therefore, that the proportion of pupils in Fourth class who use calculators on a more frequent basis is not larger. This may be because of an ambivalent attitude towards calculators in some schools. For example, in the present study, just 19% of pupils attended schools where the principal teacher strongly agreed that calculators were an important component of the 1999 PSMC. There is clearly scope for enhanced use of calculators in mathematics classes, not just to implement routine computations and check answers, but to explore number concepts, discover number facts and relationships, and solve complex problems.

ICT is underused in mathematics classrooms, with 56% of pupils ‘hardly ever or never’ using computers. Moreover, in classes where computers are used, software that provides practice on mathematics facts and skills is used more widely than software that engages pupils in higher-level thinking, while Internet resources for learning mathematics are rarely used. The 1999 PSMC recognises the potential of computers as another tool which can provide interesting extension work for pupils of all levels of ability, and can also be used in conjunction with group or paired work. Hence, schools and teachers should make greater use of this important resource.

However, this will not be easy. Teachers in the NCCA review of the PSMC noted lack of time, unsuitable/unavailable software, lack of familiarity with classroom management strategies, insufficient computers, and lack of teacher knowledge/skill as significant impediments to implementation (NCCA, 2005).

Recommendations for Use of Resources in Mathematics Classrooms	
R18	Schools and teachers should ensure that an appropriate range of resources (including environmental resources) are used in mathematics lessons at all class levels. There is a need to use resources on a more frequent basis in at least two mathematics strands in particular – Shape & Space and Data.
R19	Schools and teachers should extend the use of calculators and ICTs to teach mathematics in line with the guidelines in the 1999 PSMC. Calculators and ICTs should be used not only to develop skills such as basic computation, but also to enhance mathematics reasoning and problem solving skills.
R20	Schools and teachers should be facilitated and supported through professional development training, in extending the use of calculators and ICTs in mathematics classes as tools for teaching and learning.

9. Learning Support for Mathematics

In 2004, 6.5% of pupils in Fourth class were in receipt of learning support for mathematics, while 4% were in receipt of resource teaching for mathematics.[7] Given some small overlap between these categories, it can be estimated that about 10% of pupils were in receipt of some form of support. This can be interpreted as indicating an improvement in access to support in mathematics since 1999.[8] Nevertheless, access to support may be problematic for pupils who do not qualify for resource teaching. In 2004, just under one half of pupils attended schools in which no learning support for mathematics was provided. Moreover, pupils attending medium and small schools were less likely to access support than pupils attending large schools. The percentages of pupils in receipt of support did not differ between designated and non-disadvantaged schools, despite the lower level of achievement in designated schools. Pupils in Junior classes were less likely to access support than pupils in Senior classes. Learning support provision for English was prioritised over learning support for mathematics in many schools, even though the *Learning Support Guidelines*

[7] Resource teaching in mathematics refers to the provision of supplementary individual or small-group instruction by a teacher to pupils with a diagnosed general learning disability or a specific learning disability. Learning support teaching in mathematics refers to the provision of supplementary teaching by a teacher to pupils with low achievement in mathematics. Circular SP ED 02/05, which post-dated NAMA 2004, describes a new 'general allocation' model in which learning support and resource teaching may be provided by the same teacher.

[8] Data on the proportion of pupils in Fourth class in receipt of resource teaching in mathematics arising from a general learning disability were not gathered in 1999. However, the overall percentage is likely to have been low since schools were only beginning to provide resource teaching on a widespread basis at the time.

(DES, 2000) envisaged access to learning support in mathematics in all schools where a need existed.[9]

Even where learning support in mathematics is available, issues arise about its quality. These include lack of access to the one-year, part-time course for learning support teachers[10] (in 2004 only 57% of teachers providing learning support for mathematics had completed, or were completing, the course), low levels of co-ordination between class and learning support teachers in some schools, and low levels of emphasis on some mathematics strands (Shape & Space, Data) and skills (Reasoning, and Applying & Problem Solving) in learning support classes. In the LANDS study, the Inspectorate noted a lack of individually planned programmes for pupils with learning difficulties in mathematics in designated schools, and lack of differentiation in meeting the learning needs of pupils, even when the pupils were given time and attention on an individual basis (DES, 2005b).

The level of co-operation between the key participants involved in learning support for mathematics (the class teacher, learning support teacher, the pupil, and the pupil's parents), and their collective role in shaping the school development plan need to be reconsidered. Indeed, relative to other issues, more learning support teachers rated these areas – working effectively with teachers, working with parents, and developing/reviewing school policy on learning support – as ones that were not covered in sufficient detail on the one-year, part-time course.

An aspect of learning support in mathematics raised by principals and learning support teachers in particular was the use, at the time of the study, of the 10th percentile on a standardised test of mathematics as a cut-off point for admission to learning support classes. It was argued that pupils performing below the 20th percentile should receive additional support if needed, and that provision of such support to pupils above the criterion level at an earlier stage might serve to reduce need later on. Although the current priority should be to ensure that all pupils with very low achievement in mathematics can access learning support, it would be important to examine practices in learning support provision for mathematics in schools in which it has been available for some time to ascertain the suitability of 10th percentile cut-off point. A need is also indicated for a broader set of criteria to identify students in need of support (e.g., a combination of standardised test scores, teacher judgements, and the outcomes of more formative or diagnostic assessments).

Data for the current study were gathered before the introduction in September 2005 of the weighted system for the allocation of special needs/learning support teachers to schools, in which greater flexibility in deploying learning support and resource teachers in schools was envisaged (Circular SP ED 02/05). It would seem important to ensure that application of the new system results in an appropriate response to the needs of pupils with learning difficulties in mathematics in all schools.

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[9] Circular SP ED 02/05, which was issued after NAMA 2004 had been implemented, did not make a distinction between provision of support for English and mathematics, implying that schools should provide support for both.

[10] This course for learning support teachers, which is sanctioned by the Department of Education and Science, is typically offered in Colleges of Education.

Recommendations for Learning Support for Mathematics	
R21	The DES and schools should monitor implementation of the general allocation model for assigning support teachers to schools to ensure that adequate provision is made in all schools for pupils with learning difficulties in mathematics.
R22	The DES and schools should ensure that learning support teachers have access to an appropriate initial course when they undertake learning support teaching for the first time, and to other relevant courses on an ongoing basis thereafter.
R23	Teachers should be supported by the DES and school management in planning the co-ordination of class and learning support programmes for pupils with learning difficulties in mathematics.

10. Teacher Education in Mathematics

While in NAMA 1999 just 16% of pupils were taught by teachers with at least five years experience who had attended in-career development in mathematics in the five years prior to the study, the figure in 2004 was 94%. Much of the improvement can be attributed to the provision by the Primary Curriculum Support Service of in-service days linked to the implementation of the 1999 PSMC from 2001 onwards. The concern now is that teachers will continue to have opportunities to access in-career development in mathematics that is specifically related to their needs, both through PCSP (which currently operates the Regional Curriculum Support Service in mathematics[11]) and other organisations. While the provision of quality summer courses in mathematics, perhaps linked to some form of Certificate is one area in need of development (see Delaney, 2005), there is a need, at system level, to establish a comprehensive multi-year plan for in-career development in mathematics. Individual schools also need to be supported in addressing the ongoing in-career development of teachers in the context of within-school priorities in mathematics.

Teachers in the present study said that they were largely satisfied with the amount of ICD available to them in the context of implementing the 1999 PSMC. While they reported satisfaction with coverage of the main strands of the curriculum, however, they were dissatisfied with the emphasis on Reasoning, Applying & Problem Solving, and Communicating & Expressing. Teachers identified classroom-based assessment of mathematics, the identification of learning difficulties, the interpretation of standardised test scores, the use of ICT to teach mathematics, and the grouping of children for mathematics lessons as areas in need of further development. The areas identified by teachers and inspectors as being in need of further development were broadly similar, with neither group indicating that the use of calculators in mathematics classes was an urgent need at this time, despite their under-

[11] See footnote on page 151.

use in many classrooms, and the relatively poor performance of pupils in this study on test items for which a calculator was available.

The under-use of ICT in mathematics classrooms was also highlighted in the NCCA review of the PSMC, where lack of time, a shortage of software, concerns about classroom management, and shortage of computers were identified as difficulties (NCCA, 2005). In follow-up teacher interviews, lack of confidence in using ICTs was also identified as a barrier to greater use. Given that the consistent use of appropriate software has been shown to contribute to gains in basic skills (e.g., Mann, Shakeshaft, Becker & Kottkamp, 1999) and higher-order skills [see Kulik (2003) for a review of studies], the provision of national in-career development designed to enhance the use of ICTs in mathematics classrooms seems justified. In addition to exploring software, such in-career development might focus on the uses of Internet-based resources for teaching and learning mathematics, including virtual manipulatives.[12] ICD in this area could also identify Internet-based resources that might be used by parents to support their children's mathematics development. The wider availability of broadband in schools in the future should assist teachers in accessing web-based resources more easily.

The fact that assessment was not treated in depth in the context of preparing teachers for implementing the 1999 PSMC may have contributed to a situation in which both inspectors and teachers in the present study, and participants in the DES (2005b) and NCCA (NCCA, 2005) studies of curriculum implementation, identified in-service on classroom-based assessment as a pressing need. Clearly, the implementation of classroom-based assessment in mathematics, and the interpretation of standardised tests are key areas in need of development to improve teachers' ability to provide for pupils with learning difficulties, to group pupils for instruction, and to differentiate instruction in the classroom.

In reviewing pupil performance on problem solving, it was noted that teachers' own school mathematics experiences, which in many cases focused on the development of procedural knowledge, could be contrasted with the constructivist approaches outlined in the 1999 PSMC. In this regard, the recommendation of the Working Group on Primary Preservice Teacher Education in their report, *Preparing Teachers for the 21st Century* (2002), that a course in professional mathematics that would improve mathematical competence and pedagogical knowledge should be introduced in preservice teacher education programmes, is relevant. Such a course could address some of the issues concerning the mathematics competence of teachers raised by Corcoran (2005), who found that, on average, preservice teachers (both undergraduate and post-graduate) participating in a mathematics education course performed better on average than Irish 15-year on PISA-type problem-solving items, yet struggled with important aspects of Shape & Space. Corcoran argued that the ability to structure lessons and foster the development in children of skills such as Communicating & Expressing, and Applying & Problem Solving requires

[12] See, for example, http://nlvm.usu.edu/en/nav/index.html

considerable mathematical literacy on the part of teachers, as well as confidence in their own ability to reason mathematically.

Finally, it is a matter of concern that, in a recent study by the DES (2005c), newly-qualified teachers perceived themselves to be more poorly prepared to teach mathematics than most other subject areas. The finding reinforces the need to support teachers in the early years of their careers.

Recommendations for Teacher Education in Mathematics	
R24	The DES, its agencies, and schools should adopt a structured approach to planning in-career development in mathematics. Time should be given in ICD courses to supporting teachers in implementing approaches to teaching higher-order mathematics skills including Applying & Problem Solving, and to addressing issues in the areas of classroom assessment, the interpretation of standardised tests, identifying learning difficulties in mathematics, grouping pupils for instruction, and using calculators and ICTs to support mathematics teaching and learning.
R25	Colleges of Education should provide professional mathematics courses that would build on the students' mathematical literacy skills and develop their ability to reason mathematically in teaching contexts.
R26	Schools and other agencies should support beginning teachers in reflecting on, and developing, their knowledge about teaching mathematics.

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[1] http://www.ncca.ie/uploadedfiles/mathsreview/intpaperoct.pdf
[2] http://www.spd.dcu.ie/main/academic/education/documents/Proceedings.pdf
[3] http://www.spd.dcu.ie/main/academic/education/documents/Proceedings.pdf

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[4] http://www.education.ie/servlet/blobservlet/DEIS_action_plan_on_educational_inclusion.pdf?language=EN
[5] http://www.education.ie/servlet/blobservlet/insp_evaluation_curriculum_implementation_p.pdf
[6] http://www.education.ie/servlet/blobservlet/insp_beginning_to_teach.pdf
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Appendix

Mathematics Proficiency Levels – Descriptions of Principal Process Skills for Full Item Set

			Level 5 - Advanced Level of Mathematics Achievement	
Strand	**Skill**	**Ref**	**Principal Process Skill**	**Logit**
NUM	A&PS	B22	Solve non-routine problem involving use of fraction concepts and operations	1.98
MEAS	I&C	A21	Connect decimal and fraction notation in comparing capacities of containers	1.94
DATA	IMP	C16	Read values on a line graph	1.77
DATA	REA	C15	Interpret and analyse data in a line graph	1.57
ALG	REA	F16	Identify and extend patterns and relationships in number	1.50
NUM	REA	F15	Make hypotheses and test them for correctness (mixed operations sentence)	1.48
MEAS	A&PS	C23	Solve non-routine problem involving measure concepts and fraction operations	1.28
MEAS	A&PS	E20	Solve routine problem involving measure concepts and fraction operations	1.28
S&S	U&R	E17	Recall definition of property of lines and angles	1.24
MEAS	A&PS	C21	Solve routine problem involving subtraction of times	1.23
NUM	IMP	E13	Implement procedure for estimating quotients	1.21
MEAS	A&PS	F21	Select appropriate operation for solving routine problem on time	1.16
MEAS	A&PS	F23	Apply concepts of ratio and proportion in shopping problem	1.16
NUM	IMP	D18	Implement procedure for estimating sums	1.07

			Level 4 – High Level of Mathematics Achievement	
Strand	**Skill**	**Ref**	**Principal Process Skill**	**Logit**
NUM	A&PS	C06	Solve routine problem involving fraction concepts and operations	1.02
S&S	REA	A25	Make informal deductions about 2-D shapes	1.01
MEAS	A&PS	F17	Solve non-routine problem involving measure concepts and operations	1.01
MEAS	A&PS	F20	Solve non-routine problem involving measure concepts and operations	0.99
MEAS	A&PS	B25	Solve routine problem involving fraction and length concepts	0.94
S&S	U&R	D14	Recall and use definition of perpendicular lines	0.94
NUM	A&PS	F04	Solve routine problem involving multiplication of times	0.94
MEAS	A&PS	F19	Solve non-routine problem involving operations with weight measures	0.90
DATA	REA	D20	Systematically list options in a roadmap context	0.87
S&S	REA	E25	Make informal deductions about properties of 2-D shapes	0.86
NUM	REA	F05	Make hypotheses and test them for correctness (multiplication sentence)	0.84
MEAS	A&PS	C10	Analyse a timetable to solve a problem	0.82
DATA	A&PS	E11	Solve a routine problem using data from a line graph	0.82
MEAS	A&PS	E18	Solve routine problem involving subtraction of weights	0.79

NUM	A&PS	C19	Solve routine problem involving division of whole numbers	0.77
MEAS	A&PS	A22	Solve non-routine word problem involving measures of time	0.76
S&S	REA	C24	Visualise properties of 3-D shapes from 2-D diagrams	0.76
NUM	U&R	E22	Identify fraction of area of regular shape	0.75
ALG	U&R	C22	Recall meaning of < symbol	0.73
MEAS	A&PS	B19	Apply concept of scale to map-reading	0.67
S&S	REA	D16	Recall and use definition of a right angle	0.65
ALG	REA	E19	Complete number sentence involving distributive property	0.65
NUM	REA	E21	Identify a fraction between two fractions	0.65
MEAS	A&PS	E24	Solve routine problem involving calculation of perimeter	0.65
NUM	IMP	A09	Implement procedure for long multiplication	0.62
S&S	U&R	D21	Recall and use definition of a right angle	0.61
S&S	REA	C25	Partition 2-D shape using area concept of fraction	0.60
MEAS	IMP	D15	Add measures of length	0.60
NUM	U&R	A20	Identify example of a fraction	0.57
S&S	U&R	A24	Identify angle types in a 2-D shape	0.57
NUM	IMP	E23	Round whole numbers to nearest hundred	0.56
NUM	IMP	A19	Round four-digit whole numbers	0.55
NUM	REA	D17	Identify missing information in a problem	0.55
MEAS	A&PS	D22	Solve routine problem involving multiplication of whole numbers	0.55
S&S	REA	B11	Visualise properties of 3-D shapes from 2-D nets	0.53
S&S	U&R	B24	Recall and use definition of parallel lines	0.53
NUM	IMP	C20	Calculate a fraction of a number	0.51
NUM	IMP	F08	Make hypotheses and test them for correctness (division sentence)	0.51
ALG	I&C	A23	Connect verbal and symbolic representations of a word problem on operations	0.50
NUM	U&R	C08	Identify place value in decimals	0.50
ALG	REA	D24	Complete number sentence involving associative property	0.46
NUM	REA	F10	Test answers for correctness in mixed operations sentences	0.46
MEAS	A&PS	F25*	Solve routine problem involving division of whole numbers	0.45
DATA	A&PS	F12	Analyse a table of data to solve a routine problem	0.44
NUM	U&R	B18	Convert a fraction to decimal	0.43
NUM	A&PS	B07	Solve routine word problem on fractions	0.42
NUM	I&C	B17	Connect verbal and symbolic representations of estimation procedure	0.41
MEAS	A&PS	C11	Read a timetable to solve a routine problem	0.41
MEAS	A&PS	F18	Calculate perimeter of rectangular area in problem context	0.41
MEAS	IMP	A14	Convert measures of time	0.39
MEAS	A&PS	C13	Solve routine problem involving subtraction of weights	0.35

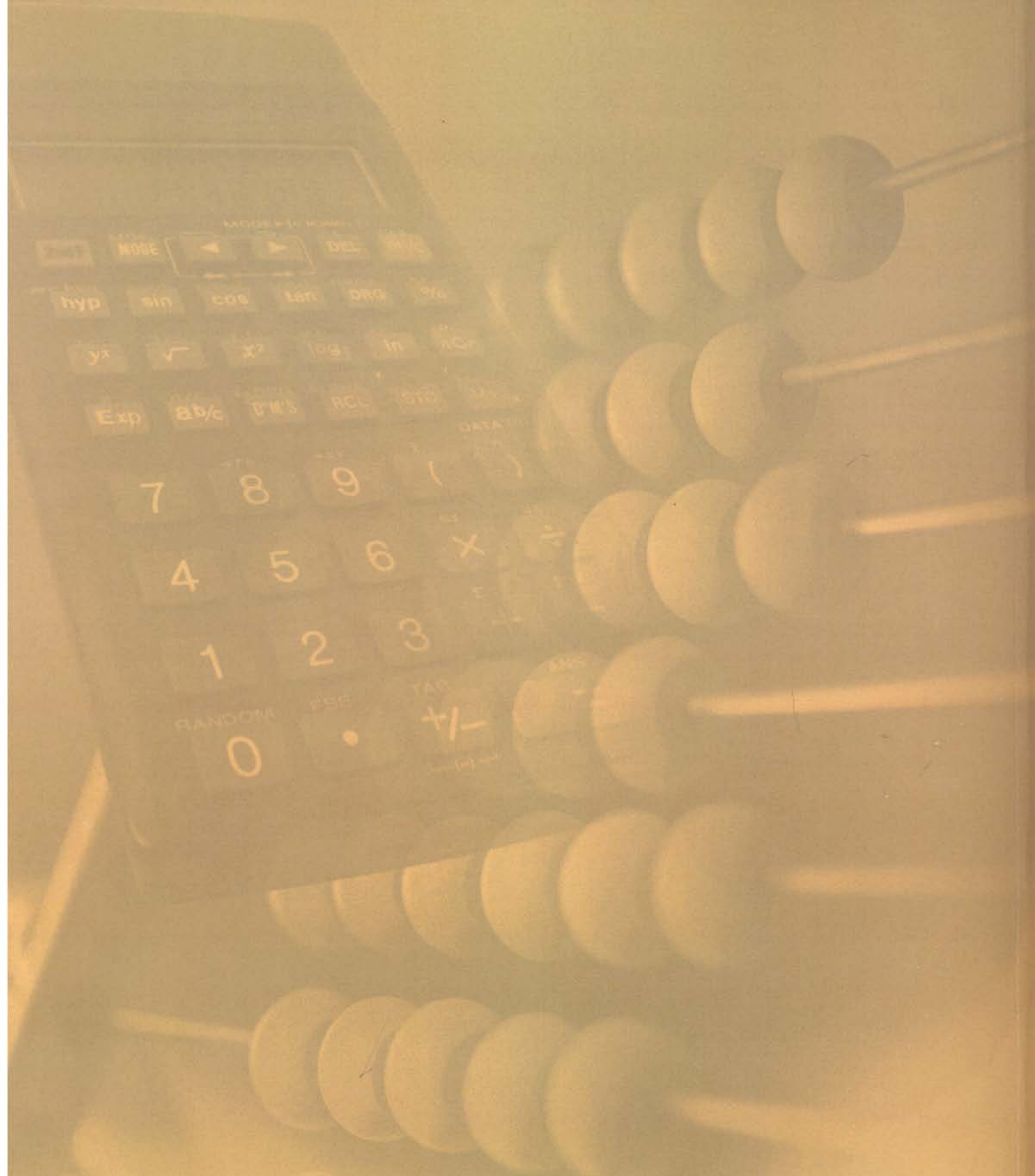
Strand	Skill	Ref	Principal Process Skill	Logit
			Level 3 – Moderate Level of Mathematics Achievement	
MEAS	IMP	B23	Calculate difference in lengths of two objects	0.33
NUM	A&PS	C17	Solve routine problem involving multiplication of capacities	0.32
NUM	REA	F09	Make hypotheses and test them for correctness (mixed operations sentence)	0.30
MEAS	U&R	B16	Select appropriate unit of weight	0.28
MEAS	A&PS	E16	Solve routine problem involving subtraction of lengths	0.27
NUM	REA	F07	Test answers for correctness in division situation	0.27
NUM	U&R	D12	Identify fractional area of regular 2-D shape	0.24
S&S	U&R	A10	Identify example of angle type	0.22
MEAS	A&PS	F22	Solve routine problem involving operations with money	0.20
NUM	A&PS	A15	Apply Unitary Method in everyday context	0.18
NUM	I&C	B13	Connect verbal and symbolic representations of a word problem on ratio	0.18
S&S	U&R	C18	Recall and use definition of line symmetry	0.18
S&S	U&R	D25	Recall and use definition of line symmetry	0.18
MEAS	I&C	B20	Connect verbal, diagrammatic and symbolic representations of perimeter	0.16
NUM	IMP	C04	Divide a decimal by a whole number	0.16
NUM	REAS	D03	Complete number sentence involving distributive property	0.16
NUM	IMP	C07	Estimate products of whole numbers	0.15
MEAS	A&PS	D08	Solve non-routine problem involving money operations	0.11
NUM	REA	E07	Order fractions in terms of magnitude	0.05
MEAS	A&PS	A12	Solve routine word problem involving subtraction of lengths	0.04
MEAS	IMP	D23	Convert measures time	0.04
ALG	I&C	B14	Connect verbal and symbolic representations of a word problem on operations	0.03
NUM	A&PS	B10	Solve non-routine problem involving whole number operations	0.02
NUM	IMP	E02	Implement procedure for division of whole numbers	-0.01
MEAS	A&PS	E15	Solve routine problem involving subtraction of times	-0.02
MEAS	A&PS	E14	Solve routine problem involving subtraction of times	-0.04
NUM	REA	F06	Make hypotheses and test them for correctness (multiplication sentence)	-0.04
MEAS	A&PS	C14	Solve non-routine problem involving systematic listing of possible routes(map)	-0.08
NUM	IMP	D02	Round four-digit numbers	-0.10
DATA	U&R	D10	Order simple events in terms of likelihood of occurrence	-0.11
NUM	A&PS	D07	Solve routine problem involving fractions	-0.13
NUM	REA	F02	Reason systematically about multi-digit numbers in column addition	-0.17
NUM	A&PS	D11	Solve non-routine problem involving division of whole numbers	-0.18
DATA	A&PS	F14	Analyse a table of data to solve a routine problem	-0.19
MEAS	A&PS	D19	Solve routine problem involving subtraction of capacities	-0.20
NUM	REA	E05	Identify and extend decimal number pattern	-0.21
NUM	A&PS	A08	Solve word routine problem involving fraction concept	-0.22

Strand	Skill	Ref	Principal Process Skill	Logit
			Level 2 - Basic Level of Mathematics Achievement	
MEAS	IMP	A17	Calculate area of regular shape using a grid	-0.27
MEAS	A&PS	A16	Apply Unitary Method in everyday context	-0.29
MEAS	I&C	C09	Connect diagrammatic and verbal representations of weight problem	-0.29
DATA	A&PS	F11	Analyse a table of data to solve a non-routine problem	-0.29
S&S	U&R	A18	Visualise properties of 3-D shape	-0.32
MEAS	A&PS	D13	Solve routine problem involving addition of whole numbers	-0.34
S&S	U&R	B12	Identify properties of 2-D shapes	-0.36
DATA	A&PS	F13	Analyse a table of data to solve a non-routine problem	-0.37
MEAS	A&PS	A11	Solve non-routine word problem involving money operations	-0.38
NUM	IMP	A13	Count even numbers in a specified range	-0.38
NUM	IMP	D04	Identify place value in decimals	-0.40
NUM	REA	D05	Reason with notation of decimals	-0.40
S&S	REA	D09	Visualise properties of 3-D shapes from 2-D diagrams	-0.54
MEAS	A&PS	A06	Solve routine word problem involving measures of time	-0.55
NUM	IMP	B03	Implement short multiplication procedure	-0.56
NUM	REA	C12	Reason with notation of four-digit numbers	-0.58
NUM	IMP	E01	Implement procedure for column addition	-0.58
MEAS	U&R	A07	Select appropriate unit of length	-0.59
S&S	REA	E09	Visualise properties of 3-D shapes from 2-D diagrams	-0.62
NUM	IMP	D01	Implement procedure for multi-digit subtraction	-0.67
DATA	IMP	E10	Read values from a line graph	-0.75
MEAS	A&PS	A02	Solve routine word problem on addition and subtraction of money	-0.77
MEAS	IMP	C05	Solve routine problem involving addition of lengths	-0.78
MEAS	U&R	E03	Read time from a clock	-0.81
S&S	REA	E04	Analyse a table classifying shapes by four properties	-0.84
DATA	REA	B06	Make informal deductions about graphical data	-0.89
NUM	REA	B21	Identify decimal between two decimals	-0.93

Strand	Skill	Ref	Principal Process Skill	Logit
			Level 1 - Minimum Level of Mathematics Achievement	
NUM	A&PS	A05	Solve routine word problem involving use of a division fact	-1.00
MEAS	A&PS	E08	Solve routine problem involving calculation with a calendar	-1.01
S&S	U&R	E12	Recall and use definition of line symmetry	-1.08
NUM	U&R	B08	Identify place value in four-digit numbers	-1.09
NUM	IMP	C01	Implement short multiplication procedure	-1.13
NUM	U&R	C02	Read points on a decimal scale	-1.18
NUM	U&R	A01	Recall basic multiplication/division fact	-1.23
DATA	IMP	B04	Read and interpret tabular data	-1.23
MEAS	A&PS	D06	Analyse a diagram to solve a problem on area	-1.28
ALG	REA	B05	Identify and extend a number pattern	-1.31
DATA	U&R	B15	Order events in terms of likelihood of occurrence	-1.32

NUM	A&PS	F03	Solve routine problem involving multi-digit subtraction	-1.32
MEAS	IMP	B01	Select procedure to solve a problem	-1.38
MEAS	U&R	E06	Select appropriate unit for measuring capacity	-1.50
DATA	A&PS	A04	Solve routine word problem on concept of chance	-1.58
S&S	REA	B09	Make informal deductions about 2-D shapes	-1.59
NUM	IMP	F01	Implement procedure for column addition	-1.67
S&S	REA	C03	Partition a 2-D shape into a set of specified shapes	-1.70
DATA	IMP	A03	Draw a simple line graph	-1.81
DATA	IMP	B02	Read and interpret a bar chart	-1.86
MEAS	A&PS	F24*	Solve routine problem involving operations with fractions	

* *This item was not scalable, as it had a negative biserial value.*
ALG = Algebra; NUM = Number; S&S = Shape and Space; MEAS = Measures; DATA = Data;
A&PS = Apply and Solve Problems; I&C = Integrate and Connect; IMP = Implement; I&CREA = Reason; U&R = Understand and Recall;



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