The Education and Training Inspectorate - Promoting Improvement

Providing Inspection Services for

Department of Education
Department for Employment and Learning
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Better Mathematics

EVALUATION AND PROMPTS FOR SELF-EVALUATION AND IMPROVEMENT IN POST-PRIMARY SCHOOLS

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INTRODUCTION

In 2001, the Education and Training Inspectorate (the Inspectorate) published *Improving Mathematics*[1], in which the strengths and areas for development of the mathematics provision in post-primary schools were identified. This document built on the evaluations of previous Inspectorate reports[2 3] and added further to the overall understanding of the characteristics of good quality mathematics provision *(Evaluating Mathematics, 1999)*. Since then, the Inspectorate has reported on mathematics/numeracy in the biennial Chief Inspector's Reports[4 5], and has also promoted the role of self-evaluation in improving the quality of education[6 7].

In 2005-06, the Inspectorate carried out a Quality Assurance Inspection (QAI) of the self-evaluation of the Northern Ireland Numeracy Strategy (NINS) undertaken by the NINS Steering Group. In the QAI report[8], the Inspectorate states,

> *"In the post-primary sector, ... the strategy has been less effective in improving the overall quality of the pupils' classroom experiences."*

It is thus timely to update the findings of *Improving Mathematics* and provide a basis for mathematics departments to self-evaluate effectively their work. This report provides an evaluation of the

1 *Improving Mathematics in Post-Primary Schools 2001 (based on inspections of, and visits to, mathematics departments between 1996 and 2000).*

2 *Mathematics in Secondary Schools 1990-1991.*

3 *Secondary Education 1994: Mathematics.*

4 *The Chief Inspector's Report 1999-2002, paragraphs 2.40 and 2.41.*

5 *The Chief Inspector's Report 2002-2004, paragraphs 3.62 and 3.63.*

6 *Together Towards Improvement.*

7 *The Reflective Teacher.*

8 *Northern Ireland Numeracy Strategy, Quality Assurance Report 2006.*

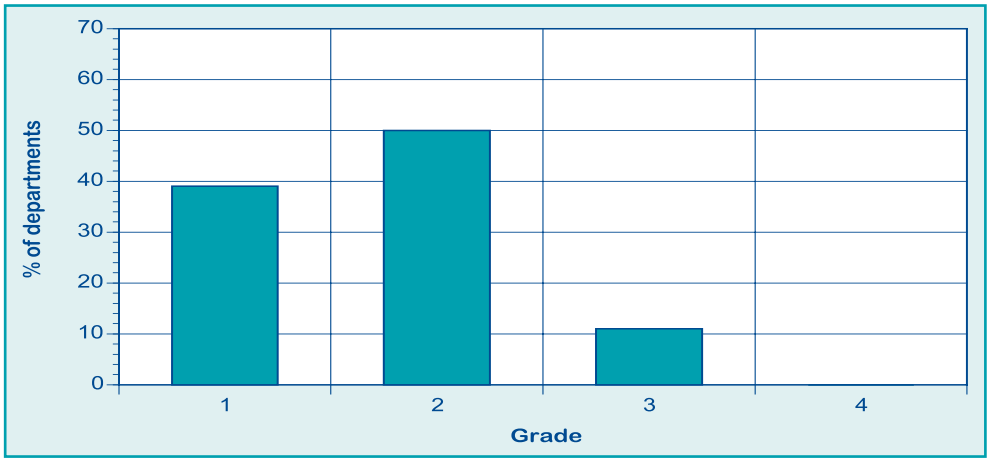
quality of provision based on evidence gathered through inspections of, and specialist visits to, 55 post-primary mathematics departments between the years 2001 and 2006. As an aid for teachers, working collaboratively at departmental level, the report also provides some questions that may be used to guide the self-evaluation and improvement process.

Summaries of the Inspectorate's evaluations, using the four grades below, are shown in the accompanying charts[9].

Grade	Description	
1	Significant strengths	Good (ranging to outstanding)
2	Strengths outweigh any weaknesses	Fully satisfactory (ranging to good)
3	Weaknesses outweigh any strengths	Fair (ranging to satisfactory)
4	Significant weaknesses	Poor

9 The percentages are based on the number of inspections and visits for which there was sufficient evidence gathered in the particular aspect of provision.

Ethos



In most departments, there were important strengths to the ethos; in particular:

Do pupils ever express enjoyment in maths classes?

- the working relationships between the pupils and teachers were strong;
- the pupils were well-settled and motivated;
- the teachers gave sensitive individual support when difficulties arose with the pupils' understanding; and
- generally, the pupils believed that, with the help of the teacher and their hard work, they would be able to improve their standard of achievement.

Do some pupils believe that they just cannot do maths and so are not able to improve?

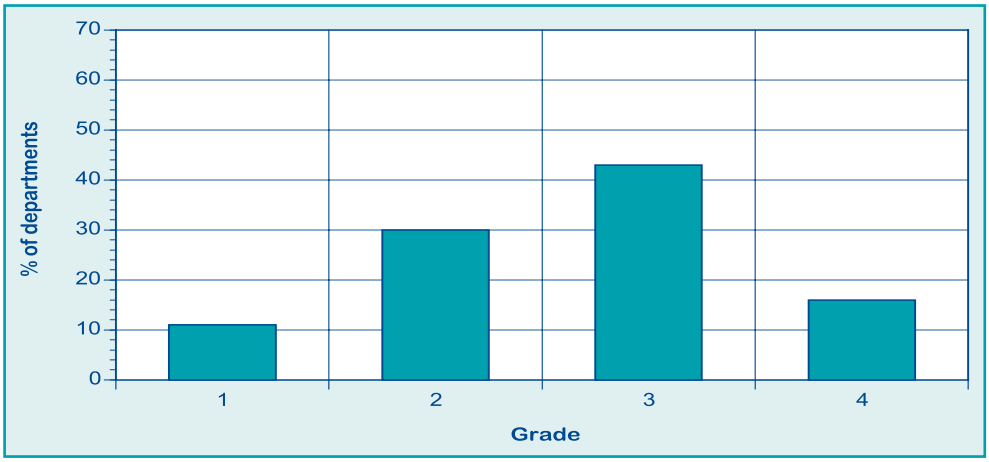
In the best practice, classrooms had a distinctive subject identity; the wall displays modelled good examples of pupils' work, were used to aid the teaching and learning, provided information on mathematics in day-to-day life and careers in mathematics, or illustrated aspects of mathematics to raise the level of interest in the subject, for example through competitions or puzzles. Frequently, however, the displays were out-of-date or dominated by commercial posters that were not suitable reference points for topics being taught. In addition, when pupils' work was on display, it was often unchallenging relative to the pupils' age and stage of development[10].

Is there a clear subject identity to the maths classrooms?

Are you able to refer to displays in your teaching to help the pupils understand concepts?

10 For example: pictures drawn using co-ordinators, symmetric figures, tessellations or statistical graphs illustrating data irrelevant to the pupils.

Planning



In general teachers prepared well for their individual lessons. In a majority of departments, however, there were important weaknesses to departmental planning. In a minority, the documentation at key stage 4 (KS4) and sixth form consisted of only the relevant General Certificate of Secondary Education (GCSE) and General Certificate of Education (GCE) specifications. At KS3, the teachers often used the commercial scheme of work (SoW) that accompanied the particular textbooks and there was little evidence that it was a 'working document'. In particular, the SoW for year 8 often represented regression rather than progression from the pupils' mathematical experiences in their primary schools; this practice regularly accompanied a perceived lack of time to complete the content for the appropriate tier of entry at the end of KS3 or at GCSE.

Do you have a SoW that complements the GCSE and GCE specifications?

Does the year 8 SoW take into account the skills and understanding achieved by the pupils in year 7 of their primary schools?

In the best practice, the SoW:

- was regularly annotated to aid revision on an annual basis;
- identified when and how information and communication technology (ICT) would be used;
- outlined both formal and informal instances when the pupils would undertake work related to processes;

Is the SoW revised annually?

- emphasised appropriately the role of mental mathematics;

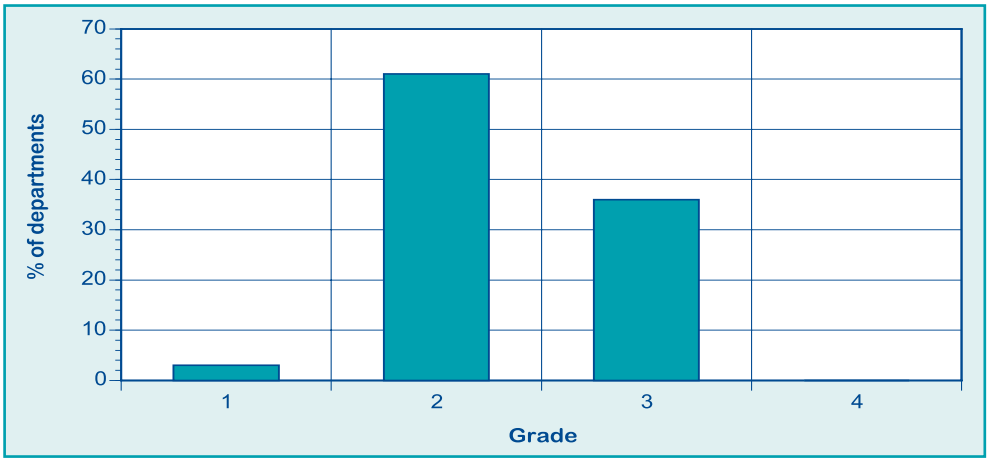
- was sufficiently detailed to help the teachers match the work to the abilities of the pupils, including those requiring additional help with their mathematics; and

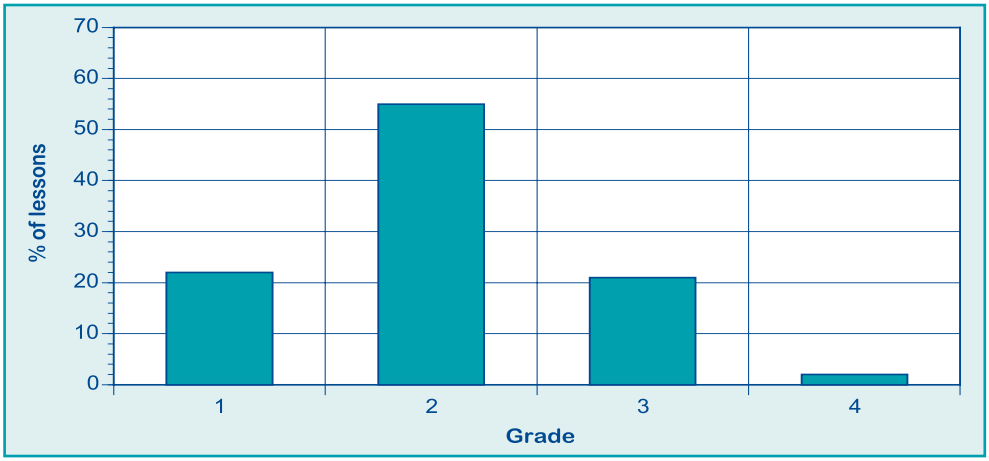
- provided a broad, balanced and coherent mathematics curriculum.

Does the SoW provide a sound basis for differentiated teaching?

In summary, SoWs were most effective when they provided clear guidance to help both the subject specialist and the non-subject specialist plan their individual lessons within a coherent structure to ensure progression in the skills and understanding of all the pupils.

Teaching





While approximately one-fifth of all lessons[11] observed had significant strengths, only in a small number of departments was this the predominant quality of teaching. The best lessons were characterised by many of the following strengths.

The teachers:

Do you share the learning outcomes with the pupils?

- share the intended learning with the pupils at the start of the lesson;

Are pupils clear about the relevance of their work?

- recap and link the work to previous learning, or set the work in an appropriate real-world context;

11 In total, 600 lessons were observed.

- provide clear exposition involving, where appropriate, multiple explanations, with board-work modelling what the pupils should do;

- use a variety of activities, including ICT and practical equipment, which entails the pupils working individually, in pairs or in groups;

  How often is group work used?

- provide opportunities for the pupils to problem-solve;

- integrate, when appropriate, the use of effective mental mathematics strategies;

  Are pupils encouraged to use their own mental strategies?

- use skilful questioning, challenging the pupils' understanding and requiring them to draw conclusions and justify their thinking;

  Do your questions require only short simple responses from the pupils?

- highlight common misconceptions and exploit these in a sensitive way;

- relate the ongoing work to other parts of the course to encourage the pupils to make interconnections and think of mathematics holistically;

- engage the pupils fully by ensuring that the lesson had appropriate pace, challenge and progression;

  Are the pupils always actively engaged in purposeful work during lessons?

- teach step-by-step algorithms only when necessary; and

  Do the pupils rely too much on their memory and not on their ability to reason?
  Do you encourage the pupils to 'have a go' and learn from their mistakes?

- encourage the pupils to think and talk about how they learn and what they have learnt, often through appropriate plenary sessions at the end of lessons.

  How often are pupils given the opportunity to discuss and explain their work?

Frequently, less effective mathematics lessons were characterised by the following:

- the pupils were shown one or two worked examples on the board, which sometimes were the ones provided in the textbook;
- the pupils began an exercise of questions from the textbook, which were often routine, repetitive and insufficiently challenging;
- the teacher gave individual support which consisted of his or her completion of the question for the pupil;
- the lessons were not drawn to an appropriate conclusion; and
- the teacher gave homework without due regard to the quantity and difficulty of the work entailed for each individual, for example, pupils being asked to 'finish the exercise'.

How often are pupils given the opportunity to think about their own thinking?[12]

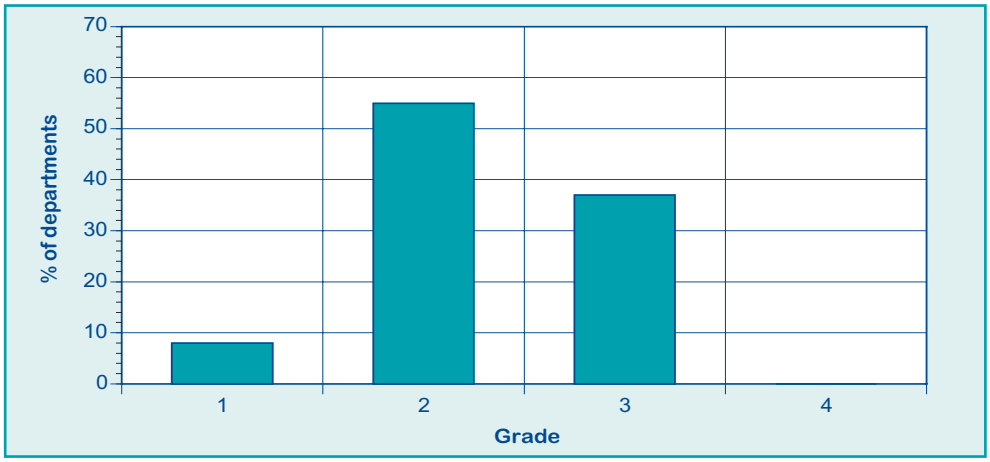
How often do lessons match this description?

Have you asked the pupils what they think of maths?

In these lessons, teachers generally taught, without sufficient explanation, step-by-step algorithms which the pupils were required to memorise. For many pupils, being good at mathematics is perceived as being able to memorise and apply accurately well-practised methods.

12 *Metacognition – the process of planning, assessing and monitoring one's own thinking.*

Learning



In a majority of departments, there were important strengths to the learning; in particular:

Do pupils show interest and take initiative in their work?

- the pupils responded well to the high expectations of their teachers;
- the pupils worked attentively and enthusiastically;

Is every pupil challenged mathematically at least once during each lesson?

- the pupils were willing to attempt new types of questions, sometimes even before the teacher's explanation; and
- the written work was of a high standard.

In the best practice, the pupils were motivated and had begun to evaluate their own work; they believed that they could and would achieve high standards.

Are pupils given opportunities to evaluate their own and one another's work?

On other occasions when the teaching was less effective, the pupils' learning was underdeveloped. This weaker learning was evident in the following aspects:

Do the pupils have a clear understanding of how their work should be presented?

- poor presentation of the pupils' work;

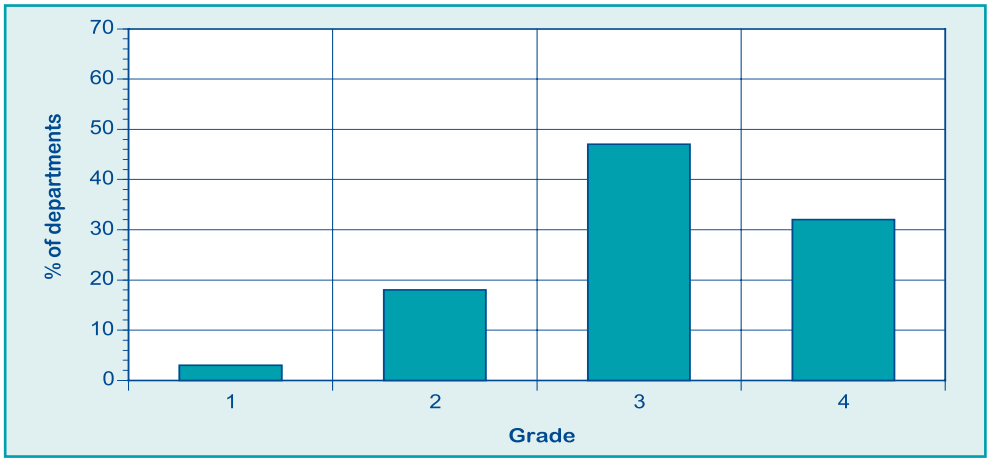
Are pupils confident when talking about maths?

- low levels of motivation and negative attitudes to mathematics;
- short, if any, responses to questions;
- pupils giving up rather than endeavouring to solve a problem;
- the pupils being unable to use a range of strategies in their mental mathematics work;

Are pupils able to express their mathematical understanding using appropriate language?

- imprecise use of mathematical language;
- the pupils, mainly but not exclusively boys, becoming easily distracted; and
- poor understanding by the pupils of what level of mathematical attainment is required for their future career pathway.

Information and communication technology



During the five years between 2001 and 2006, there has been an increase in the teachers' competence in ICT and use of it for their own work, for example, in the preparation of relevant worksheets. This has not been matched, however, by the fuller use of ICT to enhance the quality of the teaching and learning in the classroom.

How often do pupils use computers in their maths classes?

Do you share your ICT expertise amongst your colleagues?

How often do you 'surf' maths education websites?

In particular:

- whilst generic packages, eg spreadsheets and databases, are often used for GCSE coursework, their use in other work is underdeveloped;
- opportunities for pupils to explore the connection between algebraic expressions and their graphs using graph-plotting packages are often missed;
- the use of dynamic geometry packages is undeveloped, both as a means to demonstrate geometrical properties and as a means through which pupils can generalise and conjecture;

Do you know of the capabilities of dynamic geometry packages?

- when interactive whiteboards are available, their use is infrequent, and on the occasions when they are used, the 'flipchart' facility is deployed in isolation of the other ICT packages available on the computer platform; and

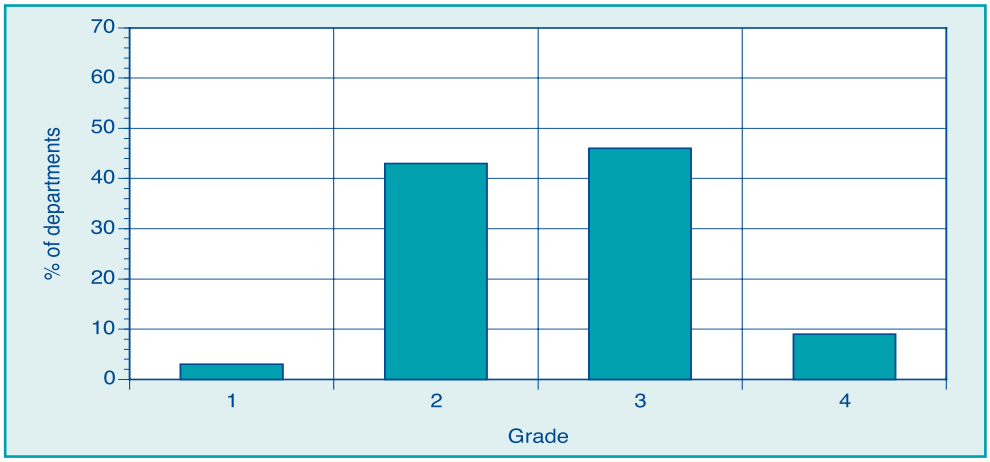
Do you make the best use of your interactive whiteboard?

- occasionally presentational software, eg Powerpoint, is used by teachers to prepare notes for their lessons, but rarely do pupils have the opportunities to use it to present their own mathematical material, say, as part of a revision session, prepared by a group for the whole class.

Are pupils encouraged to use graphics calculators?

Although graphics calculators have been available since the late 1980s, they have had little impact in the classroom. Despite their use being permitted in most of the GCE mathematics modules, it is not unusual for sixth form pupils to report that their use is discouraged.

Assessment



The strengths of the departments' assessment procedures included the regular and conscientious marking by the teachers and the internal examination arrangements that prepare the pupils well for the external examinations. In the best practice, the pupils have an appropriate understanding of examination mark schemes and structures. In a majority of the departments, there were identified weaknesses, for example:

- insufficient use of standardised tests for screening, diagnostic and tracking purposes;
- too much self-marking by pupils which was not regularly monitored and followed-up by individual, group or whole-class feedback;
- an over emphasis on marking without an appropriate proportion of errors being corrected;
- the use of comments which, although encouraging, provided little guidance to enable the pupils to improve; and
- the lack of opportunities for the pupils to evaluate their own work.

Do you use standardised testing to identify those pupils who have difficulties or those who are mathematically gifted?

Do you use standardised testing to monitor progress at individual, class and year-group levels?

Do the procedures and practices in the department reflect the 10 principles of Assessment for Learning?[13]

13 As identified by the Assessment Reform Group (www.assessment-reform-group.org).

Special Educational Needs

All of the departments inspected or visited deployed a range of strategies to address the needs of those pupils who require additional support with their mathematics: some arranged withdrawal sessions once or twice a week, others arranged for in-class support through team teaching or the use of classroom assistants, and almost all arranged for these pupils to be in smaller classes. While the evidence suggests that these strategies are helping, there is also a need for a more effective focus on the mathematical difficulties of individual pupils[14].

Do the policies and practices ensure that pupils who require additional support with their mathematics are identified at an early stage?

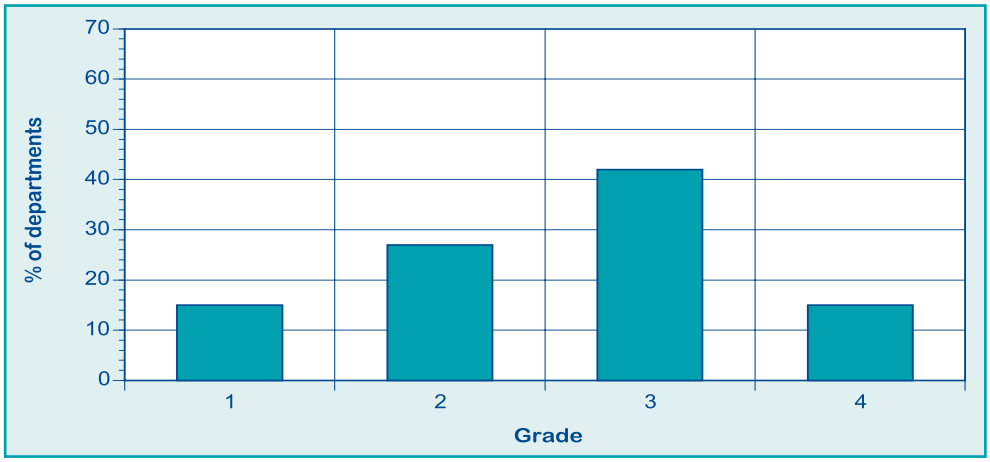
In particular, there is a need to:

- use the information collated at primary school and/or arising from effective screening procedures to identify the pupils who require additional support in mathematics;
- use diagnostic tests, where appropriate, to identify the specific weaknesses in the pupil's knowledge, understanding and skills;
- design lessons to address the specific areas identified; and
- have evidence of mathematical progression and improvement in the performance of each identified pupil.

Are you able to demonstrate that the arrangements you use bring about improvement in the skills and understanding of the pupils who require additional support with their mathematics?

14 See also the Inspectorate's report on a Survey on Provision and Outcomes for Pupils with Special Educational Needs in Post-Primary Schools, February 2006.

Departmental management



The important strengths included the strong collegiality amongst the staff and the efficient and effective departmental administration. In a majority of departments, however, the weaknesses outweighed any strengths or there were significant weaknesses. In general:

- mathematics department meetings are infrequent, dominated by administrative tasks and attended mainly by the subject specialists only;

  How often do all the teachers who teach maths meet?

- discussion of teaching and learning and the sharing of good practice often happen in an informal setting and do not involve all staff who teach mathematics;

  Is the quality of the teaching and learning always on the agenda?

- while most Head of Departments (HoDs) do keep departmental records of internal and external assessments, these are often not used effectively to aid the monitoring and evaluation of the progression in the pupils' learning;

  How effective are the procedures for monitoring and evaluating?

- peer-observation and observation by the HoD are underdeveloped; and

- the outcomes of benchmarking to evaluate the performance of the department are often not shared with all of the teachers who teach mathematics.

  How do the examination results compare with those of similar schools?

Are there opportunities for middle managers to share good practice?

Do your action plans have teaching and learning as their central theme?

Are your action plan targets SMART?[15]

When the inspection of the mathematics department was part of a broader focus, the management and leadership of the HoD often did match what was good practice in the school's other departments.

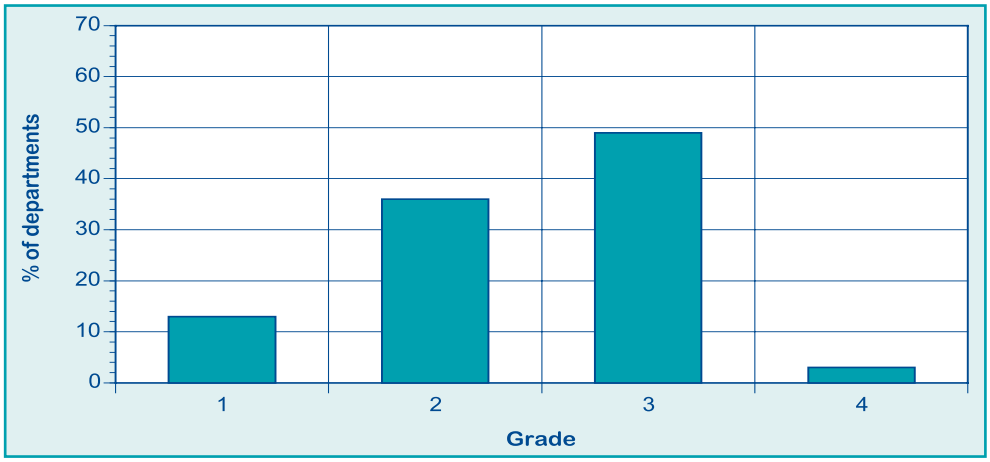
In recent years, a majority of departments - mainly as a result of participation in the NINS - have devised action plans within the context of departmental development plans. Appropriate priorities have been identified, together with a planned programme for improvement, agreed responsibilities for staff, success criteria against a timescale and strategies for monitoring and evaluation.

This approach is having a number of beneficial effects, amongst which are:

- greater staff collaboration;
- greater appreciation of the need for relevant staff development;
- development of the management and leadership role of the HoD;
- greater emphasis on benchmarking and target-setting; and
- greater monitoring and evaluation.

15 *S – specific; M – measurable; A – achievable; R – realistic; T – time-bound.*

Overall Provision



In a minority of departments, there were significant strengths to the overall provision. In approximately half of the departments, however, the weaknesses in the overall mathematics provision outweighed any strengths.

The strengths included:

- the good working relationships between the pupils and teachers and sensitive individual support provided by the teachers;
- the thorough preparation for individual lessons;
- the high quality of teaching observed in one-fifth of the lessons;
- the attentive and enthusiastic attitude of most pupils to their mathematics work;
- the regular and conscientious marking of the pupils' work;
- the strong collegiality within departments;

- the efficient and effective departmental administration; and

- the improvement brought about in departmental team-work by involvement in NINS.

The areas for improvement included:

- the need for departmental planning that provides clear guidance to help teachers address the needs of all the pupils, including the most able and those who require additional help;

- the need to use a greater variety of activities and experiences (including pupils using ICT, working in groups, communicating with one another, problem-solving, applying their knowledge to real-world contexts and using mental mathematics strategies) in order to improve the pupils' mathematical thinking and understanding; and

- the need to develop further the role of the HoD in order that the experiences of the pupils and the standards they achieve can be monitored and evaluated more effectively to bring about improvement.

Copies of this report are available on the DE website: www.deni.gov.uk or may be obtained from the Inspection Services Branch, Department of Education, Rathgael House, 43 Balloo Road, Bangor, Co Down BT19 7PR.