Looking at Mathematics

Teaching and Learning in Post-Primary Schools

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INSPECTORATE

PROMOTING THE QUALITY OF LEARNING

The Inspectorate wishes to thank Gairmscoil Mhuire, Athenry, Co. Galway for permission to use the cover photograph.

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Foreword

Looking at Mathematics is a composite report, based on the findings of subject inspections in Mathematics during which inspectors observed almost 400 lessons, interacted with students, examined students' work and had discussions with teachers, co-ordinators of Mathematics and members of in-school management.

The report identifies many features of good practice. It contains positive comments regarding the time allocated to Mathematics and the timetabling of lessons, the provision of a supportive learning environment and teachers' communication of high expectations regarding student engagement and achievement. The quality of students' learning was judged to be good or better in the majority of lessons observed and the monitoring of students' progress was good or better in almost all lessons. The report also identifies issues of concern. These include a need for greater attention to the development of higher-order skills and understanding in Mathematics among students and a need to develop cross-curricular planning for Mathematics with a view to raising awareness of the broader relevance of Mathematics to the lives of students.

These findings correspond broadly to those contained in the recently published *Chief Inspector's Report 2010 - 2012*, which refers to evidence and inspectors' judgements from 124 subject inspection reports in Mathematics between 2010 and 2012. *Looking at Mathematics* contains a more detailed analysis of subject inspections in Mathematics and is particularly aimed at teachers, school leaders and teacher educators. It offers recommendations to assist schools and teachers in addressing the concerns identified in the *Chief Inspector's Report* and in this more detailed analysis.

The results of PISA 2012 show that the performance of Irish students is at a similar level to that achieved in almost all of the PISA cycles since Ireland's first participation in 2000. It is encouraging that standards have been maintained despite the increased diversity in Ireland's post-primary student population. However, the results of PISA 2012 show that performance in Mathematics among 15-year-olds is just above the international average and that there is a need to improve the achievement of higher performing students and female students in particular.

Since the time that the evaluations that provide the basis for *Looking at Mathematics* were conducted in 2009 -10, there have been several significant developments that will make it easier for schools to build on existing good practice and address the concerns highlighted in the report. Project Maths, which continues to be phased into all post-primary schools, places an increased emphasis on the use of contexts and applications that enable students to relate Mathematics to their own life experience. At a broader level, the implementation of the national literacy and numeracy strategy has involved an increase in the time devoted to literacy and numeracy in schools and the roll-out of an extensive programme of professional development for school leaders and teachers in literacy and numeracy. The strategy also supports principals and deputy principals in implementing robust school self-evaluation, focusing in particular on improvements in literacy and numeracy. It also makes provision for the development of assessment instruments and approaches in post-primary Mathematics.

In the context of these and other positive changes that are already taking place in post-primary Mathematics, it is hoped that *Looking at Mathematics* will be a useful

reference point for schools, principals and teachers as they engage in evaluating and improving learning experiences and learner outcomes in Mathematics for their students.

Chapter 1
Introduction

1.1 Background to this report

This composite report is based on data gathered during subject inspections carried out in fifty post-primary schools by the Inspectorate of the Department of Education and Skills from September 2009 to May 2010. Most of the inspections were stand-alone subject inspections, conducted independently of any other inspection activity. In these cases, the schools involved were given notice of the inspection two weeks in advance. A small number of the subject inspections formed part of whole-school evaluations, for which schools receive notice three weeks in advance. The evaluation process for both types of inspection was the same in almost all respects.

Students' attitudes to Mathematics and their achievement in Mathematics have been a cause of concern for some time. Mathematics is a core subject on the curriculum in all post-primary schools. Since 1995, Mathematics has been available for students to study at three levels: higher, ordinary and foundation. It has been a source of concern that the percentage of students who take higher-level Mathematics for the Leaving Certificate has been lower than the percentage of students taking higher-level courses in other subjects. There has been a notable improvement in this regard, however, between 2011 and 2013. The percentage of students taking higher-level Mathematics for the Leaving Certificate increased from 16% to 26% in that period. This increase coincided with the introduction of new syllabuses in Mathematics. It also coincided with the introduction by Higher Education Institutions in 2012 of bonus points for students who achieve a grade of D3 or higher in higher-level Mathematics.

Table 1.1: Percentage uptake of Mathematics in certificate examinations

Year	Examination	Higher	Ordinary	Foundation
2009	Junior Certificate	43.1	47.4	9.5
2009	Leaving Certificate	**16.2**	71.8	12.0
2010	Junior Certificate	44.9	46.8	8.3
2010	Leaving Certificate	**16.0**	72.5	11.5
2011	Junior Certificate	45.6	46.5	7.9
2011	Leaving Certificate	**15.9**	72.1	12.0
2012	Junior Certificate	48.0	44.7	7.3
2012	Leaving Certificate	**22.1**	67.2	10.7
2013	Junior Certificate	51.6	41.8	6.6
2013	Leaving Certificate	**25.6**	63.2	11.2

Another positive trend that is evident over the past six years is a decrease in the percentage of students obtaining E/F/NG grades in Mathematics at Leaving Certificate (LC) ordinary level. This is shown in Table 1.2.

Table 1.2: Students achieving low grades (E, F or NG)in Mathematics at LC ordinary level

Year	% of students achieving E, F or NG at LC ordinary level	No. of students achieving E, F or NG at LC ordinary level
2008	12.2	4369
2009	10.3	3839
2010	9.7	3677
2011	9.8	3676
2012	9.4	3188
2013	9.4	3024

The mathematical achievement of Irish 15-year olds in the Programme for International Student Assessment (PISA) 2012 is above the OECD average and ranks 13th out of 34 countries. This is similar to the standards achieved by Irish students when Ireland first participated in PISA in 2000 and in most of the subsequent cycles.

It is encouraging to note that the standards being achieved by Irish students in PISA have been maintained despite the increased diversity of the post-primary school population, which now includes higher numbers of students with English as an additional language, students with special educational needs and students who would formerly have left school at a younger age. It remains the case, however, that the average score of Irish students has not improved since Ireland first participated in PISA in 2000. Indeed, the finding in PISA 2012 that the performance of Irish students in the PISA paper-based mathematics test was above the OECD average for the first time is explained partly because the average mathematics score across the OECD fell in 2012. PISA 2012 also demonstrated that there is a need to improve the performance of higher performing students and the performance of female students.

Recent increases in the percentage of students opting for higher-level Mathematics in the Leaving Certificate, reductions in the percentage of students performing poorly at Leaving Certificate ordinary level and consolidation of standards achieved in PISA are encouraging. One of the aims of this report is to support schools and teachers in continuing to improve further students' attitudes and achievement with regard to Mathematics.

The school inspections that provide data for this report were conducted before the national roll-out of revised syllabuses and methodologies, known as Project Maths. One school in the sample had been involved in curriculum development since September 2008, as part of an initial group of twenty four Project Maths schools.

1.2 Categories and types of schools inspected

The schools in which subject inspections in Mathematics were carried out included voluntary secondary schools, schools under the patronage of Vocational Education Committees (VEC)[1], and community and comprehensive schools. The sample comprised both co-educational and single-sex schools and the schools ranged in size from fewer than 150 students to almost 1,200 students. Table 1.3 shows that the sample was broadly in line with the national breakdown of school type, which is approximately 52% voluntary secondary, 35% VEC and 13% community and comprehensive.

In each of the fifty schools inspected, classes following the Junior Certificate and Leaving Certificate programmes were visited. Transition Year classes were inspected in forty-two schools and Leaving Certificate Applied classes in twenty-six schools. In all, 393 lessons were observed and evaluated.

[1] In 2013 the 33 Vocational Education Committees (VEC) were replaced by 16 Education and Training Boards (ETB), which are now the patrons of these schools.

Table 1.3 Categories and types of schools inspected

Schools by category	Number.	% of sample
Voluntary secondary schools	24	48
VEC (now ETB) Schools	18	36
Community and Comprehensive schools	8	16
Total	50	100
Schools by gender		
Co-educational schools	32	64
Single sex schools - girls	10	20
Single sex schools - boys	8	16
Total	50	100
School size		
<250 students	3	6
250-500 students	19	38
501-800 students	20	40
801-1000 students	4	8
>1000 students	4	8
Total	50	100

1.3 Subject inspections

Subject inspections are carried out in accordance with *A Guide to Subject Inspection at Second Level* (Department of Education and Science, 2004). Subject inspections in Mathematics, of which the school is notified in advance, take place over one or two days, depending on the size of the school and the number of teachers teaching Mathematics. During the inspection, the inspector normally meets the teachers of Mathematics and conducts interviews with the principal, the co-ordinator of Mathematics and the co-ordinator of additional support in Mathematics. Teachers' planning for Mathematics is examined, as are samples of the students' work. The arrangements and supports for the subject at a whole-school level are reviewed. Lessons are evaluated and feedback is offered to each teacher. At the conclusion of the inspection a meeting is scheduled between the inspector, the co-ordinator or teachers of Mathematics, and the principal. At this meeting the findings of the inspection and recommendations for further improvement and development are presented and discussed.

Following each inspection, the school is sent a draft report and asked to verify that it is factually correct. When this has been completed, the final report is sent to the school and the board of management of the school is given the opportunity to respond to the report. The report, along with the board's response, is then published on the web site of the Department of Education and Skills, www.education.ie. The individual school reports arising from the fifty inspections upon which this composite report is based were published on the Department's website.

1.4 Structure and purpose of the report

The structure of this composite report follows that of the individual subject-inspection reports which issued to the schools concerned. It reports on

- the quality of subject provision and whole-school support
- the quality of planning and preparation
- the quality of teaching and learning
- the quality of assessment

The report identifies features of good practice and areas of concern, with a view to advising and supporting teachers of Mathematics, school authorities and policy makers. It is hoped that this composite report will engage teachers and subject departments in a reflective professional dialogue in relation to the provision, planning, teaching and learning, and assessment of Mathematics. Above all, *Looking at Mathematics* aims to support schools and teachers in improving future learning experiences for all students.

1.5 Qualitative and quantitative terms used in the report

The Inspectorate is committed to fairness and consistency both in the manner in which inspection is carried out and in the style of reporting that it generates. To support this commitment, inspectors' judgements are recorded using a quality continuum that has been developed over a number of years.The qualitative terms used in this composite report are situated within this quality continuum.

Table 1.4: Qualitative terms used in this report

Performance Level	Example of descriptive terms
Significant strengths	Excellent; of a very high quality; very effective; highly commendable; very good; very successful; few areas for improvement
Strengths outweigh weaknesses	Good; good quality; valuable; effective practice; competent; useful; commendable; fully appropriate provision although some possibilities for improvement exist; adequate
Weaknesses outweigh strengths	Fair; scope for development; experiencing difficulty; evident weaknesses that are impacting significantly on student/pupil learning
Significant weaknesses	Weak; unsatisfactory; insufficient; ineffective; poor; requiring significant change, development or improvement; experiencing significant difficulties

Throughout this report specific terms are used as quantitative measures. The table below indicates these terms and the corresponding percentage range.

Table 1.5: Quantitative terms used in this report

Quantitative term	Percentage of occurrence
Almost all	More than 90%
Most	75-90%
Majority	50-74%
Fewer than half / A substantial minority	25-49%
A small number	16-24%
A few	Up to 15%

Chapter 2
Quality of Subject Provision and Whole-School Support

2.1 Time for Mathematics

At present, Circular M58/2011 requires schools to make every effort to ensure that students have access to a mathematics class every day, particularly in junior cycle. This equates to a weekly time allocation of 175 to 200 minutes. It is preferable for students to have mathematics lessons every day, so as to ensure regularity and continuity of learning in the subject. Some schools may experience difficulties in delivering this pattern of lessons for a variety of reasons. However, even in circumstances that do not allow for students to have mathematics lessons every day, the recommended weekly time allocation for Mathematics should not be eroded.

In the fifty schools evaluated, the recommended allocation was met or exceeded in most instances. In the small number where this was not the case, the shortfall was most often seen in the allocation for first-year classes. A substantial minority of schools provided only four periods of Mathematics per week (140 to 160 minutes), or, in a few cases, three periods (120 minutes) for these classes.

Table 2.1 shows the number and percentage of the schools evaluated in which the recommended minimum time allocation to Mathematics for each year group was met or exceeded, and the number and percentage of schools in which the recommended minimum time allocation was not met.

Table 2.1: Time allocation to Mathematics in Junior and Leaving Certificate programmes

	<175 minutes		≥175 minutes		Total
	Number of schools	%	Number of schools	%	
First year	17	34	33	66	50
Second year	7	14	43	86	50
Third year	6	12	44	88	50
Fifth year	0	0	50	100	50
Sixth year	0	0	49	100	49*

*One school had no sixth-year group in 2009-2010

It was notable that, as students progressed through the year groups and approached Junior Certificate and Leaving Certificate examinations, the allocation of time to Mathematics often increased. This may reflect schools' priorities and the importance attached by them to supporting students in preparing for examinations. However, a better balance of time through junior and senior cycles and between the junior and senior cycles would support the building of more solid foundations in the subject.

A weekly minimum of 105 to 120 minutes, or three class periods, has been recommended by the Inspectorate for Mathematics in Transition Year(TY) and in the Leaving Certificate Applied (LCA) programme. Table 2.2 shows that almost all schools satisfied or exceeded this recommendation.

Table 2.2: Time allocation to Mathematics in TY and LCA programmes

	<105 minutes		≥105 minutes		Total
	Number	%	Number	%	
TY	1	2	43	98	44
LCA1	0	0	22	100	22
LCA2	0	0	23	100	23

2.2 Teachers of Mathematics

2.2.1 Qualifications and deployment

In addition to general requirements for recognition as a mainstream post-primary teacher, the Teaching Council also sets out special requirements for recognition to teach Mathematics. These include "the study of Mathematics as a major subject in the degree extending over at least three years and of the order of 30% at a minimum of that period".[2] It is common practice in post-primary schools, however, that teachers qualified in other disciplines are scheduled to teach Mathematics. These other disciplines include business and technological subjects and non-mathematical science subjects.

In the course of the evaluations that provided the data for this report, the qualifications and registration details of the teachers of Mathematics were sought from the schools. It was noted as a matter of considerable concern that 24% of teachers deployed to teach Mathematics in the fifty schools visited did not have qualifications that met the Teaching Council's special requirements for recognition to teach Mathematics.[3]

This is a fundamental issue for Mathematics, as these deployment practices can contribute to a restricted mathematical experience for students, where investigation and questioning are discouraged and the mastering of discrete procedural skills replaces coherent understanding. Mathematics, when learned in this manner, can become seen by students as a series of 'tricks' that have no connection with each other or with the real world. This should be a concern for all educators. Given the need for students to build connected and integrated mathematical understanding, schools should, to the greatest extent possible, ensure that only teachers whose qualifications meet the Teaching Council's special requirements for recognition to teach Mathematics are deployed to teach the subject.

Opportunities for qualified teachers of Mathematics to teach a variety of programmes and at a variety of levels build the range of expertise and experience in the subject department, and provide valuable professional opportunities and challenges for teachers. This was the case in a majority of the schools evaluated. Good practice in this regard was described in one school report as follows.

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[2] From *General and Special Requirements for Teachers of Recognised Subjects in Mainstream Post-Primary Education*, available at www.teachingcouncil.ie/registration/general-recognition.468.html

[3] In September 2011, the Minister of State for Research and Innovation announced the final results of a Maths Teaching Survey carried out by the Teaching Council, which showed that 34% of teachers of Mathematics did not have qualifications that met the Teaching Council's special requirements for recognition to teach Mathematics. Press release available at www.education.ie/en/Press-Events/Press-Releases/2011-Press-Releases/PR11-09-29.html

> Teachers are deployed in accordance with their qualifications, experience and expertise. There is good rotation of levels for the junior cycle amongst members of the teaching team.

2.2.2 Continuing professional development

Continuing professional development (CPD) was facilitated and supported in almost all of the schools visited. Activities relating to Project Maths, which were beginning to be rolled out, had the highest participation rates but there was a good range of other subject-specific activities engaged in by teachers of Mathematics. These included the sharing of expertise in information and communication technology (ICT) and up-skilling in subject planning. Where practice was considered to have significant strengths, teachers had developed and maintained links with subject associations, local education centres, third-level institutions and school support services for Mathematics. The following commentary from a school inspection report describes an example of such practice.

> Teachers are encouraged [by school management] to access CPD activities; all teachers are currently participating in in-service courses for Project Maths and they are kept well-informed of developments through membership of the Irish Mathematics Teachers Association; … there are also members of the Mathematics team engaging in further academic study and currently undertaking research projects in Mathematics.

Features of good practice

- The time allocated to Mathematics, in the majority of cases, gave students a minimum of 175 minutes of class time each week.
- A majority of the schools evaluated provided opportunities for teachers of Mathematics to teach a variety of programmes and to teach at a variety of levels.
- CPD for teachers was facilitated and supported in almost all schools.
- In a few schools, many of the teachers of Mathematics were involved in CPD activities and further research and study.

Concerns

- In a substantial minority of schools, first-year students received less than 175 minutes of class time each week in Mathematics.
- Over 24% of teachers deployed to teach Mathematics were found not to have qualifications that met the Teaching Council's special requirements for recognition to teach Mathematics.

2.3 Organisation of Mathematics

2.3.1 The organisation of time for Mathematics

Mathematics can currently be studied at three levels – higher, ordinary and foundation – for both Junior Certificate and Leaving Certificate examinations. A highly appropriate way of enabling students to access the level most suited to their abilities and interests is through the concurrent timetabling of lessons in Mathematics across each year group. The majority of the schools evaluated engaged in this practice, in most cases from second year onwards. 66%of the schools timetabled lessons in Mathematics concurrently in second year and 76% in third year, indicating the importance placed by schools on the division of students into level-appropriate

groupings in preparation for the certificate examinations. At senior cycle, concurrent timetabling across each year group reached almost 90% in fifth and sixth years.

In a small number of instances it was noted that lessons in Mathematics were unevenly distributed throughout the week. Where practice was poorest, this resulted in students having lessons in Mathematics on only two days of the week. Students can be hindered in their progress in Mathematics where they do not have daily contact with the subject and this practice should be avoided. One school report commented on good practice in this area as follows.

> Lesson periods are organised to occur on different days of the week, indicating that school management recognises the hierarchical nature of the subject and the fact that students require time to assimilate new ideas and skills. In addition, the positioning of lessons is balanced, with an appropriate mix of morning and afternoon periods for each class group.

2.3.2 The organisation of classes for Mathematics

In the majority of the schools evaluated, first-year classes were organised as mixed-ability groupings, typically timetabled independently. This was good practice, allowing time for students entering a new school environment to settle in, complete a common programme of work and undergo common assessments. A few schools streamed first-year classes according to general ability. This practice gave rise to concern among inspectors, as seen in the following extract from an inspection report.

> The early determination of student ability should be monitored, as research suggests that assigning students into an ability setting too early may have negative consequences

Concurrent timetabling, operated by most schools, allowed students to study Mathematics at the most appropriate level, but also facilitated the movement of students between levels during the course of their studies. This was good practice. It was of note that fewer than half of TY classes were designed to be of mixed ability. Schools should explore the many possibilities offered by more diverse groupings working together during this developmental year.

The decisions schools make regarding organisation of classes and lessons can have a profound effect on students' academic and personal development during their time in school and beyond. Each method of organisation carries with it advantages and disadvantages. Mixed-ability classes are fully effective only when the teaching and assessment processes are differentiated appropriately to reflect the full range of abilities. The allocation of students to classes on the basis of general ability (streaming) can adversely affect the confidence and attainment of some students. Therefore, much care needs to be taken to find the correct balance, not only for each individual school, but for each intake of students. Schools must be flexible enough to organise classes based on the strengths and needs of individual groups. Moreover, having formed classes, schools should ensure that they are monitored on an on-going basis to ensure that the structure chosen continues to be in students' best interests.

Features of good practice

- Mixed-ability, common-level first-year classes were seen in the majority of schools.
- The majority of schools timetabled lessons in Mathematics concurrently within year groups, facilitating students in accessing the most appropriate level and allowing them to change level during the course of their studies.

Concerns

- A few schools were found to assign first-year students to class groups based on measures of their general ability, a practice that can have negative consequences.

2.4 Resources

Resources to enhance the teaching and learning of Mathematics were available in all schools inspected. Inspectors found that the process of acquiring resources usually involved requests to senior management from co-ordinators or individual teachers of Mathematics. Good practice was noted where the subject department had an allocated budget, facilitating planning for resource acquisition.

In the majority of schools, teachers of Mathematics had access to ICT hardware such as laptops, tablet computers, data projectors, overhead projectors and interactive whiteboards and many teachers had access to broadband in their classrooms. However, only a few schools had mathematics-specific software available for teachers' or students' use. Manipulatives, such as three-dimensional shapes, measuring tools or fraction towers, were available in a substantial minority of schools, as were mathematical games, charts and reference books.

Features of good practice

- Resources to enhance the teaching and learning of Mathematics were available in all schools.
- There was good access to ICT resources in the majority of schools.

Concerns

- Only a few teachers reported that they had access to mathematics-specific software.

2.5 Additional supports in Mathematics

2.5.1 Identification of additional mathematical needs

Systems to identify students' additional mathematical needs and to address them were under-developed in many of the schools visited. Many schools lacked a mathematics-support specialist (a qualified teacher of Mathematics who had engaged in further study in the area of learning support) and others had insufficient involvement of qualified teachers of Mathematics in the provision of additional support for the subject. In these cases, close collaboration between the school's learning-support department and the teachers of Mathematics was vital.

All of the schools evaluated provided some level of support for students who found Mathematics particularly challenging. In the majority of instances, such support was deemed by the inspectors to be of a good standard. Schools in which practice was judged to be good had an effective process for early identification of students in need

of support in Mathematics. This normally included the administration of mathematical competency tests as part of the assessment of incoming students and the gathering of information from feeder primary schools and from parents. Care should be taken by schools, however, to ensure that the test instruments they use are up to date and appropriate for the purpose intended.

Where practice was considered to have significant strengths, there was effective use of screening and diagnostic tests. Resulting data were used as a basis for planning a structured and focused remediation programme and students' attainment of mathematical skills and concepts was systematically monitored.

2.5.2 Models of support

In almost all of the schools evaluated, students were withdrawn from mainstream class for some or all of the additional support they received in Mathematics. In general, withdrawal happened when a subject not being studied by the student was scheduled, thus providing support in addition to regular lessons in Mathematics. In a few instances, students were withdrawn from their timetabled lesson in Mathematics to receive parallel, but not additional, tuition. This practice should only occur in exceptional circumstances.

Where schools offered another model of support, it was mostly in the form of smaller classes being established. This generally allowed students to work at a slower pace and to have more individual interactions with the teacher. Fewer than half of the schools evaluated supported students through team teaching or through in-class teacher support. Inspectors found that many schools focused on only one or two models of support. In order to address the needs of all students who find Mathematics particularly challenging, a range of support models should be used in schools. Furthermore, all support mechanisms should be reviewed on a regular basis to ensure their continued effectiveness.

Features of good practice

- In the majority of schools, support for students who found Mathematics particularly challenging was deemed to be of a good standard.
- Many schools had an effective process for the identification of students in need of additional support in Mathematics.
- Some schools planned a learning-support programme for Mathematics, which was based on assessment data, and monitored students' progress systematically.

Concerns

- Most schools needed to further develop learning-support policies and practices for Mathematics.
- Many schools lacked a mathematics-support specialist. In some schools, there was insufficient involvement of qualified teachers of Mathematics in the provision of additional support in Mathematics.
- Many schools had limited models of learning support in Mathematics and did not review their effectiveness regularly.

2.6 Co-curricular provision

Co-curricular activities complement and support student achievement in the curriculum. These activities can take place in the classroom setting, in the wider school context, or outside of the school. Problem-solving skills can be developed and extended, procedural skills can be improved and an enthusiasm for exploring

different facets of the subject can be instilled in students. Moreover, appropriate co-curricular activities can increase students' enjoyment of Mathematics and demonstrate its relevance in the wider world.

Most of the schools evaluated provided one or more co-curricular mathematics activities for students. The activities most commonly reported included Maths Week Ireland and World Maths Day. In a substantial minority of schools, students competed in mathematics competitions such as Problem Solving for Irish Second-Level Mathematicians (PRISM), Team Maths (organised by the Irish Mathematics Teachers' Association) and training sessions for the Irish Mathematics Olympiad. Inspectors were of the view that greater encouragement should be given to students to complete mathematics projects for national or regional science and technology events.

School partnerships with third-level institutions and liaison with local education centres are recognised by the Inspectorate as very worthwhile. The work of third-level institutions in providing enrichment programmes and summer schools for students and professional-development opportunities for teachers was acknowledged by inspectors as being very valuable in increasing interest and improving achievement in Mathematics.

Features of good practice

- Co-curricular activities are available to students in most schools.
- Partnerships between schools and third-level institutions and between schools and education centres make a significant contribution to the promotion of Mathematics at local level.

This chapter has highlighted areas of good practice, but also expressed concerns in four key areas of provision and whole-school support i.e. the time allocated to the teaching of Mathematics, the qualifications and expertise of the teachers deployed, the organisation of teaching groups and the provision of additional supports for students of Mathematics. Action by schools and teachers of Mathematics to address these concerns would establish conditions under which improvements can be made in students' progress and attainment.

Chapter 3
Quality of Planning and Preparation

3.1 The subject department

3.1.1 The subject co-ordinator

Almost all of the schools evaluated had established a subject-department structure and appointed a co-ordinator. This facilitated the valuable processes of collaboration and co-operation among the members of the subject team.

In the majority of schools, the position of co-ordinator was assumed on a voluntary basis and rotated periodically. It was notable that, in most schools, the duties of the co-ordinator of Mathematics were predominantly organisational or administrative, including managing meetings, disseminating information and drawing up class lists. While these tasks are important, it was observed by inspectors that the co-ordinator had more of an impact when the role was more clearly one of pedagogical leadership. This typically led to improved communications within and outside of the department, and an increased focus on pedagogical matters. Where such significant strengths were in evidence, minutes of meetings were more likely to include reference to teaching methodologies and the integration of resources into lesson planning.

Features of good practice

- Almost all schools had established a subject-department structure and appointed a co-ordinator to facilitate collaboration and co-operation among the members of the subject team.
- In the majority of schools, the position of subject co-ordinator was assumed on a voluntary basis and rotated periodically.
- In a few schools, the role of co-ordinator included pedagogical leadership, which helped to focus staff attention on teaching and learning.

Concerns

- A few schools had not established a subject-department structure or appointed a co-ordinator of Mathematics, thereby limiting opportunities for collaborative and collegial working arrangements.
- In almost all schools, the co-ordinator's responsibilities were primarily of an administrative nature, with insufficient focus on curriculum and pedagogy.

3.1.2 Collaborative planning

Collaborative planning among the teachers of Mathematics was observed to be taking place in almost all of the fifty schools and the overall quality of this planning was good. Formal meetings, which took place at least once per term in the majority of schools, allowed suitable opportunities for whole-team planning and discussion. Informal meetings, usually involving sub-groups of the full team, were used in all schools, typically for short-term planning.

Where significant strengths were identified in subject-department planning, it was ordered and focused, and teachers' expertise and resources were openly shared. Records were kept of informal as well as formal meetings and the minutes of meetings were circulated to team members and school management.

In most schools, subject teams worked together on annual programmes of work for year groups and subject levels. In a few schools, teachers of Mathematics had gone further, by sharing teaching methodologies and pooling expertise, therefore maximising the effectiveness of their collaboration. The benefits of this effective collaborative planning were evident in the sharing and dissemination of good practice among colleagues and in greater consistency in teaching approaches. Furthermore, teachers perceived that their work was being supported and consolidated.

There was scope for further collaborative planning on the use of ICT. In a few instances, inspectors recommended that the mathematics team identify an advocate for ICT integration in the department to collate and identify suitable ICT resources and to suggest strategies for their integration into teaching and learning.

3.1.3 The subject plan

Almost all schools had developed a subject plan for Mathematics. In the majority of schools the plan followed a template contained in published guidelines. While this template provided a solid initial direction to schools, subject teams should now adapt the template to best reflect the specific circumstances of the school. Fewer than half of the plans addressed cross-curricular planning, which can provide additional opportunities to demonstrate the relevance of Mathematics, and only a few included a documented plan for meeting the needs of more able students.

Action planning, in which short-term targets were identified, was an innovative feature of a small number of subject plans. The work of mathematics teams was energised by the identification and achievement of a small number of short-term goals. Where subject planning was considered to have significant strengths, subject teams had discussed and agreed appropriate targets as well as the actions required to achieve these targets, the time by which they were to be achieved, and the team member responsible. In these cases, there was also ongoing review and self-evaluation by the subject team.

Almost all of the subject plans contained common long-term programmes of work for different year groups and levels. These programmes varied in quality from school to school. Where inspectors identified significant strengths, the programmes were based on the relevant syllabus, were expressed in terms of learning outcomes for students, indicated clear and realistic time scales and facilitated the sharing of methodologies and resources among all members of the mathematics team. In some cases, however, the documented plans contributed little to teachers' work plans or lesson delivery, indicating only the number of textbook chapters or topics to be covered each term or half term. Documented programmes should inform classroom practice, should put students' needs at the centre of planning and have a very real and positive impact on students' learning experiences in the classroom.

In the implementation of programmes of work, significant strengths were evident where the programmes were tailored to suit specific teaching groups and were reflected upon and evaluated by teachers as they progressed. In addition, the programmes for classes within the same year group were taught in the same sequence, minimising gaps in course content for students changing level or changing class group during the course.

The majority of subject plans for Mathematics included separate or combined homework and assessment policies. Homework policies usually indicated the frequency and amount of homework to be assigned and a commitment to its correction, while assessment policies broadly referred to student tasks, class tests and term examinations. However, planning in this area could have been improved

through the inclusion of agreed policies regarding the monitoring of students' written work, frequency of class tests and strategies for following up on assessment results. There was also scope for more effective links between long-term programmes of work and planning for assessment.

Plans for assessment in Transition Year typically made reference to class tests and term examinations, only occasionally embracing more innovative and student-friendly assessment procedures. Good practice observed in this area included the grading of student projects, the assessment of individual or group presentations and the evaluation of students' contributions to class activities.

3.1.4 Planning for support in Mathematics

Most subject plans provided information regarding the provision of support for students who found Mathematics particularly challenging. Where practice was considered by inspectors to be most effective, there was close collaboration between teachers of Mathematics and the school's learning-support and resource personnel. In these cases, there was planning for a variety of interventions, including in-class support, team teaching and small-group withdrawal. Where significant strengths were identified in practice, it was evident that the choice of intervention was determined by the needs of the individual student(s).

In a few schools, subject departments had informal plans to develop expertise in learning support within the mathematics team. Building capacity among teachers of Mathematics in this area is a very important consideration for all schools.

3.1.5 Planning for Transition Year

Good planning for Transition Year (TY) included the development of programmes of work that were student focused and included unusual and interesting mathematical topics. The development of students' confidence and competence in problem solving was targeted and complemented by an emphasis on students' active engagement in project work, investigations and discovery learning. Plans made references to the real-life contexts of Mathematics and provided details of a variety of assessment strategies.

Inspectors' concerns about TY planning most frequently related to programmes of work that had an over-emphasis on the content and approaches of the *Leaving Certificate Mathematics Syllabus* . While there is a need to ensure that students' mathematical skills are reinforced and improved during TY, over-emphasising the Leaving Certificate syllabus is not appropriate to the underlying aims of the TY programme and does not allow students to gain a different experience of Mathematics. There was a need, also, to ensure that the games, puzzles and other activities listed in TY programmes were used in a way that contributed to meaningful learning for students.

Features of good practice

- Almost all of the fifty schools had developed a subject plan for Mathematics.
- Almost all plans included common long-term programmes of work for different year groups and levels and the majority included policies regarding homework and assessment.
- Action planning energised the work of a small number of mathematics teams.
- Some schools synchronised the order in which classes within the same year groups progressed through syllabus areas, ensuring continuity for students changing class group or level in the course of their studies.
- In TY, some programmes of work included unusual and interesting mathematical topics for students.

Concerns

- Cross-curricular planning was underdeveloped in a majority of subject plans and therefore opportunities to highlight the broader relevance of Mathematics to students were missed.
- Only a few schools had documented a plan for meeting the needs of more able students.
- Action planning to address identified short-term goals was not widely used.
- Long-term programmes of work were often confined to lists of textbook chapters or topics to be covered each term or half term.
- Planning for assessment was not usually explicitly linked to long-term programmes of work.
- Programmes of work for TY often had an over-emphasis on Leaving Certificate syllabus content and methods.
- The intended learning outcomes of the use of games, puzzles and other planned activities in TY were not always clear.

3.2 Planning by individual teachers

During the evaluations, teachers were asked to make available samples of their individual written planning and preparation. In the majority of schools, all or most teachers had written planning available for inspection.

Practice in this area was judged to have significant strengths when planning by individual teachers was in accordance with the programmes of work agreed at subject-department level, when the teacher made clear and effective links between new material and students' prior experience and understanding, and when programmes had been adapted to address the needs of specific classes. Very good planning focused on what students were intended to achieve in lessons and took account of the needs and abilities of particular individual students.

Short-term plans sometimes included teachers' personal reflections on the lesson and identified steps to be taken in subsequent lessons. This very good strategy was seen to enhance teachers' own professional learning and to maximise the opportunities for students to make progress. In the instances where short-term planning was considered to be fair or poor, lessons were characterised by a lack of purpose, little variation in learning activities and difficulties regarding the pitch and pace of the lesson.

Most teachers prepared resources to support student learning. Student worksheets, supplementary handouts, geometric models, games and puzzles were used widely. Where planning was judged to have significant strengths, there was evidence that careful consideration had been given to how such resources were to be integrated into lessons and how they would contribute to the achievement by students of intended learning outcomes.

Features of good practice

- Effective individual planning and preparation often complemented the collaborative work of the subject department.
- Short-term plans sometimes included teachers' reflections on the lesson and identified steps to be taken in subsequent lessons.
- Planning for the use of resources to support student learning was most effective when there was a clear indication of how the resources were to be integrated into lessons.

Concerns

- Some teachers' individual planning was confined to lists of textbook chapters to be covered with classes.
- Where planning was fair or poor, lessons were lacking in purpose, had little variation and were deficient with regard to pitch and pace.

The contribution of good planning to students' understanding of, interest in and success at Mathematics cannot be overstated. A well-prepared programme of lessons is the key to effective teaching and learning. Such a programme should be planned at subject-department level, using the collaborative expertise of the teachers of Mathematics, and adapted by individual teachers to address the needs of their students. Putting students at the centre of the planning process and engaging in systematic review at individual teacher and subject department levels are key prerequisites to ensuring that programmes are designed and implemented to provide a sound mathematical education for students.

Chapter 4
Quality of Teaching and Learning

4.1 Mathematical literacy

Mathematics has a specific vocabulary that enables the construction and communication of mathematical ideas. Familiarity with subject-specific language and notation is central to the learning of Mathematics and supports precision in mathematical work. An explicit and ongoing approach to the teaching and revision of mathematical language demystifies the terminology and symbols for students and is essential to effective teaching of the subject.

In the lessons observed, teachers normally used the terminology and symbols that were appropriate to the topic being taught. Concern was sometimes expressed by inspectors, however, when teachers over-emphasised the difficulty or strangeness of specialist terminology. Where practice had significant strengths, both teachers and students used mathematical language for pedagogical and communicative purposes as part of the normal classroom routine.

4.2 Lesson content and pace

In most lessons observed in the schools evaluated, lesson content was in line with the relevant syllabus, and also took account of the general ability level of the students. The pace of the lesson was judged to be appropriate in most cases. The optimal pace allowed students to achieve success while, at the same time, presented an appropriate level of challenge so that their knowledge and skills were extended. Where concerns arose regarding the pace of the lesson, these typically related to students not being sufficiently challenged.

In the majority of lessons observed, the teacher informed the students of the intended outcomes for the lesson at the outset. This was very good practice, as students more readily experienced success if they knew what was expected of them and could themselves ascertain their level of achievement. There were very few lessons, however, in which the teacher reviewed the extent to which the outcomes had been achieved. Ideally, all lessons should commence with a statement of the intended learning outcomes and end with a review of what has been achieved.

Students develop their understanding of Mathematics in incremental steps, by building on their prior ideas and knowledge. A key role of the teacher of Mathematics is enabling students to make links between their existing understanding and new topics. Good practice in this regard was observed by inspectors in the majority of the lessons observed.

A few school reports highlighted the good practice of teachers in helping students to see how the mathematical topics that they were studying were connected with other areas. This explicit linking of mathematical skills or topics with other topics in Mathematics, other curriculum subjects or the world at large enhances students' learning experiences. Cross-curricular connections allow students to appreciate the role that Mathematics plays in other fields of study. Connections with the world at large encourage students to see the pervasiveness of Mathematics in their lives, thus increasing students' enthusiasm for the subject.

4.3 Methodologies and use of resources

A majority of the lessons observed were taught using methodologies that were appropriate and that engaged students. Students in these lessons were attentive, responsive and made clear progress. However, in a substantial minority of lessons, methodologies failed to capture or maintain students' attention, or were unsuited to the area of study. Teacher demonstration followed by student practice was observed to be the predominant method of conducting lessons in Mathematics. While this strategy is appropriate and, at times, necessary, it is very seldom sufficient to cater fully for the different ability levels and preferred learning styles of all students in a class group. Many of the inspection reports emphasised the need for a broader range of teaching methodologies in Mathematics lessons.

Where students were allocated time for written work during lessons, in most instances this meant individuals working on assigned exercises. Inspectors often recommended the use of pair work as a means of promoting collaborative skills and facilitating peer learning. Successful use of group work was seen in a few lessons, invariably where the teacher had completed preparatory work with the class, had given careful consideration to the make-up of the groups, had focused on keeping groups on task and had chosen activities that required discussion, negotiation and exploration by students.

In most lessons, there was a good balance between the level of teacher activity and the level of student activity. Where the balance was not appropriate, this was usually because either the lesson was dominated by the teacher or the students spent most of the lesson completing written assignments.

The resources most commonly used to support students' learning were text-book exercises and prepared work sheets. Where work sheets provided appropriately graduated challenges for students, their effectiveness was acknowledged by inspectors. There were concerns, however, over worksheets that simply occupied students in repetitive work, offering little opportunity for stimulation or progress.

Significant strengths were evident in a small number of lessons, in which teachers optimised students' learning through the use of suitable equipment and materials. These included three-dimensional shapes, geometry equipment, dice, shopping catalogues, paper and scissors, sand, cardboard boxes, adapted playing cards and a video game console. The following extract from one inspection report describes an example of very good practice in this area.

> The innovative use of resources was seen to very good effect where students engaged in experiments to record the outcomes when a pair of dice was thrown. … Very interesting conversations followed as anomalies in the results achieved by the different pairs, when compared to the expected outcomes, became apparent.

In almost all lessons where appropriate resources were used, the activity allowed for discovery or experimentation, facilitated differentiation for students of different ability levels and helped to generate enthusiasm among students.

The integration of ICT into mathematics lessons as an aid to teaching and learning was observed in some instances. Laptop computers, tablet computers, digital

projectors and, to a lesser extent, interactive whiteboards, were readily available in some classrooms. As with other resources, where the use of ICT was judged by inspectors to have significant strengths, it was employed purposefully as part of a well-structured lesson. The following extract from an inspection report describes such practice.

> ICT was integrated into lesson delivery. It was seen to best effect where dynamic software was used to explore the features of quadratic graphs and to enable the students to immediately establish if their proposed solutions were correct. The technology was supported by excellent teacher questioning and written resource materials designed to facilitate collaborative learning and exploration.

Teachers frequently used ICT as a presentation tool, in place of the chalk board or white board. This strategy in itself did not constitute a different methodology and was only a first step in realising the potential of ICT in supporting students' understanding of mathematical concepts. All schools should have a plan for the use of ICT to support teaching and learning in Mathematics.

Features of good practice

- Short-term planning and lesson preparation were appropriate in most instances.
- In the majority of lessons, new material was linked effectively with students' prior knowledge.
- In some cases students' learning was optimised through the use of a wide range of appropriate resources.

Concerns

- Almost 20% of lessons were conducted at a pace that did not appropriately stimulate or challenge students.
- In over 30% of the lessons observed, the intended learning outcomes were not communicated to students. The achievement of the intended outcomes was rarely reviewed during the lesson.
- In many cases, there was a lack of variety in the teaching methodologies used, meaning that students' different ability levels and preferred learning styles were inadequately addressed.
- The majority of schools had not planned for the use of ICT to support teaching and learning in mathematics lessons.

4.4 Teacher expectations, differentiation and questioning

In the majority of lessons, teachers' expectations of how the students would engage with class activities and tasks were appropriately high. In these lessons students were expected to complete homework, have text books and other class materials, answer questions and engage fully in class work. The expectations that teachers have for their students profoundly influence students' engagement in learning and their levels of achievement. Therefore, expectations of engagement and achievement needed to be set at high but realistic levels for all lessons and to be clearly communicated to students. This was not done in almost 20% of the lessons evaluated.

Differences in students' levels of ability and achievement were not appropriately accommodated in a substantial minority of lessons evaluated. As all class groups

include students of varying abilities, regardless of the method of class formation adopted, it was recommended by inspectors that strategies for differentiated learning be integrated into all lessons. Suggested strategies included providing graduated exercises containing questions of increasing difficulty or creating a bank of alternative material to provide students with additional work.

Oral questioning was the most commonly used method of checking students' focus and understanding. Good practice was evident in most lessons, with questions being distributed among the students. Teachers often directed questions at individual students by name. This was more effective than questions that elicited a choral response, which made it difficult to check individual students' progress and allowed some students to avoid answering questions.

In the majority of lessons observed, teachers made some good use of higher-order questions that appropriately challenged students' thinking and problem-solving skills. However, in a substantial minority of the lessons observed, the only questions used were lower-order questions that tested recall or required the answer to a calculation. This represents lost opportunities for students to practise and reinforce their understanding of mathematical concepts and language. Inspectors recommended more use of higher-order, probing questions. The following extract from an inspection report provides clear reasons for this recommendation.

> All teachers should increase their use of higher-order questions, appropriately challenging students, actively involving them in the work of the class, checking for understanding, and supporting them in developing the important skills of mathematical thinking and communication.

Students' contributions to lessons were encouraged by teachers and were handled with consideration and affirmation in almost all cases.

4.5 Students' learning and achievement

Almost 70% of the inspection reports on the schools visited stated that the quality of students' learning was good or better. In such cases, students had interacted confidently with teachers and with inspectors, demonstrating knowledge and understanding of the lesson topics. They were also able to suggest and justify solutions to problems, to explain the approaches they took in solving problems and to make relevant links between topics. One report made the following observation.

> The quality of student learning, as demonstrated by responses to questions, the quality of written work, their ability to solve highly challenging problems and their ability to express themselves using appropriately mathematical language, was most impressive.

In a substantial minority of lessons observed by inspectors, learning was judged to be fair or poor. In these cases students were typically unable to answer questions posed by the teacher or to use correct mathematical terminology. In a number of instances, students had become over-dependent on their teachers and were unable to progress without the guidance of the teacher. The standard of students' written work was judged to be fair or poor in a substantial minority of reports. Inspectors recommended that teachers impress on students the importance of maintaining good-quality work, presenting it neatly and recording corrections accurately.

4.6 Classroom atmosphere and environment

There were commendable efforts made by teachers in almost all lessons to create a supportive learning environment for students. Mutual respect was evident between teachers and students, affirmation was given by teachers for students' efforts and care was shown by teachers for their students.

Classroom management was often very effective and, at its best, teachers maintained a warm and interactive atmosphere. There were a few lessons that were lively, interactive and conducted with a sense of enjoyment.The very good practice of students being provided with individual support in a discreet and caring manner was also in evidence.

Some classrooms were enhanced through the use of posters, graphics, displays of students' projects and other visually stimulating materials. This practice of creating a mathematics-rich environment should be extended to all classrooms in which Mathematics is taught.

Features of good practice

- Teachers communicated appropriately high expectations to students in most lessons.
- Some teachers demonstrated a high level of awareness of the individual needs of students and differentiated their lessons to meet these needs.
- Higher-order questions that posed an appropriate level of challenge were used in a majority of lessons.
- Learning was good or better in almost 70% of schools.
- Efforts were made by almost all teachers to create a supportive learning environment for students.
- Classroom management was effective in almost all lessons.
- A mathematics-rich environment was seen in some classrooms.

Concerns

- In a substantial minority of lessons observed, differences in students' levels of ability and achievement were not appropriately accommodated.
- A substantial minority of lessons included only lower-order questions for students.
- Progress in learning was reported as fair or poor in 30% of lessons.
- There was evidence in some lessons that students had become over-dependent on their teachers and their progress was limited as a result.
- Students' written work was judged to be fair or poor in a substantial minority of schools.
- Often, the potential of illustrative materials and displays to enhance students' mathematical learning was not optimised.

Numerous elements of good and very good practice were observed and reported on by inspectors during the evaluations. However, it was clear that some students' progress was less than what could be expected of students at their particular stage in school. This was frequently attributed by inspectors to lessons that were insufficiently challenging for students, lessons that were pitched exclusively to the middle ability range, over-dependence on a single methodology and insufficient use of higher-order questioning to extend students' understanding.

Chapter 5
Quality of Assessment

5.1 Assessment

The quality of assessment in the majority of schools was judged by inspectors to be good. The main assessment modes used in almost all schools were oral questioning of students in class, and written tests or examinations. The range of assessment modes was commendably extended in a few schools to include portfolio, project or interview assessment for TY students. The good practice of setting common end-of-term examinations for classes following the subject at the same level was in place in many schools. A small number of mathematics departments also set common class tests. Significant strengths were identified in the practice described in the following extract.

> Class groups within each year and level sit common classroom-based assessments, with agreed marking schemes, upon completion of each topic.…an examination of the outcomes of the various tests offers a very clear picture of how the cohort as a whole is performing and how individual performances within the cohort vary from test to test.

In some cases, inspectors gave specific advice regarding assessment of first-year students, recommending that a mathematical competency test be administered upon their arrival in the school. This should have as its aim the identification of strengths and weaknesses in the students' mathematical skills and knowledge. The outcomes should support the targeted implementation of the first-year Common Introductory Mathematics Course. The information gained could also be used as baseline data against which to monitor and chart students' progress during their time in school.[1]

Written tests or examinations were most often administered on concluding a chapter or topic and at the end of the first and last terms. Where the approach to written tests was left solely to the discretion of individual teachers, the frequency and timing of such tests varied widely. A consistent school approach to the ongoing and regular assessment of students' progress at key points would have been beneficial in these instances.

In most schools the teachers of Mathematics had agreed a policy on assessment. However, the policy was judged by inspectors to have a meaningful impact on practice in just over 50% of cases. In these instances, policies needed to be revised and there was a particular need to make a clear link between assessment and the learning outcomes identified in subject plans.

5.2 Homework

Most schools visited had put in place an agreed homework policy and the assignment and correction of homework were appropriately managed in most instances. In a small number of cases, more stringent monitoring of homework was required so as to assist students in maintaining consistently high standards in work and presentation. In almost all lessons, the homework assigned complemented class work and supported

[4] Since 2011, the principal of each primary school is required, on receipt of confirmation that a former pupil has enrolled in a particular post-primary school, to provide the post-primary school with a copy of that pupil's sixth-class report card, including information from standardised numeracy tests. Reporting templates have been developed for this purpose by the National Council for Curriculum and Assessment (NCCA).

students' learning. In only a small number of lessons was the overall effectiveness of homework assignment and monitoring considered to be very good. The following extract from an inspection report gives an account of practice with significant strengths.

> Homework is assigned at the end of each lesson and corrected at the outset of the following lesson. In some instances the teachers held a short question-and-answer session in relation to the material assigned in the previous night's homework at the beginning of the lesson. This worked very well as it established whether the students understood the material covered in earlier lessons rather than just checking for compliance with the homework assignment. The process also provided ideal opportunities for shared learning and meant that each student was actively involved in the lesson from the outset.

Effective use of 'assessment-for-learning' strategies was noted by inspectors in fewer than half of all lessons observed. Where these strategies were used, they often included 'comment-only' marking. However, the brevity of the written comments meant that they were often of limited assistance to students. To maximise the effectiveness of feedback, there was a need for teachers to focus on giving students clear direction as to how to address difficulties and make improvements.

5.3 Monitoring students' progress

The monitoring of students' progress was good or better in almost all schools. Teachers typically maintained records of students' attendance and the results of all class tests and term examinations in Mathematics. One school report provided the following observation.

> A key feature of the planning documentation is the exhaustive tracking of students' performance in the house and certificate examinations. The profile of each student that emerges as a result is very instructive and provides a very useful vehicle for informing [Mathematics] department planning.

Inspectors also observed good examples of the use of assessment data to inform teaching and learning.

> An analysis of the school's performance in the certificate examinations, compared to national norms and to previous years, is carried out. In keeping with best practice, this analysis is used to devise action plans to make improvements …

Overall, the assessment of students' progress was a strength in the majority of schools, with some notable innovations introduced for some TY classes. Two areas have been identified as requiring further development. First, each school's assessment policy for Mathematics should be aligned with the learning outcomes identified in programme plans and should influence assessment practice in all classes. Second, assessment data should be analysed carefully and the results should be taken into account in programme development and in the identification of areas that need to be improved.

Features of good practice

- The good practice of setting common examinations for classes following the subject at the same level was in place in many schools.
- In most schools, written tests were set regularly following completion of a chapter or topic.
- Most schools had an agreed policy on assessment and homework for Mathematics.
- In almost all lessons, the homework assigned complemented class work and supported students' learning.
- The monitoring of students' progress was good or better in almost all schools.
- Some schools used data on assessment outcomes to inform teaching and learning.

Concerns

- In schools with no agreed school approach to ongoing class-based tests of students' progress, there was often a lack of consistency between teachers in the frequency and timing of such tests.
- Practice regarding class-based assessment was in line with school or subject-department policy in just over half of the classrooms visited.
- Significant strengths were evident in homework allocation and monitoring in only a small number of lessons.
- There is a need for teachers to focus on giving students clear direction as to how to address difficulties and make improvements.

Chapter 6
Summary of Main Findings and Key Recommendations

This chapter summarises the features of good practice and areas of concern identified in fifty announced subject inspections in Mathematics conducted in the 2009-2010 school year and makes recommendations to address the main areas of concern. New syllabuses and methodologies (Project Maths) have been introduced in all schools since the data-gathering phase of this study. Even in this changed context, however, the findings and recommendations of this report remain pertinent. By consolidating the good practice identified in this report and implementing the report's recommendations, schools and teachers can improve future learning experiences for all students.

6.1 The Quality of Subject Provision and Whole-School Support

Main Findings

- In almost all schools, the time given to Mathematics was in line with syllabus guidelines and Inspectorate recommendations.
- In the majority of schools, students' access to different levels was facilitated through concurrent timetabling arrangements.
- First-year classes were of mixed ability and followed a common programme of work in the majority of schools.
- Additional resources to support teaching and learning in Mathematics were available in all schools.
- The quality of support for students who found Mathematics particularly challenging was good in the majority of schools. Where significant strengths were identified, support programmes were tailored to individual needs and progress was systematically monitored.
- 24% of teachers deployed to teach Mathematics in the fifty schools evaluated did not have a qualification that met the Teaching Council's special requirements for recognition to teach Mathematics.

Key Recommendations

- In accordance with Circular M58/2011, schools should make every effort to ensure that students have access to a mathematics class every day, particularly in junior cycle.
- Schools should, to the greatest extent possible, ensure that only teachers whose qualifications meet the Teaching Council's special requirements for recognition to teach Mathematics are deployed to teach the subject.

- The range of models used to support students who find the subject particularly challenging should be widened. The development of expertise in this area among teachers of Mathematics should be prioritised.

6.2 The Quality of Planning and Preparation

Main Findings

- Collaboration and co-operation among teachers of Mathematics were facilitated in almost all schools and led by a subject co-ordinator.
- Subject plans had been prepared in almost all schools and almost all of these included long-term programmes of work for different year groups and levels.
- Action planning was an innovative feature of subject planning in a small number of schools. In these cases, the work of mathematics teams was energised through identifying short-term targets and through planning, implementing and monitoring the actions required to achieve these targets.
- Where all of the class programmes within a year group addressed topics in the same sequence, this minimised gaps or duplication in course content for students who changed level or class group during the course.
- Where practice was judged by inspectors to have significant strengths, there was evidence that teachers reflected on past lessons and incorporated findings into their short-term planning for subsequent lessons.

Key Recommendations

- The role of subject co-ordinator should include providing leadership in the areas of curriculum and pedagogy.
- Mathematics teams should use action planning to address short-term goals.
- Long-term programmes of work should identify expected learning outcomes and should link directly to planning for assessment.
- Plans of work for TY should provide innovative learning opportunities for students and not be overly focused on the Leaving Certificate programme.
- Mathematics teams should ensure that games, puzzles and other activities used in TY programmes contribute to the achievement of planned learning outcomes.
- Planning for the use of resources, including ICT, should address how the resources will be integrated into lessons and how they will contribute to achieving the intended learning outcomes.

6.3 The Quality of Teaching and Learning

Main Findings

- The quality of students' learning was good or better in the majority of lessons observed.
- A supportive learning environment was provided for students in almost all lessons.
- In the majority of lessons, effective links were made between new material and prior learning.
- Teachers communicated suitably high expectations regarding students' engagement and achievement in most lessons.
- Progress in learning was reported as fair or poor in 30% of lessons.
- While intended learning outcomes were communicated to students at the beginning of most lessons, only a small number of lessons included a review of the extent to which these outcomes had been achieved.
- In a substantial minority of lessons observed, differences in students' levels of ability and achievement were not appropriately accommodated.
- In a substantial minority of lessons the questions addressed to students were limited to lower-order questions. There was scope for greater use of teaching approaches and resources that develop students' independence, creativity and higher-order thinking in Mathematics.

Key Recommendations

- Intended learning outcomes should be communicated to students at the beginning of each lesson and progress in achieving the intended outcomes reviewed at the conclusion of the lesson.
- Teaching approaches and learning activities should be differentiated sufficiently to address students' different ability levels and preferred learning styles.
- Open-ended, higher-order questions and tasks that require collaboration and decision-making by students should be an integral part of each lesson in Mathematics.
- Activities that are wholly teacher-directed or that require repetition of lower-order skills or procedures should only be used as necessary.
- Students should be enabled to appreciate how the mathematical skills and concepts that they are learning are connected with and applicable to other areas of Mathematics, other fields of study and the world of work.

6.4 The Quality of Assessment

Main Findings

- Common examinations for classes studying the subject at the same level were organised in many schools.
- Mathematics teams had an agreed policy on assessment and homework in most schools.
- In most schools, written tests were set regularly and in almost all lessons, homework complemented class work and supported students' learning.
- The monitoring of students' progress was good or better in almost all lessons.

Key Recommendations

- Assessment practice should be in accordance with policy agreed at whole-school level and at the level of the subject department.
- Schools should ensure greater consistency between individual teachers regarding the frequency and timing of class tests in Mathematics.
- Greater use should be made of data on assessment outcomes in planning for teaching and learning.

References

Department of Education and Science (1995) *Leaving Certificate Mathematics Syllabus (Higher level and Ordinary level)*. Dublin: Stationery Office.

Department of Education and Science (1995) *Leaving Certificate Mathematics Syllabus (Foundation level)*. Dublin: Stationery Office.

Department of Education and Science (2000) Junior Certificate Mathematics Syllabus. Dublin: Stationery Office.

Department of Education and Science (2001) *Chief Examiner's Report on 2001 Leaving Certificate Examination in Mathematics Ordinary Level.* Athlone: Brunswick Press.

Department of Education and Science(2002) *Professional Code of Practice on Evaluation and Reporting for the Inspectorate.* Dublin: Department of Education and Science.

Department of Education and Science/National Council for Curriculum and Assessment (2002) *Junior Certificate Guidelines for Teachers*. Dublin: Stationery Office.

Department of Education and Science (2004) *A Guide to Subject Inspection at Second Level*. Dublin: Department of Education and Science.

Department of Education and Science (2007) *Inclusion of Students with Special Educational Needs: Post-Primary Guidelines.* Dublin: Department of Education and Science.

Department of Education and Science (2008) *Investing Effectively in Information Communications Technology in Schools, 2008-2013: The Report of the Minister's Strategy Group*. Dublin: Department of Education and Science.

Economic and Social Research Institute (1999) *Do Schools Differ? Academic and Personal Development among Pupils in the Second-Level Sector.* Dublin: The Economic and Social Research Institute.

Institute of Public Administration (2003) *Inside Classrooms: the teaching and learning of Mathematics in social context.* Dublin: The Institute of Public Administration

OECD (2010)*PISA 2009 Results: What Students Know and Can Do – Student Performance in Reading, Mathematics and Science*. Paris: Organisation for Economic and Cultural Development.

State Examinations Commission (2008–2010) *Leaving Certificate Examination Statistics: Percentage breakdown of candidates by grade awarded in each subject.* Athlone: State Examinations Commission.

Useful Web Sites

Useful web sites

www.education.ie	Department of Education and Skills
www.ncca.ie	National Council for Curriculum and Assessment
www.ncte.ie	National Centre for Technology in Education
www.examinations.ie	State Examinations Commission
www.pdst.ie	Professional Development Service for Teachers
www.scoilnet.ie	Scoilnet (NCTE schools web site)
www.sess.ie	Special Education Support Service
www.projectmaths.ie	Project Maths development team
www.nce-mstl.ie	National Centre for Excellence in Mathematics and Science teaching and learning
www.teachingcouncil.ie	The Teaching Council
www.imta.ie	Irish Mathematics Teachers Association