Report on a Pilot Project
for a
Non-tiering GCSE in Mathematics

by

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1.   Introduction

For the past four years, Mathematics (alone of all subjects) has used a 3-tier system for GCSE exams:

Tier				Grades available				
Higher Tier	A*	A	B	C	D			U
Intermediate Tier			B	C	D	E	F	U
Foundation Tier					D	E	F	G	U

This system is designed so that candidates are not exposed to mathematics which is beyond their capabilities but it has inherent structural problems, namely:

(1)   many of the grades (but particularly Grades B and C) can be obtained in two distinct and different ways; for example:

Grade C can be obtained by:

(a)   *Higher Tier*:   a very poor performance on a more advanced syllabus,

(b)   *Intermediate Tier:* a reasonable performance on a much reduced syllabus.

They are **not** the same and someone (usually the teacher) has to decide the tier of entry for the candidate[1].

(2)   Candidates on the *Foundation Tier* cannot obtain the all important Grade C, thus causing great demotivation; no matter how well candidates do, in essence they still see it as failure!

Of course, there is also the problem of comparability between exam boards but that is not the issue addressed here.

For 1998, QCA decided to restrict the grades available at each tier, so that:

•   Grade D was no longer available to the *Higher Tier* candidates,

•   Grade F was no longer available to the *Intermediate Tier* candidates.

The amended system is shown below.

Tier				Grades available				
Higher Tier	A*	A	B	C				U
Intermediate Tier			B	C	D	E		U
Foundation Tier					D	E	F	G	U

It was a strange decision to make and, as could so easily have been predicted, although the awarding of the higher grades remained pretty static (QCA and OFSTED inspectors now ensure this) there were other significant changes. The table below shows this.

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(1)   In the past, you could take both 'O' Level and CSE, but with the current system you cannot enter for more than one tier; in Scotland, candidates can enter for two tiers, which have no overlapping grades, and the best grade from either tier is awarded.

Year	% gaining each grade							
	A*	A	B	C	D	E	F	G	U
1998	2.1	7.8	15.6	21.4	17.3	16.3	9.2	5.1	5.2
1997	2.1	7.5	14.6	23.1	16.5	15.6	12.2	6.3	2.1

The startling changes were:

- Grade U increased by 3.1%
- Grade F decreased by 3%.

This would appear to be accounted for by candidates 'falling off the edge', i.e. entered for the *Intermediate Tier* and not achieving Grade E, so being awarded a Grade U, and similarly for Grade D on the *Higher Tier*. The 3.1% increase in Grade U candidates represents about 20 000 candidates. (There were slightly fewer candidates taking GCSE Mathematics this year, so the argument suggested by QCA that there were likely to be more low achievers entered this year due to pressure on schools for all candidates to achieve something at GCSE, does not fit in with the entry data!)

Most of these students can, of course, try again, but for many of them it is a real motivational disaster. Worse, though, is the possible knock-on effect for the next and subsequent years. Teachers responsible for deciding entry tiers will have learned the lesson and no more risks will be taken, i.e. more potential *Higher Tier* candidates will be entered for the *Intermediate Tier* and more potential *Intermediate Tier* candidates for the *Foundation Tier*, so the long term effect will be to lower expectations and attainment. At a time when we are all trying to raise standards in mathematics, this is a disaster and something that could so easily be avoided by using either the Scottish system or, even better, a non-tiering system such as the one we have been advocating for some time.

In this report, we will outline the results from a pilot project which put into effect a non-tiering system, using two compulsory *Basic* papers and one optional *Extension* paper. The exam was non-operational but we regard the results as a justification for recommending that such an assessment system does work and does not have the problems encountered in our current system.

2. Proposed Non-tiering GCSE

The NEAB, in conjunction with CIMT, put forward to SCAA in 1996 a proposal for a non-tiering pilot GCSE examination for 1998. The system is summarised below.

Papers	Grades available
Basic: 1* and 2 (compulsory)	C D E F G U
Extension: 3 (optional)	A*A B

(*Paper 1 is a non-calculator paper.)

Extension Paper 3 is optional and only counts when a Grade C has been obtained on the *Basic* papers. It is also divided into two sections:

Section 1 – Questions appropriate for Grade B

Section 2 – Questions appropriate for Grades A and A*

so that candidates aiming for a Grade B are not too intimidated by the harder Grade A and A* questions. On this paper, candidates write their answers in Answer Books rather than in spaces on the question papers. It is felt that high grade candidates should be able to write out their working clearly and logically, as they must do in A-level exams.

All papers should be done without the aid of a Formula Sheet.

In this framework there is one, and only one, way of obtaining any grade, opportunities for improvement are encouraged rather than restricted and the framework ensures that even high grade candidates must do well on basic number work.

This proposal, submitted in early 1996, was turned down by SCAA for approval as a pilot, the argument being that 13 other syllabuses had been approved and this was one too many!

CIMT, NEAB and supporting teachers were disappointed by the decision. The only glimmer of hope was in the suggestion of having a non-operational version of the scheme to see whether it worked. Although reluctant to go down this route, CIMT agreed to go ahead with such an exercise with support from NEAB, as it appeared to be the only possible chance of convincing SCAA that a more appropriate framework existed for GCSE Mathematics assessment.

3. Pilot Project

Around Easter in 1997, about 1000 Y11 pupils in 9 schools took our non-operational GCSE in Mathematics. The question papers and marking scheme were set by staff at CIMT but reviewed and approved by NEAB examiners. We tried to use, in the main, previous questions from NEAB exam papers and, as would be expected, designed the papers to give a suitable spread across attainment targets and national curriculum levels.

The distribution of marks is summarised in the tables below.

Summary of Papers 1 and 2

Attainment Targets

Levels	2	3	4	5	Total	%
4	11	7	7	5	30	15
5	21	3	10	24	58	29
6	14	24	15	22	75	37.5
7	8	6	15	8	37	18.5
Totals	54	40	47	59	200	
%	27	20	23.5	29.5		

Paper 3 Overall

Attainment Targets

Levels	2	3	4	5	Total
7	3	9	3	0	15
8	4	10	11	14	39
9	6	10	8	0	24
10	6	3	5	8	22
Totals	19	32	27	22	100

As can be seen from the first table for Papers 1 and 2, there was a reasonable spread across Levels 4 to 7, with Level 6 being the modal level. Similarly on Paper 3, questions spanned Levels 7 to 10.

The distribution across attainment targets ensures that *Number* is give prominence over *Algebra* in Papers 1 and 2 but combined they constitute about 50% of the marks available, whilst the reverse is true in Paper 3.

Candidates sat the exam as if it was a real exam, under strict exam conditions. The results reflected the fact that candidates were serious in their attitude to the exercise and this has been backed up by the teachers' comments.

All the marking was done centrally at CIMT in the spirit of a real life exam. Each paper had just one marker to ensure continuity of awarding. Reports on each paper were provided.

An 'award' took place, undertaken by NEAB examiners with some input from CIMT, and the results have been analysed further by CIMT. The estimated grades were returned to the schools before candidates took their actual exams and in some cases used to encourage borderline candidates to work just that little bit harder. Many schools felt that it was a very useful pre-exam exercise, although they did comment that the awards at the lower end seemed very severe. Many schools remarked that they hoped that, in reality, their candidates would achieve higher grades. This aspect is commented on later.

4.   Awarding

At the award meeting the provisional grade boundaries on Papers 1 and 2 were decided in the usual way by judgementally awarding the C/D and F/G boundaries and then proportioning the other grade boundaries. These were fixed on the combined papers at:

C/D	D/E	E/F	F/G	G/U	
137	108	79	50	21	(Total: 200)

Similarly on Paper 3, the A/B and B/C boundaries were awarded judgementally and the A*/A fixed in the usual way. This led to the following grade boundaries:

A*/A	A/B	B/C	
78	53	28	(Total: 100)

The distribution of estimated grades were as follows.

Grade	Number	%	Cumulative %
			(to nearest whole number)
A*	28	2.9	2.9
A	106	11.1	14.0
B	147	15.5	29.5
C	89	9.4	38.9
D	167	17.6	56.5
E	145	15.2	71.7
F	139	14.5	86.3
G	117	12.3	99.6
U	13	1.4	100.0

The obvious blip here is the low percentage of Grade C's. There are a number of possible explanations for this:

(i)   the awarding on Papers 1 and 2 was too severe and perhaps did not take into sufficient account the fact that on Paper 1 no calculators were allowed and that on both papers no formulae sheet was provided (candidates at this lower level might be more dependent on both calculators and formulae sheets and these candidates had not been specially prepared for these papers);

(ii)   the candidates at this level (i.e. Grade D) are motivated to work very hard during the last few months in order to achieve a Grade C;

(iii)   we have not included a coursework element (20% of the final assessment in the actual award) which tends to upgrade the low attaining candidates more than the high attaining candidates.

Despite this seemingly low Grade C award, it is interesting to note that only 4 out of the 1000 candidates did not achieve Grade C on the *Basic* papers when they had achieved Grade B in the *Extension* paper. Of course, on the proposed system of non-compensation, these candidates would be awarded Grade D (for the *Basic* papers) and the Grade B would not be awarded.

5.   Comparison with Actual Results

About 2 or 3 months after taking these non-operational papers, all the candidates took their real GCSE in Mathematics. The results for the 941 candidates for whom we have full results are summarised below.

Grade	Estimated	Actual
A*	28	28
A	105	123
B	147	159
C	88	186
D	165	144
E	144	126
F	139	109
G	115	55
U	12	11

The biggest difference is in the Grade C numbers, with significantly more actually obtaining this grade. The distribution of actual grades for each estimated grade is shown in the chart below.

1997 Actual Grades	U	G	F	E	D	C	B	A	A*	
A*								10	18	28
A						5	34	74	10	123
B					7	31	100	21		159
C				23	99	51	13			186
D			20	73	50	1				144
E		19	59	39	9					126
F	2	53	45	9						109
G	5	37	13							55
U	5	6								11
	U	**G**	**F**	**E**	**D**	**C**	**B**	**A**	**A***	

1997 Estimated Grade

It is interesting to note that at the top end the correlation between grades is very high but from Grade D downwards there is better correlation between each estimated grade and one higher grade achieved.

6.   Quanlitative Summary

To shed more light on the statistical survey, we interviewed the teachers and pupils who took part in the pilot, and also asked them to complete questionnaires.

On the whole, responses from both pupils and teachers were very positive and the following comments are representative:

Pupils

Paper 1   'I was worried at first, but I found the paper easier than I expected.'

'I had no problems with it.'

'I think it's a good idea.'

'It gives you confidence that you can do sums without a calculator.'

'If you write out all your working, you should get some marks even if you make a silly mistake.'

'It is easier to check your mistakes if all the working is written out.'

Paper 2   'I thought it was good, clean fun!'

'The questions were good.'

Paper 3 'I didn't like having a separate Answer Book because it is more difficult to see if you missed out a question.'

'I liked it because if you write answers in the Question Book there is never enough space.'

'I think there is sometimes too much space and you worry about what else you should write down!'

'If I had known that Part 2 was Grade A questions, I would have tried harder on Part 1.'

General 'I missed having a Formula Sheet, but not as much as I expected.'

'I thought they were all boring but I don't like maths anyway!'

'I enjoyed doing *all* the papers.'

Teachers

'The proposed system would cut out arguments between teachers, pupils and parents over which tier to enter.'

'With everyone taking the same exam there was a sense of equality which benefited all candidates.'

'Higher level candidates did not seem at all bored with taking the *Basic Papers* but relished the chance to show what they could do.'

'No teachers in our consortium of schools are happy with the three-tier system. Does SCAA ever consult with real teachers in real schools?'

'The few candidates who scored well enough to obtain a Grade B on the *Extension Paper* but did not achieve a C on the *Basic Papers* would, with appropriate practice, achieve the Grade C and it would be a good idea if they were forced to be competent on basic calculations.'

7. Revised Awarding

In hindsight, we feel that the grade boundaries set on the *Basic* papers were too severe because of the reasons highlighted earlier, so we thought that it would be instructive to run the aalysis again with a slightly eased award.

We used the recommended grade boundaries given by the markers and these gave us the revised grade boundaries on the combination of Papers 1 and 2. (There were no changes to Paper 3.)

C/D	D/E	E/F	F/G	G/U
128	101	74	47	20

These revised boundaries gave the following distribution of grades.

Grade	Number	%	Cumulative %
		(to nearest whole number)	
A*	28	3.0	3.0
A	105	11.2	14.2
B	152	16.2	30.4
C	130	13.8	44.2
D	151	16.0	60.2
E	133	14.1	74.3
F	135	14.3	88.6
G	97	10.3	98.9
U	10	1.1	100.0

The awards at each grade now look more consistent with the actual grades achieved, as shown in the table below.

Grade	Estimated	Actual
A*	28	28
A	105	123
B	152	159
C	130	186
D	152	144
E	132	126
F	135	109
G	97	55
U	10	11

The data now compares well with the actual grades awarded, with of course some enhancement, particularly at the key Grade C, as would be expected. The distribution of grades is shown below.

	U	G	F	E	D	C	B	A	A*	
A*								10	18	28
A						5	34	74	10	123
B					1	34	103	21		159
C				13	74	84	15			186
D			15	57	65	7				144
E		14	50	50	12					126
F		41	56	12						109
G	5	36	14							55
U	5	6								11

1997 Actual Grades (row labels)

1997 Revised Estimated Grade

With the slightly more lenient award, there are a few candidates who go down by a single grade but the vast majority either achieve the estimated grade or one grade higher.

In summary, this revised awarding system seems more appropriate, because when compared to the actual grades achieved it is reasonably consistant.

8.   Conclusions

In this report, we have presented a revised assessment framework for GCSE which undoubtedly solves some of the problems associated with the current 3-tier model. What we have aimed to show is that:

(1)   the proposed framework works, in that the grades can be successfully awarded from the papers sat;

(2)   it benefits **all** pupils, raising attainment and increasing motivation rather than closing down opportunities;

(3)   it is a fairer system and there is a unique way of achieving each grade.

The only drawbacks might be:

(1)   some candidates might achieve Grade B on the *Extension* paper but not qualify for this award as they did not obtain a Grade C on the *Basic* papers (in fact, on the revised awarding only one candidate actually did this) but we would want to argue that **all** candidates should show that they can achieve a good standard on basic numerical topics;

(2)   the *Basic* papers have a few questions which are more advanced than the current *Foundation Tier* questions (although even the weakest candidates were clear that they would prefer to take papers in which a Grade C could be achieved) but in the current system many just do not bother to try and invest their time on those subjects in which they think they do have a chance of achieving Grade C;

(3)   high ability candidates have to answer questions which, for them, might be too easy and straightforward; in fact, the evaluation showed that the high ability candidates seemed to enjoy gaining success on the *Basic* papers.

In summary, this revised framework is fair and will encourage enhanced attainment rather than reduce opportunities and demotivate candidates. We hope that both QCA and the exam boards will take note of these findings and seriously consider changes to the current flawed system.

If changes do take place, it is crucial that for any revised framework:

•   there is one, and only one, way of achieving any grade,

•   all candidates should have the opportunity of achieving Grade C.

Any framework not meeting these criteria would still be inherently unfair or demotivating or, as is currently the case, both!

APPENDICES

The appendices are filed separately but may be obtained
by clicking on the appropriate heading in red.

1.	**Examination Papers**	–	**Paper 1**
			Paper 2
			Paper 3
2.	**Mark Schemes**	–	**Paper 1**
			Paper 2
			Paper 3
3.	**National Curriculum References**		
4.	**Examiners' Reports**	–	**Paper 1**
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