The Future of Mathematical Education in Scotland

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The aim of the Scottish Mathematical Council (SMC) is to support and further the well-being of mathematical education in Scottish schools, and indeed one of its main activities is to organise an immensely popular day conference at Stirling, attended by around 450 teachers from all over the country. As the only mathematical body in Scotland with such a wide membership, the Council is very well placed to survey the future of mathematical education in Scotland.

The SMC has around 15 members, representing school teachers, advisers, FE and HE lecturers (both mathematics and education faculties (ITE)), and business or industrial mathematicians. Over recent years the Council has discussed the serious concerns felt by teachers about various issues affecting the support and leadership of mathematics in Scottish schools. Representatives from the SMC have met with officials in the Executive to voice these concerns, but as the issues continue to be of such importance to our community, the wider views of mathematics teachers were sought. SMC members designed a questionnaire for distribution to teachers across Scotland in order to determine if there was widespread eveidence of concern in the mathematics community. This report is an analysis of the responses to the questionnaire sent to all principal teachers of mathematics in Scottish schools.

There have been many changes in Scottish education over the last ten years that have had a significant impact on practice. These changes have a particular impact at subject level, which led to this survey on the *Future of Mathematical Education* that attempts to gauge the views and feelings of Secondary mathematics departments. Various issues are explored, including:

- the consequent changes following the Scottish Examination Board has been replaced by the Scottish Qualifications Authority;
- the new National Qualification framework;
- the subject-specific advisory role being replaced by a service geared more to quality assurance;
- the change in role of HM Inspectorate;
- the recruitment difficulties and shortage of mathematics teachers in Scotland;
- the new career structure for teachers that calls into question the role of subject-leadership in schools – as outlined in The Teaching Profession for the 21st Century.

In England, concerns about the state of mathematical education led the Royal Society and the Joint Mathematical Council jointly to set up an Advisory Committee for Mathematical Education (ACME). The Secretary of State for Education supported the initiative which was funded by the Gatsby Foundation for three years. The government subsequently set up an inquiry into post-14 mathematical education chaired by Professor Adrian Smith FRS, vice-chancellor of Queen Mary University of London. Professor Smith's report, published in 2004, presented a picture that identified points for concern in terms of mathematical education and its future provision in the UK. There is currently no overall supporting infrastructure to provide strategic direction and coordination, hence the current provision displays fragmentation, lack of coherence and gaps in CPD provision. The Smith report endorsed the ACME group's recommendation to set up a National Centre for Excellence in the Teaching of Mathematics (NCETM) in order to redress the current situation and to provide appropriate leadership, direction and CPD in an area of the profession that has particular difficulties with recruitment and retention. In addition to the National Centre (NCETM), there was a call for Regional Mathematics Centres (RMCs) to encourage the formation of local communities of teachers of mathematics and relevant stakeholders. The recommendation in the Smith report was for the introduction of RMCs – 'to be located one in each of the 9 English regions as defined by RDAs, with possible additional centres in Wales, Northern Ireland and Scotland'; subsequently referred to as the 'territories'.

Although the Smith report is primarily concerned with developments in England and Wales, many of the issues have parallels in Scotland that the SMC has raised with the Scottish Executive. One of the central tenets of the Smith report concerned the training and continuing development of mathematics teachers, through CPD on subject matter, general pedagogical issues and subject specific pedagogical skills. The general feeling appears to be that the situation in Scotland is healthier. Certainly, there is not the chronic shortage of qualified specialist teachers experienced south of the border but recruitment is beginning to present new difficulties. However, for some time the SMC has been concerned about the lack of leadership and strategic overview of mathematical education, and the lack of genuine support and guidance for teachers. These concerns led to a subgroup meeting with representatives of the Scottish Executive to express their concerns. In 2002, the Executive appointed a Numeracy Development Officer, a seconded 2-year appointment with a remit that seemed to the SMC to be unrealistic; in fact, the appointment lasted only a year and has not been renewed. More recently, the Association of Advisors in Scotland and a recently formed group comprising members of the Edinburgh Mathematics Society (EMS) and SMC representatives, has voiced similar issues to those outlined above.

While politicians and the SQA can assure us that 'all is well' – after all, pass rates in national exams get better every year – there is one group whose views have not been canvassed, as far as we are aware, namely the mathematics teachers in schools. The SMC sent the questionnaire (Figure 1) to 417 principal teachers of mathematics in Scottish schools. Within a few weeks, 249 replies were received, giving a strong response rate of 60%.

The SMC believes that anyone interested in the teaching of mathematics in schools will find matters of concern in this report. It invites the Scottish Executive to address the serious issues involved, in order to provide the support and leadership required to ensure the flourishing of mathematical education well into the 21st century.

The remainder of this report summarises the results of an independent analysis of the responses from principal teachers of mathematics in Scottish schools.

Figure 1 Questionnaire distributed to all Principal Teachers of Mathematics

	*Please complete and return in the envelope provided by **10th November** by ticking the box that reflects your view of each statement.* ***NB your responses will be treated confidentially by the SMC.***	Strongly Agree	Agree	Disagree	Strongly Disagree
1	The number of opportunities for teachers of Mathematics in different schools to share ideas has reduced in recent years				
2	There are sufficient opportunities for teachers of Mathematics in different schools to share ideas. **(Please feel free to list these overleaf)**				
3a	There is adequate opportunity for those responsible for Mathematics Departments to meet with SQA representatives.				
b	Such meetings are/would be valuable.				
4	The Advisory Service no longer provides adequate subject specific support for Mathematics.				
5	I feel that I am working in isolation with nobody offering direction in Mathematics.				

6	Mathematical Education in Scotland is being driven forwards in a thoughtful, positive way.				
7	I feel optimistic about the future of Mathematical Education in Scotland.				
8	Intermediate 2 is as good a preparation for Higher Mathematics as Standard Grade.				
9a	My school has no experience of teacher recruitment shortages in Mathematics.				
9b	If you disagree or strongly disagree in part a please give details:				
10a	The move to Faculty Heads will have no adverse effect on the management of the Mathematics Department.				
10b	If you disagree or strongly disagree in part a please list the main effects you have experienced/foresee:				

Name		School
Please state Education Authority		

Please use the reverse of this sheet for any further comments

We greatly appreciate your help – thank you

Methodology

A questionnaire sent to Principal Teachers of Mathematics in all local authority and independent schools in Scotland in October 2004.

Summary of Responses

249 questionnaires were returned from across a wide geographical area.

The survey responses suggest significant concerns amongst Principal Teachers in all regions in relation to the support mechanisms available to mathematics departments, the effects of curricular and management changes and the future direction of mathematics education in Scotland. Comments given by respondents highlight the strong consensus of views and experiences across the sector.

Support/Sharing Ideas (percentages are of those giving a response)

84% believe the Advisory Service no longer provides adequate subject specific support

84% feel that there has been a reduction in the number of opportunities for teachers from different schools to share ideas

79% think there is inadequate opportunity to meet with SQA and 97% would value such meetings

54% feel isolated with nobody offering direction in Mathematics

The SMC conference and Principal Teacher meetings/ networks were the most notable examples of opportunities to share ideas. It can be difficult, however, for staff to find the time or cover to allow them to attend. Costs can also be prohibitive. The majority of respondents felt that the loss of an advisory service, or more specifically subject advisors, was having a detrimental effect on subject organisation.

Specific issues relating to the SQA related to costs, the centralised location of events and scope for expanding seminars to qualifications other than Higher Maths.

Future Direction

86% believe that Intermediate 2 is not as good a preparation for Higher as S Grade

77% think that the move to Faculty Heads will have an adverse effect on management of Maths departments

77% do not think that Mathematics Education in Scotland is being driven forward in a thoughtful, positive way

70% have experienced teacher recruitment shortages in Mathematics

67% are not optimistic about the future of Mathematics Education in Scotland

Intermediate 2

Comments suggest that Intermediate 2 is valuable as an end-point itself, but not as preparation for Higher; in practice, conversion to Higher is poor. Problems with Intermediate 2 include the level of algebra, problem solving, reasoning and the application of skills.

Some general worries about changes in the mathematics curriculum were also raised, in particular: a fragmentation of 5–14, S Grade and Higher; and perceived lowering of standards.

Faculty Heads

The main issues are:

- Workload & time to fulfil the remit. This is directly linked to the effects already being felt by PTs, due to the loss of APTs.
- The ability of a Faculty Head to manage and offer leadership where they are not the subject specialist. Specific problems include:
- Planning and development of curriculum
- Implementation of new initiatives (subject specific pedagogical skills)
- 'Fighting the corner' for Mathematics
- Allocation of resources
- Ensuring commitment from departmental staff to take on tasks previously done by subject PT

Most respondents felt that Mathematics should be treated as a single faculty and in many cases staff have successfully argued such a case. However, in smaller schools the fear is that this will not be possible.

There were few positive comments about this development. Most of those who said there would be no adverse affect did so because Mathematics is, or will be, a single faculty in their school or because their Head of Faculty is a Maths specialist.

Teacher Recruitment

This seems to be a major concern across most of Scotland. A significant number of schools have been at least 'one teacher' short for long periods resulting in the use of non-specialists to cover classes and consequently cutting maths sessions. The main issues are:

- Lack of supply teachers, particularly for long-term absence and maternity cover
- Few applicants for advertised posts – full-time, part-time and temporary
- Poor quality of applicants and supply teachers
- Some of the schools not currently experiencing problems have a large number of staff coming up to retirement in the next few years and fear replacement will be difficult.

Future Direction of Mathematics Education in Scotland

The main problems mentioned were confusion and inconsistencies caused by too many changes over too short a time, often made by people not directly dealing with pupils. There is a need for consolidation and national leadership from staff with the appropriate expertise.

Detailed Analysis

Responses by Local Authority (total number distributed in each council/ sector)

Aberdeen	9	(12)	Independent	17	(37)
Aberdeenshire	13	(16)	Inverclyde	5	(8)
Angus	6	(8)	Lothians	1	(N/A)
Argyll & Bute	8	(10)	Midlothian	5	(6)
Borders	5	(9)	Moray	5	(8)
Clackmannanshire	3	(3)	North Ayrshire	5	(10)
Dumfries & Galloway	8	(16)	North Lanarkshire	13	(26)
Dundee	7	(10)	Orkney	2	(6)
East Ayrshire	6	(9)	Perth & Kinross	5	(9)
East Dunbartonshire	4	(9)	Renfrewshire	8	(12)
East Lothian	3	(6)	Shetland	4	(9)
East Renfrewshire	5	(7)	South Ayrshire	5	(9)
Edinburgh	12	(23)	South Lanarkshire	11	(21)
Falkirk	7	(8)	Stirling	4	(7)
Fife	13	(19)	West Dunbartonshire	5	(7)
Glasgow	16	(28)	West Lothian	5	(11)
Highland	21	(28)	Western Isles	3	(10)
			Total	249	(417)

Sharing Ideas

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*	*No response*
Opportunities for teachers from different schools to share ideas have reduced in recent years	41%	43%	16%	–	1%
There are sufficient opportunities for teachers from different schools to share ideas	2%	15%	56%	26%	3%
There is adequate opportunity for Maths departments to meet with SQA	2%	19%	54%	24%	2%
Such meetings would be valuable	39%	58%	2%	<1%	3%

Comments:

'Little opportunity for meetings between primary and secondary schools even associated primaries. Where there are opportunities getting cover for time out is difficult'

'Availability of cover, time and costs are the main reasons for problems'

'In Strathclyde days regular meetings with colleagues gave opportunities to keep abreast of developments now subject/departments go it alone and rely on personal contacts with other PTs'

'As a new teacher to Scotland, I could have done with some training in exam and assessment structure'

'No external networks operating currently, like reinventing the wheel with everyone operating in isolation'

'With no advisory service no-one is organising events regionally so national events such as Stirling Maths Conference are now seriously over-subscribed'

'The in-service days that do exist have been hijacked for generic issues because nobody in the local authority has knowledge or responsibility for promoting maths issues'

'Today's technology should enable sharing of ideas and information and materials through websites, e-mails etc'

'E-mail and Internet provides the opportunity for teachers to set up contacts but this is so lacking in organisation as to be virtually worthless'

'Region has introduced Open Forum meetings for all maths teachers but to date meetings have been cancelled due to lack of interest'

'Maths Advisor currently setting up a forum where teachers can share ideas, get help etc on-line'

'Very few maths in-service courses. Within the region, we have set up local support group to organise CPD courses with view to networking time being given. East of Scotland Maths Association is up and running again'

SQA

'SQA are improving their communication but consultation on changes still appears limited'

'Communication with SQA has been a major problem in the past, all information was paper based. It is getting better, SQA workshops allow face-to-face interaction'

'SQA seminars offered over the last few years to discuss Higher Maths have been excellent, the same thing for credit and Intermediate 2 would be good' (2)

'SQA talk on Higher Maths in Glasgow will be valuable but over-priced and venues are always Edinburgh, Glasgow or Stirling'

Support

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*	*No response*
The Advisory Service no longer provides adequate subject support for Mathematics	53%	31%	13%	3%	9%
I feel isolated with nobody offering direction in Mathematics	15%	39%	41%	6%	3%

Comments:

'Loss of subject advisors has been very detrimental'

'The removal of advisers has been a disaster for subject organisation'

'Advisory service is top heavy with management/quality assurance officers so absolute minimum of support to schools at any subject level'

'Help is uncoordinated'

'As sole teacher for S1-6, greatly regret axing of advisory service and few subject specialists training days in this region, little chance to meet others'

Future Direction, Courses and Recruitment

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*	*No response*
Mathematics Education in Scotland is being driven forward in a thoughtful positive way	<1%	22%	57%	20%	6%
I feel optimistic about the future of Mathematics Education in Scotland	1%	32%	55%	12%	3%
Intermediate 2 is as good preparation for Higher as Standard Grade	4%	10%	34%	51%	2%
My school has no experience of teacher recruitment shortages in Mathematics	5%	25%	32%	37%	1%
Move to Faculty Heads will have no adverse affect on the management of Maths Departments	2%	21%	25%	51%	9%

Comments:

Future of Maths Education

'I feel there is a role for SMC here perhaps similar to the National Council of Teachers of Maths in the USA'

'There seems to be no driving force in Scotland. Any new initiative seems to be imposed by government or SQA'

'The direction offered should be from people with expertise in the area of maths education'

'Maths education is changing but not in a structured way, nobody thinking long-term and in a planned way. Ideas brought in but not thought through, as the 'ideas' people are not at the chalk-face dealing with pupils.'

'Reforms and then more reforms, a period of stability would be very helpful'

'Changes have come about too quickly, need time for consolidation'

'Inconsistencies and pressures to reach targets concern me'

'Greater demands are being placed on maths teachers because of lack of students being attracted to the profession'

'Training of new maths teachers is a worry'

Intermediate 2

'Intermediate 2 exam poorly prepares for Higher. The exam tests little beyond the basic aspects with very little reasoning, application or integration of knowledge and skills - all essential for the potential Higher candidate'

'Intermediate 2 was constructed as a building brick to enable someone to raise their level of qualification by one notch. It was not constructed with Higher in mind'

'Intermediate 2 totally inadequate – valuable as end in itself but Credit gives in-depth preparation for Higher, lots missing in Intermediate 2'

'Problem solving in Intermediate 2 is weak'

'Not enough algebra content in Intermediate 2' (4)

General course/curriculum issues

'There are some good courses but overall the curriculum is discontinuous and bitty. 5-14 does not provide a smooth transition to standard grade. The Higher course is too short to be able to investigate and develop ideas'

'Consultation on the dumbing down of standards with both 5-14 and H are ignored. New H exam is too short at allow adequate sampling of course'

‘I have concerns that maths curriculum is too disjointed and compartmentalised with 5-14, S grade, Higher Still all being viewed as separate entities with not enough scope to flow easily from one to next. Higher in particular is far too rushed’

‘Suggested phasing out of S grade in favour of NQ is worrying. There is no safety net currently for NQ exams’

‘We do not think Credit course prepares well for Higher either. Lot of extra work needed at Credit and Intermediate 2 to realistically prepare for Higher’

Teacher recruitment

‘5 years ago 72 applicants received for an advertised teaching post, 2 years ago only 2 applicants - Teacher shortage critical’

‘At present 1.0 FTE short. Dept has been understaffed for over two years with cover provided by a number of teachers - up to 5 at a time - teaching out of subject’

‘Aug 2004, 4 of 8 posts vacant, these were filled by one trainee and 3 Canadian - inexperienced teachers from an agency’

‘Dept hasn't been fully staffed for several years. Currently two teachers short out of 6’

‘Few applicants, virtually no supply’

‘For past 2 yrs impossible to find replacements for long-term sickness - permanent or supply’

‘In 3 of last 6 sessions we have struggled to fill maths post. Usually only a few applications and appoint the one who will do least damage’

‘No stability of staffing since March 2004 constantly rotating staff to cover classes, quality of staff available very poor’

‘Our last 3 recruits are Australians, no Scots applied’

‘School has been forced to create maximum class sizes at S1, 2 and 3 and cut provision this year’

Effect of Faculty Head structure on department management:

1. *Workload/Time*

‘I am currently a Faculty Head and feel the effect can be positive if the remit is realistic and manageable’

‘I am a Faculty Head of Maths/ICT. I feel that a better distribution of tasks, i.e. collegiate responsibility, will actually improve management of Maths dept, not sure the same can be said for subject that is new to me’

‘I am now Faculty Head for Maths/ICT and feel it is very difficult to support staff, develop curriculum etc. in both subjects to a high standard’

‘Heads will not have the time to manage effectively’

‘Loss of APT post has greatly affected my job. Almost impossible to do allotted tasks as well as teach full timetable’

‘In this school less adverse effect because Maths was declared a discrete faculty but I am now having to do the tasks my APT used to do plus additional ones of monitoring etc. but with no extra non-contact time’

‘Increased workload with demise of APT and addition of whole school responsibility’

‘The same amount of work previously done by 2 people (APT/PT) can't be done by one’

‘Heads would have to have virtually no classroom contact to allow them to run several departments. There is no point in increasing their duties elsewhere when they are also the ideal people to teach (mathematics), and we are short of teachers’

‘System would be strongly dependent on willingness of dept staff to take on extra remits’

‘Increased pressure/stress on ordinary classroom teachers. Lack of promotion prospects’

2. *Need for subject specialist*

'A new PT Maths has recently been appointed - Maths Graduate with many years experience in teaching. Had this not been the case major difficulties would have ensued'

'The new Faculty Head of Maths, Business Management, Numeracy & Enterprise is a Maths specialist. There is little adverse effect. Benefits - Maths has secured extra time with Head helping to formulate school policy'

'Although new Faculty Head is approachable and has maths knowledge I feel we lack an experienced maths teacher, in touch with other schools and whose main aim is maths'

'New Head not a mathematician, great at paper work but no experience of specific challenges facing maths teachers. No one with vision/new ideas and drive to take them forward'

'Whole concept of Faculty Head is seriously flawed, serious doubt/worries about future, have objected strongly to authority but no chance of change, something needs to be done, perhaps collectively we have a stronger case'

'Actual curricular knowledge is needed as well as generic mgt skills to run and plan a dept's work'

'Dept needs dedicated PT with relevant teaching experience to manage, motivate and lead other staff, allocate resources and develop curriculum'

'Development of Higher Still, in which PTs were identified as crucial, will be very difficult to implement in future'

'Little enough direction outside schools without losing the direction and expertise within'

'In a small school it is unlikely that maths would be stand-alone but few other departments see all pupils at all levels, or have experience of presenting entire year group for Standard grade'

'Lack of specific leadership/direction as with removal of advisers, split loyalties, over work of incumbent, falling teaching/learning standards and staff morale'

The purpose of this survey was to gather views on various issues affecting mathematics education in Scotland with a view to disseminating further in the form a small brochure. This should very shortly arrive in schools, for the attention of Head Teachers, and land on the desks of the policy makers for their consideration and response. If you have any comments or further contributions to make, please direct your correspondence to Sally Crighton (Secretary); contact details as provided at the front of the Journal.