Towards universal participation in post-16 mathematics: lessons from high-performing countries

Country profile: Scotland

Population (2011):[1]	5,254,800
Population aged 5-18:[1]	804,500
Population aged 16-18:[1]	188924
Registered state school students (2011): [2]	366,429 primary 297,109 secondary 6973 special
Number of state schools:[2]	2081 primary 367 secondary 158 special

Upper-secondary mathematics education in Scotland is in the process of instigating significant curriculum and assessment reform. This is of interest to us, particularly where the rationale for change relates to attainment and participation levels. A consequence of studying an education system at the time of reform is that available information may be incomplete, or the implications and outcomes of the reform may not be known. As such information within aspects of this profile may be incomplete.

Over the last decade, the 16-18 population rose until 2008, but since then has fallen back to a level equivalent to 2002 levels:

[1] http:2003//www.gro-scotland.gov.uk/files2/stats/time-series/pop-est-time-series-1981-2011-nhs-boards.xls
[2] http://ww2004w.scotland.gov.uk/Publications/2011/12/06114834/4

16-18 population in Scotland[1]

Year	Population
2002	191903
2003	195521
2004	196901
2005	195603
2006	194824
2007	195154
2008	197181
2009	197029
2010	193317
2011	188924

In 2002 the Scottish Executive embarked on an extensive consultation exercise on the state of school education - the 'National Debate on Education'. In response to the National Debate, Ministers established a Curriculum Review Group in November 2003. Its work resulted in the publication in November 2004 of aims and principles in 'A Curriculum for Excellence[3]'. Final Outcomes and experiences for implementation were published in 2009. Implementation of the Curriculum for Excellence for pre-school to S1 began in 2010 (S2 and above continue with the old curriculum / qualifications structure). The first new National Qualifications will be taken in 2013-2014.

A detailed summary of the Curriculum for Excellence (CfE) mathematics programme is available from Learning and Teaching Scotland.[4]

Schools in Scotland are owned and operated by the local Education Authorities. The schooling system is different from that in England, Wales and Northern Ireland in that is emphasises breadth of study as well as depth, currently progressing from 12 subjects in S3 to 8 in S4, 5 in S5, and 3 in S6.[5]

Pupils in Scotland start school between the ages of 4 ½ and 5 ½. Pupils spend 7 years in primary school from the age of 4/5 to 12 (Primary 1 to Primary 7) followed by up to 6 years in Secondary / High school (S1 to S6). Education is compulsory until the age of 16 (S4), when the first exams are taken (at SCQF level 5 or below).

Scotland, in comparison to other UK countries, emphasises breadth of study over depth of study. The Curriculum for Excellence is designed such that lower-secondary students experience a wide curriculum and no options are closed off when they progress to S4. Students currently cover a full range of subjects in S1 & S2, choose 7-8 qualifications to study in S3 & S4 to Standard Grade, then 5 courses in S5 at Higher level, providing more breath of study than the English system. Under CfE breadth will continue to be emphasised and there will also be further embedding of literacy and numeracy in other subjects. The focus on breadth in Scotland has an impact on the curriculum and subject choice within schools as well on the education structure, including HE, more generally. Courses in

[3] Detailed information on the Curriculum for Excellence can be found on its website: http://www.ltscotland.org.uk/curriculumforexcellence/ . A timeline is presented at http://www.educationscotland.gov.uk/thecurriculum/whatiscurriculumforexcellence/howwasthecurriculumdeveloped/processofchange/timeline.asp

[4] http://www.ltscotland.org.uk/curriculumforexcellence/mathematics/index.asp

[5] http://www.gtcs.org.uk/education-in-scotland/scotlands-education-system.aspx

Scottish universities tend to be longer (typically 4 years) and school students (very few students take academic subjects in college) may progress to university after S5 (this means that their level of mathematical study is slightly lower than in England. Those staying in school to the end of S6 and taking Advanced Highers may start in the 2nd year of some courses).

1. What is the national policy for, and structure of, mathematics education provision for 16-18/19 year-old (pre-university level) learners?

→ Is upper secondary education compulsory or optional?
→ What is the structure of upper secondary programmes?
→ Is any mathematics compulsory in the upper secondary age group?
→ What, if any, are the mathematics options in upper secondary education?

From the age of 16, education is non-compulsory in Scotland. Currently (2011) 12.2% of 16-19 year old are not in Employment, Education, or Training (NEETs).[6]

Pupils who do not leave formal education at the end of S4 (end of ISECD 2) will either progress to ISCED 3, normally at the same secondary school, or will move to one of 42 further education (FE) colleges for ISCED 3 and 4 level National Qualifications (NQ) or do work-based Scottish Vocational Qualifications (SVQ) courses.[7] An increasing number of partnerships between schools, colleges and employers provide vocationally oriented National Qualifications for pupils before and after the end of compulsory education.

From 2010, the Scottish Qualifications Authority developed a new type of qualifications, with Course, Unit, and Course Assessment Specifications at various levels of the Scottish Credit and Qualifications Framework[8], see Table below. Course and Unit specifications, and other materials, are published on the SQA website[9].

QCF	SCQF	New Qualifications	Current Qualifications	
4	7	Advanced Higher	Advanced Higher	
3	6	Higher	Higher	
2	5	National 5	Intermediate 2	Standard Grade Credit
1	4	National 4	Intermediate 1	Standard Grade General
E3	3	National 3	Access 3	Standard Grade Foundation
E2	2	National 2	Access 2	
E1	1	National 1	Access 1	

There are no compulsory subjects/qualifications that a pupil must take within the Scottish education system. The precise number and range of qualifications on offer to pupils is a decision for individual schools and local authorities. Upper-Secondary students tend to take more balanced course combinations than students across the rest of the UK. The usual number of subjects taken in S4 is 8. Combinations involving physics/biological sciences and

[6] http://www.scotland.gov.uk/Topics/Statistics/Browse/Labour-Market/MCMC-E1
[7] http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/national_summary_sheets/047_SC_EN.pdf
[8] See timeline at http://www.sqa.org.uk/sqa/57729.3449.html
[9] For Mathematics, see http://www.sqa.org.uk/sqa/45750.html

mathematics and appear to be comparatively more popular and fewer students take biological sciences in isolation. The modal number of Higher subjects – normally taken in S5 – taken is five which has remained stable, although there has been a recent increase in the numbers of students taking two or more Advanced Highers.

Number of students taking Highers and Advanced Highers (all subjects, 2005 - 2011) [10]

Student numbers by number of Highers / Advanced Highers taken							
Number of Highers	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1	13,953	13,927	14,527	14,854	15,376	16,286	16,298
2	13,060	12,809	12,842	13,228	13,534	14,222	14,361
3	11,904	11,698	11,278	11,322	11,964	12,717	13,027
4	8,938	8,523	8,591	8,765	8,941	9,225	9,526
5	10,388	9,947	10,372	10,318	10,577	10,962	11,111
6	105	110	133	106	131	168	186
7 (or more)	5	2	2	2	3	2	7
Total candidates	58,353	57,016	57,745	58,595	60,526	63,582	64,516
Number of Advanced Highers	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1	6,307	6,348	5,821	6,212	6,350	6,844	6,955
2	3,308	3,615	3,501	3,688	3,745	3,874	4,048
3	1,258	1,425	1,526	1,595	1,753	1,799	1,913
4	75	99	95	119	131	141	149
5 (or more)	1	3	10	1	5	6	9
Total candidates	11,021	11,490	10,953	11,615	11,984	12,664	13,074

New qualification documentation has recently been released. Current Standard Grades, Intermediate and Access qualifications have been replaced by the new Nationals, while Higher and Advanced Higher have been reviewed to the same design principles as the new Nationals, based on the Curriculum for Excellence (CfE). National 2 to National 5 Course documents are valid from August 2013 (for implementation in session 2013/14) and Higher Course documents are valid from August 2014 (for implementation in session 2014/15).[11]

Currently, the Scottish National Qualifications Framework (SCQF) organises qualifications in Scotland into a hierarchy, ranking each qualification according to level. This allows both learners and employers to better understand the value of each qualification. As well as whole qualifications being certificated, it is possible to certificate individual units. Units are assessed internally, by the centre, on a Pass/Fail basis. SQA provides assessment materials and quality assures internal assessment.

[10] Compiled from tables available at: http://www.sqa.org.uk/sqa/58979.html
[11] http://www.sqa.org.uk/sqa/57094.3346.html

SCQF Level(s)	National Qualification	Subjects
7	Advanced Higher	• Applied Mathematics • Mathematics
6	Higher	• Mathematics
5	Standard Grade Credit level and Intermediate 2	• Mathematics
4	Standard Grade General level and Intermediate 1	• Mathematics
3	Standard Grade Foundation level and Access 3	• Mathematics
2	Access 2	• Mathematics
2-6	Core Skills[12]	• Numeracy

The new 'Suite of Courses' under the revised National Qualifications structures these options slightly differently:[13] It is notable that the standard mathematics courses at Higher and Advanced Higher level provide no optional units. At Advanced Higher Level, students have the option of mechanics or statistics pathways.

SCQF Levels	National Courses	
7	Mathematics Applied Mathematics: Mechanics Applied Mathematics: Statistics	
6	Mathematics	
5	Mathematics	Lifeskills Mathematics
4	Mathematics	Lifeskills Mathematics
3	Lifeskills Mathematics	

The Scottish system emphasises breadth in subject choice. Of those taking 5+ Highers in 2012, 86% took mathematics[14]. Of those taking 5+ Highers in 2012, relatively few students did not take any science or other STEM related subjects: 18% did not taking any science and 11% did not take any other STEM-related subject. Over 60% of these students took mathematics (i.e. a majority of those who are taking otherwise exclusively arts, humanities and social science subjects also take mathematics). This suggests that the breadth of subjects students choose from may be successful in encouraging a broader range of students take mathematics. The table below shows, for all students taking 5+ Highers in 2011, the proportions who take other subjects alongside mathematics:

[12] Core skills such as Numeracy can be certificated up to SCQF level 6 through any Unit or Course which has been audited against the Core Skills framework and validated as fully covering one or more Core Skills component named Core Skills Units
[13] http://www.sqa.org.uk/sqa/44876.html
[14] Information supplied by David Rowley, Education Scotland statistician

Subject	Pupil takes higher mathematics		% of subject entries taking mathematics
	No	Yes	
Accounting	13	196	94%
Administration	51	164	76%
Art and Design	394	1055	73%
Biology	369	2716	88%
Business Management	188	620	77%
Chemistry	218	4611	95%
Computing (New)	79	914	92%
Drama	194	265	58%
English	1100	7794	88%
French	359	1252	78%
Geography (New)	278	1529	85%
German	91	260	74%
Graphic Communication	80	912	92%
History	548	1694	76%
Human Biology	131	1078	89%
Information Systems	21	146	87%
Mathematics		8147	100%
Modern Studies	404	1041	72%
Music	258	836	76%
Physical Education	120	628	84%
Physics	101	3725	97%
Product Design	41	182	82%
Religious, Moral and Philosophical Studies	183	181	50%
Spanish	90	283	76%
Technological Studies	5	187	97%

Note that 88% of those taking Biology also take mathematics. Students who take mathematics Highers have been found to achieve higher in every major higher course (with the exception of English and Product design) than those who did not take mathematics, suggesting that it is the higher attainers who are more likely to take Higher Mathematics.[15]

2. What are the overall participation rates in mathematics study for 16-18 year-olds both as proportions of students and proportions of the age cohort?

- → What are current levels of participation in mathematics overall amongst the upper secondary cohort and age group?
- → What are the current levels by gender?
- → How have these participation rates changed over time?

[15] Information supplied by country expert

Standard Grades are predominantly taken in S4 (although in 2012, 5.8% of the cohort of students in state secondaries was enrolled to take Standard Grade mathematics in S3 as early entry – a statistic which is expected to fall as this practice is being strongly discouraged through the new curriculum model in the CfE).

Proportion of students in state secondaries enrolled in National Qualification maths courses in 2012[16]

	S4		S5		S6	
Roll	55243		43179		32246	
	Number	**%**	**Number**	**%**	**Number**	**%**
Standard Grade	35583	64.4	13	0.0	3	0.0
Access 2	116	0.2	21	0.0	11	0.0
Access 3	3137	5.7	90	0.2	31	0.1
Intermediate 1	5052	9.1	4623	10.7	726	2.3
Intermediate 2	6023	10.9	11581	26.8	3073	9.5
Higher	27	0.0	12682	29.4	5745	17.8
Advanced Higher	4	0.0	12	0.0	2933	9.1
Any Maths	49942	90.4	29022	67.2	12522	38.8

Change in proportion of students in state secondaries enrolled in any National Qualification maths courses, 2003-2012

	S4		S5		S6	
	Number	**%**	**Number**	**%**	**Number**	**%**
2003	57514	94.2	27238	70.3	9600	35.1
2004	57129	94.5	27654	70.3	9457	35.0
2005	55469	94.2	27073	69.5	9249	34.2
2006	57500	94.0	26329	69.7	9588	35.8
2007	57456	93.1	27646	69.8	9440	36.2
2008	54881	91.0	27883	69.2	10105	36.7
2009	52257	89.5	28229	69.6	10727	38.4
2010	50671	88.5	28655	68.2	11510	38.2
2011	50436	89.4	29028	68.0	11851	37.6
2012	49942	90.4	29022	67.2	12522	38.8

Of those who took courses in state-funded secondaries, 23% took Higher mathematics and 5% took Higher and Advanced Higher Mathematics.

Around 97% of pupils who took courses in state-funded secondaries left school with a Maths qualification at SCQF level 3 or above. 22% left with a higher or advanced higher in maths.

Intermediate courses, although originally intended as a bridge between Standard Grade and Higher Grade, have been increasingly chosen as an alternative to Standard Grade, and are mostly taken in S4, although learners also choose them later to broaden their range of subjects, or when re-entering education. Access courses are basic levels (i.e. not part of a progression route – most students would start at Standard or Intermediate Grade) below the Intermediate courses and have been excluded from these tables.[17]

[16] Information supplied by David Rowley, Education Scotland statistician
[17] http://www.learningatschool.net

Percentage of National Qualification entries in all subjects by stage 2011[18]

Stage	Total Entries (All subjects)	Entries at S4 (age 15-16)		Entries at S5 (age 16-17)		Entries at S6 (age 17-18)	
	Number	Number	%	Number	%	Number	%
Standard	330,690	309,840	94	598	0	88	0
Intermediate 1	72,324	40,817	56	15,814	22	2,606	4
Intermediate 2	134,573	48,283	36	61,232	46	15,766	12
Higher	178,925	670	0	106,605	60	58,131	32
Advanced Higher	21,431	5	0	222	1	20,792	97

In 2011, there were over 20,000 entries to Higher Maths from S5, over 8000 from S6 and nearly 900 from FE.[19] There were 3098 entries to Advanced Higher Mathematics, 97% were from S6 students. An additional 279 students were entered for Advanced Higher Applied Mathematics (95% from S6 students). Not all students entered for the qualification actually achieve it (and many of the entries may drop out of the course early and thus effectively not participate)[20]. However, this data suggests that participation in Advanced Higher Mathematics, as measured by examination passes, is likely to be slightly greater than 27% of the EET cohort.[21] Note that this figure differs from the 22% of state school students who leave with a higher or advanced higher in mathematics above. The additional students are primarily from the independent sector. The overall figure may be a slight underestimate as a small number of independent sector students take A-levels, although no data is available on these figures.

In addition, just over 2000 students achieved an Advanced Higher in Mathematics in 2011, almost exclusively from S6, or approximately 3% of the cohort, or approximately 6% of those students in S6.[22] This is likely to be an underestimate as a small number of independent sector students take A-levels, although no data is available on these figures.

[18] http://www.sqa.org.uk/sqa/47250.html (NB. total entries includes S3, hence rows for S4 – S6 do not match total column)
[19] http://www.sqa.org.uk/sqa/47250.html
[20] The pass rate for Higher Mathematics were 79% in S5 and 60% in S6: http://www.sqa.org.uk/sqa/47250.html
[21] In 2011, the number achieving Higher Mathematics in S5 was just over 16,000 or 27% of an estimated EET cohort of 60,000. Additionally, small numbers of students take Higher Mathematics in FE Colleges and a small number of students are likely to take Higher Mathematics for the first time in S6. Around 5000 students achieve Higher Mathematics in S6, although it is likely that many of these students are retakes.
[22] In 2011, 3098 students took Advanced Higher Mathematics, 97% from S6 with a pass rate of 69%. This is just over 3% of an estimated EET cohort of 60,000. The S6 school cohort is just over 30,000.

Participation by Gender 2011

Qualification	Subject	% of entries		% Pass Rate	
		Male	Female	Male	Female
Advanced Higher	Mathematics	61	39	65	74
	Applied Mathematics	71	29	79	78
	All subjects	48	52	78	84
Higher	Mathematics	53	47	72	73
	All subjects	45	55	76	79
Intermediate 2	Mathematics entries	49	51	71	75
	Total entries	48	52	80	83
Intermediate 1	Mathematics entries	51	49	64	66
	Total entries	51	49	75	79

Boys are more likely than girls to take a higher or advanced higher in Maths but are also more likely to not take a Maths course beyond Access 3.

Participation does not appear to be influenced by SES once prior-attainment has been accounted for.[23]

Entries at SCQF level 4-7 for 2008 – 2011[24]

Qualification	Subject	Entries 2008	Entries 2009	Entries 2010	Entries 2011
Advanced Higher	Mathematics	2,752	3,027	2,963	3,098
	Applied Mathematics	305	305	263	279
	All subjects	18,854	19,648	20,585	21,431
	Mathematics as percentage of	15%	15%	14%	14%
	Applied Mathematics as	2%	2%	1%	1%
Higher	Mathematics	19,636	19,638	20,657	20,552
	All subjects	162,576	167,792	175,614	178,925
	Maths as percentage of all	12%	12%	12%	11%
Intermediate 2	Mathematics entries	19,480	21,487	21,938	22,409
	Total entries	113,388	122,463	130,497	134,573
	Mathematics as percentage of	17%	18%	17%	17%
Intermediate 1	Mathematics entries	12,650	12,082	12,737	12,852
	Total entries	60,267	65,735	69,834	72,324
	Mathematics as percentage of	21%	18%	18%	18%

[23] Information supplied by country expert
[24] http://www.sqa.org.uk/sqa/47250.html

Pass-rates at SCQF level 4-7 for 2008 – 2011

Qualification	Subject	% Pass Rate 2008	% Pass Rate 2009	% Pass Rate 2010	% Pass Rate 2011
Advanced Higher	Mathematics	70	68	67	69
	Applied Mathematics	78	75	72	78
	All subjects	78	80	80	81
Higher	Mathematics	72	70	72	72
	All subjects	75	76	76	77
Intermediate 2	Mathematics entries	73	72	71	73
	Total entries	79	80	80	82
Intermediate 1	Mathematics entries	60	60	56	65
	Total entries	75	76	75	77

3. What are the patterns of participation in terms of following different routes involving mathematics?

→ What are current levels of participation in different mathematics options amongst the upper secondary cohort and age group?

See Section 2.

Percentages of students leaving Upper Secondary education in the 2010/11 academic year with mathematics qualifications at each level:[25]

	Levels 3-5	Level 6	Level 7
Mathematics	95.4%	22.2%	3.4%

Of students leaving upper secondary education in the 2009/10 academic year, 16.2% held level 7 qualifications, 34.1% held level 6 qualifications, 26.5% held level 5 qualifications and 17.4% held level 4 qualifications (based on highest level of qualification held at time of leaving).[26]

Between 2000/01 and 2008/09, the percentage of S4 pupils staying on at school until S6 remained largely unchanged at about 45%. However, in 2009/10, possibly as a result of the recession, the percentage of S4 pupils staying on to S6 increased to 50 per cent.[27]

[25] Extracted from data available at: http://www.scotland.gov.uk/Topics/Statistics/Browse/School-Education/sqala/sqalasupp/sqala2012
[26] http://www.scotland.gov.uk/Publications/2011/06/24142721/2
[27] http://www.scotland.gov.uk/Publications/2011/06/24142721/2

Destination of School Leavers 2009 – 2011:[28]

	2008/09		2009/10		2010/11	
Destination	**Number**	**%**	**Number**	**%**	**Number**	**%**
Higher Education	17,936	33.6	18,137	33.7	18,298	34.0
Further Education	12,747	23.9	13,212	24.5	13,293	24.7
Training	2,370	4.4	1,827	3.4	1,860	3.5
Employment	12,187	22.9	12,436	23.1	12,925	24.0
Voluntary Work	153	0.3	244	0.5	285	0.5
Activity Agreement	-	-	-	-	312	0.6
Unemployed seeking	6,709	12.6	6,637	12.3	5,642	10.5
Unemployed Not Seeking	1,009	1.9	971	1.8	898	1.7
Unknown	213	0.4	378	0.7	337	0.6

4. What is the content and level of the different kinds of provision?

→ What is the structure and content of the mathematics options?
→ How is teacher education organised in order to offer the mathematics options?

Pupils currently in upper secondary mathematics education are following the previous curriculum as the implementation of the Curriculum for Excellence works through the school years. In the academic year 2013-2014 students will take the first of the new qualifications. Upper secondary mathematics will not change much under the Curriculum for Excellence as the current programme is popular and relatively successful.[29]

Details of the current curriculum:

The Higher and Advanced Higher mathematics courses focus on pure mathematics, although the number of entries is very small. Students taking Applied Mathematics can choose from either mechanics or statistics. The applied options are all at an advanced level geared towards complex use of mathematics for study in higher education.

Standard Grade and Intermediate qualifications focus on pure mathematics, but up to 15% of candidates take the 'Applications of mathematics' unit offered in Intermediate 1 and 2 instead of the pure mathematics unit 3. Access courses and core skills cater for more everyday uses of mathematics.

The main change under the Curriculum for Excellence is that each study unit will include an explicit focus on the applications of learning to real-life and the work-place.[30]

SQA offers a range of qualifications in numeracy skills including Core Skill Numeracy Units at SCQF levels 2 (simple) to SQCF level 6 (complex). Core Skill Numeracy has two

[28] Extracted from data tables available at: http://www.scotland.gov.uk/Topics/Statistics/Browse/School-Education/leavedestla/follleavedestat/leaverdestla2012
[29] Norris, E. (2012). *Solving the maths problem: international perspectives on mathematics education.* England: Royal Society of Arts.
[30] Norris, E. (2012). *Solving the maths problem: international perspectives on mathematics education.* England: Royal Society of Arts.

components, Using Number and Using Graphical Information. Core Skills in Numeracy are necessary for coping with the demands of everyday life, including work and study; people need to be comfortable with numbers, and with graphs, symbols, diagrams and calculators.

Core Skill Numeracy focuses at different levels on skills such as

- Using numbers to solve problems and to understand the results
- Reasoning and logic
- Reading and producing graphical information
- Time, money and measurement

Learners can achieve the national standard either through discreet Core Skill Numeracy Units or through automatic certification where these standards are embedded in a National qualification. For example, the qualification *Laboratory Science: Working in a Laboratory* has the Numeracy component of Using Number at SCQF level 5 embedded in its standards.

National Core Skill Numeracy Units are context free and are used across sectors from school, college to community based learning. Workplace Core Skill Units available at SCQF levels 3-6, use the same standards but learners must provide evidence from the workplace context.

New National Qualifications under the Curriculum for Excellence will also offer National Units in Literacy and Numeracy at SCQF levels 3, 4 and 5. These Units will be built into English/Gaidhlig and Maths/Lifeskill Maths National Courses at SCQF levels 3 and 4. At SCQF level 5 appropriate coverage of literacy and numeracy skills will be embedded across English/Gaidhlig and Maths Courses. Like all NQ Units these will be ungraded. Those wishing or needing certification in literacy and numeracy can also take the free-standing Units. These units will also be available to adult learners[31]. This focuses on basic and life-skills mathematics including:

- Basic number processes
- Understanding time
- Money
- Information handling
- Chance and uncertainty

Teacher Training

Teaching in Scotland is an all graduate profession with courses offered by eight universities. Teachers must be qualified in their chosen subject(s) and hold a teaching qualification: PGDE or B.Ed.[32] Secondary trainee teachers spend approximately a 1/3rd of their time on placement and 2/3 in the Initial Teacher Education Institution (university based). There is no specific training for upper-secondary teachers (teachers taking Highers and Advanced Highers classes); these teachers tend to observe colleagues and progress to these classes after several years teaching.

Teachers in FE have a school-based qualification and then take the Teaching Qualification in Further Education (TQFE).

[31] The Scottish Government. (2011). Curriculum for excellence: Building the curriculum 5: A framework for assessment. Edinburgh: The Scottish Government.

[32] http://www.gtcs.org.uk/education-in-scotland/secondary-teaching.aspx

Continuing Professional Development is seen as a major challenge for Scottish education and is currently under review.[33] Education Authorities provide in-service training as deemed necessary and training has also been run through the National Numeracy Network. Online support is available to teachers through SQA assisting teachers with examination preparation through publishing marking instructions and practice. Teachers are entitled to 35 hours of CPD and this entitlement will be strengthened within the new teacher registration agreement which will be in place from August 2013.

5. How are the different mathematics options assessed?

→ How and when are students assessed for summative purposes?
→ Are any alternative assessment pathways available?

The curriculum for excellence reforms have been implemented for the current 2013 S3 cohort and the effects of this reform will begin to take effect on mathematics qualifications and upper secondary mathematics from 2014 for mathematics at 16 and 2014/15 for participation in mathematics post-16.

In Upper Secondary mathematics in Scotland, there is a prioritisation of diversity in curriculum content over diversity in qualification type. All students take the same qualification: The Higher.[34] (Although a very small proportion of students in independent schools may take English qualifications – see the profile for England for details.)

NQs are currently being reviewed to ensure they reflect the values, purposes and principles of Curriculum for Excellence.[35] The new National 2- 5 will be taken first in 2013-2014, Higher in 2014-15, and Advanced Higher in 2015-16.

See National Qualifications table in Section 1.

Previously, most pupils took Standard Grades or Intermediate levels in S3-S4. Standard Grade General and Credit and Intermediate 1 and 2 qualifications have been replaced with National 4 and National 5 Qualifications.

Currently students usually take Highers in S5. Students may go to university after S5 or they may stay into S6 and take further Highers and Advanced Highers. Highers and Advanced Highers are being revised to align with the new National 4 and National 5 Qualifications.[36]

The design principles for the new National Course (National, Higher, or Adv. Higher) [37] state:

The new Courses will use a new type of Unit — more skills-based, less prescriptive, and more user-friendly. These Units will require knowledge and understanding as well as skills.

[33] Donaldson, G. (2011). *Teaching Scotland's Future: Report of a review of teacher education in Scotland.* Edinburgh: The Scottish Government.
[34] Norris, E. (2012). *Solving the maths problem: international perspectives on mathematics education.* England: Royal Society of Arts.
[35] http://www.educationscotland.gov.uk/learningteachingandassessment/curriculumareas/mathematics/nqs/index.asp
[36] The Scottish Government. (2011). *Curriculum for excellence: Building the curriculum 5: A framework for assessment.* Edinburgh: The Scottish Government.
[37] See the design principles available from http://www.sqa.org.uk/sqa/42135.html

Their specifications will be more flexible and open. They will have fewer, broader outcomes that encourage holistic assessment, and will rely on assessors to exercise professional judgment instead of having to satisfy long lists of criteria.

National 4, National 5, Higher and Advanced Higher Courses will be based on a notional 160 hours of study, and at all levels there will be flexibility in the number of Units. National 2 and National 3 Courses will be based on a notional 120 hours of study.

National 4, National 5, Higher and Advanced Higher Courses will have a Course Assessment (final exam).

Since 2009, the highest achieving students in Upper-Secondary education in Scotland have also had access to the Scottish Baccalaureate although not all schools offer this.[38] One of the Courses in the Baccalaureate in Science must be Mathematics (or Applied Mathematics) and this may be at Higher or Advanced Higher level.[39] One of the Courses in the Baccalaureates in Social Sciences and in Expressive Arts must be English (or ESOL or Gàidhlig) or Mathematics (or Applied Mathematics) and this may be at Higher or Advanced Higher level.

6. What information is available on students' learning outcomes in secondary education?

→ What research or policy evidence is available on students' expectations, attitudes and attainment in relation to mathematics in lower and upper secondary education?

Attainment Outcomes (International):

For upper-secondary, see Sections 2 and 3.

In TIMSS 2007, Grade 8 students in Scotland produced an average scale score in mathematics of 487. This compares to the English average scale score of 513. Scotland's score decreased significantly between 2003 and 2007:[40] In PISA 2009, Scotland's average score was 499.[41]

	1995 average scale score	2003 average scale score	2007 average scale score
Scotland	493	498	487

Attainment Outcomes (In School):

Lower secondary students usually take seven or eight Standard Grade and/or Intermediate courses including Mathematics and English. Standard Grade has three levels: Credit (grades

[38] The Royal Society. (2011). *Preparing for the transfer from school and college science and mathematics education to UK STEM higher education: A 'state of the nation' report.* London: The Royal Society.
[39] http://www.sqa.org.uk/sqa/35858.html
[40] Mullis, I. V. S., Martin, M. O., Foy, P., Olson, J. F., Preuschoff, C., Erberber, E., Galia, J. (2008). *TIMSS 2007 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
[41] Cooke, M., & Bejtka, K. (2010). *Programme for International Student Assessment (PISA) 2009: Highlights from Scotland's Results*. Edinburgh: Education Analytical Services Division, Scottish Government.

1-2), General (3-4) and Foundation (5-6). Most learners sit exams at two adjacent levels in each Standard Grade subject.

In 2011 there were 42,656 entries to Standard Grade Mathematics. The following table shows awards given at each level:[42]

Standard Grade Level	Awards	% of Total
1	7,425	17
2	6,674	16
3	11,702	27
4	6,256	15
5	7,763	18
6	2,286	5
7	525	1

In 2011 there were 12,852 entries to Intermediate 1, and 22,409 to Intermediate 2. The following table shows grades given at each level:

	A	B	C	TOTAL PASSES	D
Intermediate 1	31%	17%	16%	65%	7%
Intermediate 2	37%	19%	17%	73%	7%

7. What vocational education options are available at upper secondary level?

- → What is the structure and content of the vocational courses available?
- → What status do vocational courses have in comparison to other options?
- → What are the participation levels in these courses?
- → How much mathematics is included in vocational education courses and at what levels?

Vocational qualifications such as the Scottish Vocational Qualifications are tailored to specific industry requirements, and as such any required mathematical content will be focused on how it will be applied for the particular vocation. Colleges offer Higher National Certificates at SCQF level 7. These prepare more in general for areas of work. Following a successful 2 year pilot from 2005-7 SQA has made a range of Skills for Work Courses available for centres. These Courses are for pupils in third and fourth year of secondary school and above and they focus on the world of work. There are multiple vocational courses which include mathematics (see Appendix 1). There is very limited information on participation numbers in vocational education available.

Scottish Vocational Qualifications (SVQs) are designed to certificate successful students who can meet the national occupational standards defined by standards setting bodies.

[42] http://www.sqa.org.uk/sqa/47250.html

There are SVQs available at up to five levels, for virtually every occupational area. The Units of which SVQs consist are designed to be assessed in the conditions of the workplace.[43]

SVQ Level	Notional SCQF Level
1	4
2	5
3	6
4	8
5	11

Total entries at each SVQ Level 2007 – 2011:[44]

	2007		2008		2009		2010		2011	
	Total entries	Students <20	Total entries	Students <20	Total entries	Students <20	Total entries	Students <20	Total entries	Students <20
Level 1	1,875	1,170	1,745	1,078	1,520	946	1,539	872	1,492	981
Level 2	21,940	8,619	22,029	8,880	19,691	8,180	18,344	6,173	14,823	5,479
Level 3	19,193	6,929	17,772	6,930	13,215	5,528	18,788	5,789	12,862	4,510
Level 4	2,295	2	2,624	0	1,822	0	2,160	3	1,959	12
Level 5	53	0	62	0	133	0	76	0	139	0
Total	**45,356**	**16,720 (37%)**	**44,232**	**16,888 (38%)**	**36,381**	**14,654 (40%)**	**40,907**	**12,837 (31%)**	**31,275**	**10,982 (35%)**

Skills for Work Courses are different from other vocational provision because they focus on generic employability skills needed for success in the workplace. The courses offer opportunities for learners to acquire these critical generic employability skills through a variety of practical experiences that are linked to a particular vocational area such as construction, hairdressing, hospitality etc. The Skills for Work Courses are also designed to provide candidates with opportunities for developing Core Skills. Apart from these, National Courses include a wide range of vocational subject type Courses blurring the distinction between academic and vocational education and qualifications, see the list below[45].

- Administration
- Architectural Technology
- Beauty
- Building Construction
- Business Management
- Care
- Care Practice
- Computing
- Design
- Early Education and Childcare
- Home Economics: Health and Food Technology
- Home Economics: Lifestyle and Consumer Technology
- Hospitality - Food and Drink Service
- Hospitality - Professional Cookery
- Information Systems
- Mechatronics
- Mental Health Care
- Personal and Social Education
- Personal Development
- Play in Early Education and Childcare

[43] From 'Scottish Vocational Qualifications' table at: http://www.sqa.org.uk/sqa/33682.html
[44] Extracted from data available at: http://www.sqa.org.uk/sqa/58979.html
[45] See http://www.sqa.org.uk/sqa/47250.html for entries and achievements

- Electronics
- Fabrication and Welding Engineering
- Food Production Supervision
- Graphic Communication
- Hairdressing: Principles of Colouring Hair
- Health and Social Care
- Home Economics: Fashion and Textile Technology
- Product Design
- Professional Patisserie
- Retail Travel
- Selling Scheduled Air Travel
- Structural Engineering
- Technological Studies
- Travel and Tourism

A recent review suggests the need to adapt and reform the current system. Recommendations are to create a coherent system of post-16 and vocational education, with a blurring between academic and vocational education. Systems are recommended to be learner centred, preparing students for work though collaboration with employers.[46]

8. What drives the pattern of take-up? How is it linked to the needs of HE, employers and national policy objectives?

→ What are the official criteria, if any, for acceptance to the mathematics options?
→ Are there any unofficial / local criteria for acceptance to the mathematics options?
→ What information, advice or guidance is there about the mathematics options?
→ Are any mathematics recruitment policies targeted to specific groups or types of students?
→ Which subjects and options are students expected or required students to take?
→ Please note the views of, for example, further/higher education institutions, employers, parents or the public more generally

→ Are there 'unofficial' expectations to have particular mathematics qualifications for entry to particular HE courses?

There are no admissions criteria for continuing to ISCED 3 in a secondary school. However, in order to take some courses, the school may impose specific requirements. Admission to colleges is at the discretion of each college.[47]

University admission drives take-up of the higher and advanced higher qualifications. Scottish universities tend to provide 4 year courses, which compensates for students being able to attend university a year earlier than in England. Students who have stayed on for a sixth year at secondary school and taken Advanced Highers may enter directly into the second year of university.

Many degree courses such as engineering, physics and mathematics will require applying students to have taken the mathematics Higher paper, and may have grade requirements.

In other cases, students will pursue mathematics qualifications for their own interest without specific career or educational goals in mind.

[46] Roe, W. (2001). *Review of Post-16 Education and Vocational Training in Scotland.* Edinburgh: The Scottish Government.
[47] http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/national_summary_sheets/047_SC_EN.pdf

At the time of the last change to the National Qualifications, a review of the reforms suggested that, whilst satisfaction rates amongst employers, Higher Education admissions, careers guidance providers and training providers were at a broadly similar level in 2003, careers guidance providers and training providers satisfaction had risen over the 4 previous years, whereas the satisfaction of Higher Education admissions had fallen and that of employers had not changed significantly.

Stakeholder satisfaction ratings of the qualifications system pre- (1999) and post- (2003) Higher Still reforms[48]

Stakeholder	Percentage Satisfaction	
	1999	2003
Employers	59.4	60.1
HE Admissions	67.2	62.9
Careers Guidance	59.9	66.0
Training Providers	52.8	59.4

9. What policies and practices are there for transition and retention?

- → What policies or practices are there to support students' transition from lower secondary to upper secondary mathematics options?
- → More generally, what policies or practices are directed at students struggling with upper secondary mathematics?

There is limited advice available to students in the "Progression Routes" guide to Mathematics and Science. This outlines potential Mathematics and Science careers, the qualifications obtainable and the entry routes and requirements.[49]

10. What information is available on (other) factors affecting recruitment and retention?

- → What factors would you attribute to the upper secondary mathematics recruitment levels in your education system?
- → Please give details of any supporting information or sources

Information unavailable.

[48] Scottish Executive. (2003). *Insight 11: An evaluation of the Higher Still reforms*. Edinburgh: Scottish Executive Education Department.
[49] http://www.sqa.org.uk/files_ccc/PG_Pt18_ScienceandMaths.pdf