MATHEMATICS EDUCATION 5- 18 IN THE FOUR NATIONS

A comparative analysis.

A Report for the Joint Mathematical Council of the United Kingdom

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1. INTRODUCTION

Education in the UK is a devolved policy area, with the four nations of England, Scotland, Wales and Northern Ireland each responsible for their own education systems. Joint Mathematical Council has posed the question:

What are significant differences in mathematics education in the four nations of the UK, in relation to:

- the curriculum, overarching philosophy and current initiatives?

- relationships between key stakeholders?

- responsibilities for assessment, curriculum, and teacher development?

The comparison was undertaken using the following methods:

- Analysing the four Descriptions of Mathematics Educations provided to JMC

- Use of the wider knowledge base of the research team

- Identifying and summarising significant differences in approach

- Identifying gaps in knowledge to be filled

- Liaising with contacts and stakeholders to ensure accuracy

2. ANALYSIS

2.1 Framework

Working from the four descriptions as source data, we have identified the following five/six areas in which there are significant and interesting differences between the Nations. For each we set out the questions that contribute to understanding this difference.

Curriculum framing and enactment	What is the curriculum and how is it renewed? What is the overall framing? How is teaching organised by age? Who is responsible for monitoring and inspecting the enacted curriculum?
Numeracy	What is meant by numeracy? How is numeracy addressed in curriculum and assessment? Where/how do the following feature: financial capability, application to extra-mathematics contexts, fluency with number skills
Significant assessment 5 - 11	What are they? How are they reported? Individually (to parents), at school level (for comparison) and/ or nationally (as cohorts) Anything innovative?
Significant assessment and qualifications 11-16	What are they? How are they reported? How are they developed? Anything innovative?
Mathematics pathways 16-18	Parallel pathways or flexible timing?
Professional Learning	Entry level? What structures exist for initial and continuing learning? What is the focus in mathematics? Who organises and provides?

This comparison is reported as a table in 2.2. In section 3 we then identify one or two distinctive aspects for each of the four nations.

2.2   Comparison Table

	England	Northern Ireland	Scotland	Wales

Curriculum framing and enactment	National Curriculum launched in 2013 and updated 2014 follows versions in 1988,1995,1999 and 2008. Programme of study gives detailed learning objectives for each year in key stages (KS) 1 & 2, and for the whole key stage in KS 3 & 4. The mathematics curriculum aims for students to be fluent in mathematics, able to reason and to solve problems.
	
	   The current National Curriculum is a legal requirement only for local authority run schools but in practice most schools follow it. Schools and colleges are responsible for developing their curriculum, closely monitored by Office for Standards in Education (Ofsted).
		Northern Ireland Curriculum was launched in 2007 by Council for Curriculum, Examinations and Assessment (CCEA). It focuses on learning processes as well as outcomes of education, equally emphasising knowledge, skills and understanding. At each key stage, mathematics appears in two strands: *Using mathematics* is one of three cross curricular skills taught over KS 1-4; *Mathematics and Numeracy* is a compulsory learning area for KS 1-3.
		   Schools and teachers have flexibility to decide topics and approaches. The Education and Training inspectorate promotes good practice, with no specific focus on curriculum.
			The 2010 Curriculum for Excellence has a 2019 Refreshed Narrative focusing on fuller enactment and promoting Maths-positivity. For ages 3-15, the Broad General Education (BGE) promotes inter-disciplinary learning, with 22 benchmarked statements of experiences and outcomes in *Numeracy and Mathematics* at five levels. For Senior phase, 16-18, schools offer a range of subject qualifications.
			   Schools are responsible for designing and implementing their curriculum, backed by Local Authorities in Regional Improvement Collaboratives RICs all inspected and supported by Education Scotland.
				The 2008 "Skills" curriculum, with four key stages, was supplemented by the 2012 National Literacy and Numeracy Framework setting year-by-year expectations. Schools are now planning towards Curriculum for Wales (CfW) in 2022 for ages 3-16, which demands cross-disciplinary planning across six Areas of Learning and Experience including *Mathematics and Numeracy,* with progression steps broadly corresponding to expectations at ages 5, 8, 11, 14 and 16.
				   Schools are responsible for developing their own curriculum, inspected by Estyn and supported by four Regional Education Consortia.

Numeracy	Numeracy is implicit in the 2014 curriculum, enacted as a focus on numerical reasoning through KS 1-3. Financial capability is embedded within the Number, Measurement and Ratio and proportion curriculum strands. From 2020, results of national online multiplication-tables tests for 9-year olds and baseline assessments of 4-year olds are reported to parents, with school results compiled by DfE.	Numeracy is defined broadly as ability to apply appropriate mathematical skills and knowledge in familiar and unfamiliar contexts and in a range of settings throughout life, including the workplace. Early emphasis during KS 1-3 is monitored by performance on international comparisons. In KS3 cross-curricular numeracy is promoted through Using Mathematics and a Financial Capability strand within Mathematics. CCEA is piloting online diagnostic adaptive assessments in numeracy.	Current focus in Broad General Education is on embedding numeracy, understood as the application of mathematics across learning, life and work. Many numeracy experiences and outcomes, including financial literacy (Money), are achievable in any subject, while others are mathematics-specific. Ongoing assessment relies on teacher judgements informed by diagnostic national numeracy tests.	Evolving definition of numeracy: from numerical reasoning (2013) to applying mathematics to solve problems in real-world contexts (2020). Numeracy shares the same proficiencies and progression statements as Mathematics, including financial literacy element. Currently, teachers report ongoing assessment with annual national test results. CfW 2022 approaches numeracy by promoting application within all curriculum areas.
Significant Assessment 5 -11	Teacher assessment at the end of KS1 is informed by national tests and reported individually. National tests (SATs) in mathematics at end of KS2 are reported at individual, school and national level. These assessments are statutory only for maintained schools.	At end of KS 1 & 2, standardised and moderated teacher assessments in Using Mathematics are reported to parents and the DE through CCEA. Schools also prepare 11-year-olds for unregulated commercial numeracy tests for some post-primary school selection.	Teacher assessments are informed by Scottish National Standardised Assessments in numeracy, scheduled by teachers within P1, P4 and P7, and reported individually. CfE levels and test performance are reported at national level. Personalised online tests since 2019.	Annual numeracy test performance from Year 2 and teacher assessment of Maths NC levels at age 7 and 11 are currently reported at individual and national level. Online adaptive tests start 2019 but CfW will limit results to in-school use only.

Significant assessment and qualifications 11-16	Almost all students sit Mathematics GCSE at 16 years old. Results are reported at individual, school and national level. Continuing students who did not achieve threshold GCSE at age 16 are expected to retake GCSE mathematics. Other qualifications: Statistics GCSE, Entry level mathematics, Functional skills in Mathematics. Ofqual regulates and accredits awarding organisations of which there are three (in 2020). Schools choose which one they use.	At KS4 the study of Mathematics and numeracy is not compulsory but in practice it is one of the main areas of learning and schools must offer at least one qualification (GCSE and /or Entry level). Nearly all schools use CCEA's GCSEs in Mathematics, Statistics, Further mathematics and Economics, although they can use English boards. Other qualifications: Entry level mathematics (pupils gain Entry Level 1, 2 or 3). Assessment is by a portfolio of work, there are no exams.	Scottish National Standardised Assessments are reported (as above) for S3. At 16, most students gain National 4s (internally assessed) or National 5s (externally). Range of qualifications includes National 4 and 5s in Mathematics and Applications of Mathematics and awards in Personal Finance, Data science. SQA develops and awards qualifications and accredits other awarding bodies.	Numeracy tests and Mathematics levels are reported (as above) at 14. Only WJEC GCSEs are permitted in state schools. From 2016, there are two GCSEs, *Mathematics* and *Mathematics Numeracy*, with three tiers. At 16, most students take both. The Welsh Baccalaureate requires C in either and includes an Individual Project involving numeracy. Qualification Wales regulates awarding bodies. It is considering qualification design and requirements to support CfW (from 2026).
Mathematics pathways 16-18	Parallel pathways: A level Mathematics and Further Mathematics for students who wish to specialise in mathematics. Core Maths for students who wish to continue mathematics study to support other subjects. Continuing students who did not achieve threshold GCSE must study mathematics, some taking Entry Level 1, 2 or 3 before retaking GCSE. FE colleges offer Entry level, GCSE and A level mathematics and vocational courses	GCE A levels in Mathematics and Further Mathematics are offered by CCEA. (NI schools can use English GCEs). Students may retake GCSE mathematics, or add Further Mathematics GCSE. Other qualifications: Entry level mathematics (pupils gain Entry Level 1, 2 or 3), offered by CCEA. FE colleges offer mathematics within Essential Skills, apprenticeships, A levels and vocational courses	S4 to 6 has flexible learner journeys and exit points through National 4 and 5s, Highers in Mathematics and Applications of Mathematics (2022), Advanced Highers in Mathematics, Statistics and Mathematics of Mechanics plus awards in Statistics and Data Science. Offer decided by school and LA. FE/HE colleges offer Nationals, Highers and vocational courses. Higher Mathematics includes no statistics or mechanics.	WJEC AS and A levels in Mathematics and Further Mathematics are permitted in state schools. The individual project of the post-16 Welsh Baccalaureate Advanced has a numeracy assessment component. Offer decided by school. FE colleges offer GCSES, A levels and vocational courses with Welsh Baccalaureate.
Professional Learning	ITE has several pathways: the traditional route solely through HEIs; School Centred Initial Teacher Training (which may have some input from an HEI); School Direct consortia (where the training is shared between school and HEI); Teach First (an education charity), Now teach or Transition to Teach (for career changers). PGCE is only accredited through HE but any other organisation, e.g. schools, can award QTS. Professional development for teachers of mathematics is available through NCETM and Maths hubs.	All ITE courses are provided by HEIs. Teachers have to register with the General Teaching Council NI for approval of qualification and recognised eligibility to teach. Teaching competencies, was launched 2011 and developed within a constructivist view of teaching and learning, 4 phases of professional development including ITE, Induction, Early Professional Development and Continuing Professional Development. There is no specific requirement for teachers to undertake mathematics-related professional development, although this exists.	Established Career-long Professional Learning, with high entry requirements and 5-yearly updates, follows a national model of locally-driven development agreed by partners, including the General Teaching Council for Scotland which manages and accredits professional learning. Recent focus in Numeracy and Mathematics is on building shared understandings of curriculum intentions and levels. In 2019 £2m funding was available to schools and LAs for STEM learning projects.	All courses that lead to QTS are provided by HEIs. The developing National approach to Professional Learning 2018 aims to reduce variety and increase impact for pupils. Education Workforce Council registers teachers. It co-ordinates rather than provides learning, supporting individual journeys within schools as learning organisations, tailored towards CfW 2022. Mathematics specific element is a database of STEM training events e.g. offered by Consortia, FMSP Wales and SEREN Hubs supporting academic excellence.

3. DISTINCTIVE ASPECTS OF EACH NATION

This section identifies one or two features of the mathematics education in each nation. England has a network of maths hubs (administered by NCETM) promoting the Teaching for Mastery approach. Northern Ireland has invested in a well-qualified teaching profession and Teaching Competency Framework. Scotland has developed its Curriculum for Excellence with a range of new qualifications. Wales has made Numeracy a focus, developing curriculum and assessment through to GCSEs in both Mathematics and Numeracy.

3.1 England – Teaching for Mastery programme and Maths Hubs

> 8.8 million students in 17000 state funded primary schools, 3400 state funded secondary schools, 1000 special schools. State funded schools include local authority run schools, free schools, academy schools, foundation schools, voluntary schools.
>
> 670,000 16-18 year old students in post 16 colleges plus 69 000 undertaking an apprenticeship.
>
> 580,000 students in 2300 independent schools.

The Smith report (2004) into post 14 mathematics identified three main issues of concern: a shortage of specialist mathematics teachers in England (and Wales), the failure of the curriculum and assessment framework to meet the needs of many learners and the lack of resources to support mathematics teachers in their professional development. As a response the National Centre for Excellence in Teaching Mathematics was set up in 2006 to provide CPD for teachers of mathematics. In 2013 the government announced funding for the Maths Hubs programme which would be co-ordinated by NCETM. 37 Maths hubs now cover the whole of England and each one centres on a lead school acting as the hub for professional development of mathematics teachers in their locality. The hubs were tasked with the roll-out of the Teaching for Mastery programme beginning with key stage 1 and using new textbook schemes. Two teachers in each of the early adopter schools had five days of CPD in the use of the Teaching for Mastery approach as promoted through the textbooks, with an expectation that they would cascade the training to their colleagues. The Teaching for Mastery approach has since been rolled out to later years primary classes and subsequently some secondary schools. The hubs also appointed and trained Lead teachers to deliver CPD in Teaching for Mastery, teaching Core Maths and other mathematics based CPD within the locality. Many schools have taken advantage of the CPD offered through the Maths Hubs but not all schools have engaged with their local hubs, or the Teaching for Mastery approach, so the picture of development is unevenly distributed. The best CPD offered through the Maths Hubs develops in-depth conceptual understanding and progression in mathematical concepts with a detailed focus on lesson content and delivery. This model of CPD provision through the local level, using the expertise within the teaching workforce, is a distinctive attribute of the English system.

Northern Ireland – commitment to a strong teaching profession

> 340,000 students in 800 State funded primary schools, 70 grammar schools, 130 (post primary) non grammar schools, 160 schools with a sixth form, 40 special schools.
> 38,000 students aged 16-18 in FE colleges. 600 students in 14 independent schools.

Whilst there is a diversity of schools: Controlled (mainly Protestant), Catholic Maintained, Voluntary Grammar (entry via academic selection through testing), Integrated, and Irish Medium schools in Northern Ireland, there is a coherence in the way that the curriculum is delivered. High standards are achieved by Northern Ireland's students as indicated by GCSE mathematics results where NI students outperform those taking GCSEs in England and Wales. Part of the reason for this may be the strong teacher education offered in Northern Ireland. Teaching in Northern Ireland is a high status graduate profession and student teachers and recently qualified teachers are viewed as being of high calibre. The ITE curriculum is research informed and reflects the competencies and values set out by the General Teaching Council for Northern Ireland. ITE is solely undertaken through four accredited HEIs; either full time 4 year BEd or Bachelors degree +PGCE. Teaching competencies - launched 2011, developed within a constructivist view of teaching and learning, talk of the reflective and activist teacher. They are separated into professional values and practice, professional knowledge and understanding, professional skills and application. Teacher development through the competencies is set out in four phases of professional development: ITE, Induction, Early professional development and CPD (collaborative practice and school improvement).

3.2   Scotland - the qualifications portfolio and professional learning culture

Sector:

700,000 students in 2000 primary schools (5 - 12), 360 secondary schools (ages 12-18),110 special schools. 140,000 15-24 year olds in 26 FE/HE colleges. 100 independent schools (mostly following English curriculum)

Distinctively, the Scottish Qualifications Authority (SQA) combines the roles of accrediting external awarding bodies with developing, carrying out and awarding its own qualifications. A new set of qualifications was developed alongside Curriculum for Excellence (CfE) based on a central spine of seven levels, adopting traditional examinations such as Mathematics and developing new ones (in consultation with teachers and universities). Higher Mathematics is unusual in including no statistics or mechanics. Applications of Mathematics runs as an alternative to Mathematics at Scottish Curriculum Qualification Framework levels 3 to 6, including externally assessed National 5 and Higher (from 2022). This course enables learners to apply mathematical ideas and strategies in managing finances and using statistics, geometry and measurements in real-life contexts. Awards in Personal Finance, Data Science and Statistics extend the curriculum. Learners build their portfolio of qualifications from the Senior Phase (S4 to 6). Uniquely, there is no government specification of the range, level or timing of qualifications to be taken, only of broad CfE principles. The number of subjects that learners study in S4-6 is decided by the particular school or local authority, usually between five and eight in S4. The 15-24 Learner Journey Review (2018) envisages flexible routes through school, college, higher education and work. Over half the National 5s entries are in S4, but a quarter are in S5, and over half of Highers are taken in S6. Scotland delegates significant responsibility to schools, for curriculum development, self-evaluation and teacher professional learning. This is mediated through Local Authorities and Regional Improvement Collaboratives. Education Scotland is unique in both supporting and challenging these agencies in its two roles as improvement leaders and as inspectorate. It draws on well-established relationships with the General Teaching Council for Scotland and the (independent) Scottish Mathematical Council. Recent mathematics initiatives (Transforming Scotland into a maths positive nation; Multiplying Skills, Adding Value; Enhancing STEM learning) work through these existing cross-disciplinary structures.

3.3   Wales – the emphasis on numeracy

470,000 students in 1200 primary schools, 190 secondary schools (16% Welsh medium), 40 special schools, 30,000 16-18 year-olds in 13 colleges. 10,000 students in 80 independent schools.

A feature of mathematics education in Wales has been the emphasis on Numeracy, growing out of concerns about PISA results in 2010 and the subsequent 2012 National Literacy and Numeracy Programme. Although initially defined by the Welsh government in terms of numerical reasoning (Dauncey 2013), the approach is now closer to quantitative literacy, that is application of mathematics to solve problems in life, work and other learning. GCSE Mathematics Numeracy was introduced for 2016 as a full GCSE, with the same size and demand as GCSE Mathematics. It focuses on applications of number, measure, statistics, with some algebra and geometry. Questions require students to decide and communicate multi-step approaches to problems. GCSE Mathematics addresses aspects of mathematics needed for further mathematical or technical study (notably algebra and geometric proof). They are taught together, and most students take both. The Welsh National Baccalaureate requires a C grade in either Mathematics or Mathematics with Numeracy.

Students' numeracy skills are assessed and reported annually by teachers, in addition to reporting of Mathematics performance at the end of each key stage. Two annual national numeracy tests were introduced in 2014, assessing procedural fluency and reasoning. Individual performance is reported as age-standardised scores and progress measures; national performance is monitored by government, while school-level reporting stopped in 2017.The tests move to personalised online assessment from 2019, and within-school use only from 2022.

Curriculum for Wales maintains the integration of numeracy and mathematics, emphasising opportunities and responsibilities to apply mathematics in cross-disciplinary teaching. Curriculum for Wales was constructed by teachers and education practitioners, supported by Welsh Government and there is significant continuity between the Numeracy framework and its statements specifying numeracy and mathematics.

KEY DOCUMENTS

England

[National curriculum in England: mathematics programmes of study (2014)](#)

[Maths Hubs: Teaching for Mastery](#)

[Initial teacher training (ITT): core content framework (2019)](#)

Northern Ireland

[The Northern Ireland Curriculum](#)

[Learning Leaders: A Strategy For Teacher Professional Learning (2016)](#)

[Information on school types in Northern Ireland](#)

Scotland

[National Improvement Framework and Improvement Plan: 2020](#)

[Multiplying Skills, Adding Value inspection report (2019)](#)

[Transforming Scotland into a maths positive nation (2016)](#)

[National Numeracy and Mathematics Progression Framework (2016)](#)

Wales

[Curriculum for Wales Guidance (2020)](#)

[Teaching Tomorrow's Teachers. (Furlong, 2015)](#)

[Literacy and Numeracy in Wales. (Dauncey, 2013).](#)

[National Literacy and Numeracy Framework (2012)](#)

4. ACKNOWLEDGEMENTS