Northern Ireland

Sigrid Boyd
National Foundation for Educational Research

Introduction

Overview of Education System

Northern Ireland has a complex education structure with numerous entities involved in its management and administration.[1] Overall responsibility for preprimary, primary, secondary, and special education lies with the Department of Education (DE). Responsibility for further education (FE), employment and skills programs, and higher education lies with the Department for the Economy (DfE). When the Northern Ireland Assembly is sitting, Northern Ireland departments are accountable to the Assembly through the responsible minister. In 2017, the power sharing executive in Northern Ireland collapsed, and until its restoration in January 2020, the Northern Ireland Assembly did not sit, and there were no executive ministers. During this time, Northern Ireland departments made the decisions required to uphold good governance and protect the public interest, but major policy decisions were deferred.[2]

The Council for the Curriculum, Examinations, and Assessment (CCEA), an arm's length body, advises the Department of Education on school curricula, assessments, and qualifications. The General Teaching Council for Northern Ireland (GTCNI) is responsible for registering teachers and regulating the profession. The Education Authority is responsible for ensuring that efficient and effective primary and secondary education is available. Depending on the type of school, the employing authority for teachers is the Education Authority, the Council for Catholic Maintained Schools, or the individual school's Board of Governors.

There are four main types of grant-aided (publicly funded) schools, differing in terms of their ownership, management, and ethos: controlled, maintained (mostly Catholic), voluntary, and grant-maintained integrated schools.[3] All schools have a high level of autonomy. Overall responsibility for strategic matters lies with each school's Board of Governors, leaving the principal responsible and accountable for day-to-day school operations.

School autonomy is counterbalanced by a system of accountability. Schools are required to set their own targets for improvement, including for literacy and numeracy, and include these targets in the School Development Plan.[4] Schools are inspected by the Department of Education's Education and Training Inspectorate (ETI).

Compulsory education spans 12 years from ages 4 to 16. Secondary education is provided in nongrammar and grammar schools, known collectively as post-primary schools. The majority of

grammar schools use academic selection as the basis for admission.[5] During the 2018–2019 school year, 44.2 percent of post-primary school students attended a grammar school.[6]

All grant-aided schools are required to follow the Northern Ireland Curriculum for ages 4 to 16. The curriculum does not prescribe teaching hours by subject, and subject to meeting prescribed minimum requirements, schools are responsible for implementing the curriculum according to their students' needs and circumstances.

Full-time education is compulsory to age 16. The great majority of young people continue with full-time education after age 16. Although noncompulsory, full-time education is free up to age 19 and is provided by post-primary schools and further education colleges.

Exhibit 1 lists the key stages of the 12-year compulsory education system and their corresponding International Standard Classification of Education (ISCED) levels.

Exhibit 1: Key Stages of Curriculum in Northern Ireland[a]

Stages	ISCED Levels	Years	Ages
Primary Education			
Foundation Stage	ISCED 1	1–2	4–6
Key Stage 1	ISCED 1	3–4	6–8
Key Stage 2	ISCED 1	5–7	8–11
Post-Primary (Secondary) Education			
Key Stage 3	ISCED 2	8–10	11–14
Key Stage 4	ISCED 3	11–12	14–16

Use and Impact of TIMSS

Northern Ireland took part in TIMSS for the first time in 2011, after evidence from the Organisation for Economic Cooperation and Development (OECD) Programme for International Student Assessment (PISA) survey showed a decline in reading and mathematics achievement from significantly above the OECD average in 2000 and 2003, to average in 2006 and 2009.[7]

The results for TIMSS 2011 showed that, although Northern Ireland's average scale score was significantly above the international average, its students did comparatively worse in science than in mathematics. Since the results of TIMSS 2011 were published in December 2012, the Department of Education has been keen to improve on the results, particularly in science.

In 2015, the Department of Education commissioned an analysis of seven education systems that outperformed Northern Ireland in the TIMSS 2011 science assessment. The report suggested that achievement in science could be improved by increasing the amount of formal monitoring of science learning and/or by raising the profile of science within its subject area, The World Around Us.[8] The Department of Education also commissioned an analysis of the performance of disadvantaged students and found that socioeconomic background had a strong association with TIMSS achievement in Northern Ireland, particularly for mathematics.[9]

[a] In Northern Ireland, TIMSS Grade 4 is equivalent to Year 6 (age 9), and TIMSS Grade 8 is equivalent to Year 10 (age 13). In 2019, Northern Ireland participated in Grade 4 (Year 6) testing only.

The Department of Education has since commissioned science lesson plans covering areas from the science curriculum in which students in Northern Ireland did not perform as well as expected in TIMSS 2015. These plans were launched in 2018.[10]

The Mathematics Curriculum in Primary and Lower Secondary Grades

The mathematics curriculum for students assessed in TIMSS 2019 was the Northern Ireland Curriculum, introduced in the 2007–2008 school year. The Education (Northern Ireland) Order 2006 and the Education (Curriculum Minimum Content) Order (Northern Ireland) 2007 provided the legislative basis for the curriculum. The curricula for Key Stages 2 and 3 are outlined below.

For Key Stage 2, the 2007 order specifies seven areas of learning and includes mathematics and numeracy as one area. The minimum content for mathematics and numeracy at this key stage is organized under the following domains,[11] in which teachers are expected to help students develop knowledge, understanding, and skills:

Exhibit 2: Curriculum Outline for Key Stage 2

Domain	Content Area	Skills
Processes in Mathematics	Making and monitoring decisions	▪ Taking increasing responsibility for selecting and using appropriate materials and mathematics for work ▪ Identifying and obtaining information required for a task; suggesting appropriate information sources ▪ Planning and organizing work, learning to work systematically ▪ Developing a range of strategies for problem solving; looking for ways to overcome difficulties
	Communicating mathematically	▪ Understanding mathematical language and using it to discuss work and explain thinking ▪ Comparing their ideas and methods with others' ▪ Interpreting situations mathematically using appropriate symbols or diagrams ▪ Presenting information and results clearly
	Mathematical reasoning	▪ Recognizing general patterns and relationships and making predictions about them ▪ Asking and responding to open-ended questions and explaining their thinking ▪ Understanding and making general statements ▪ Checking results and considering whether they are reasonable
Number	Understanding number and number notation	▪ Counting, reading, writing, and ordering whole numbers ▪ Developing an understanding of place value up to two decimal places ▪ Using this understanding to multiply and divide numbers by 10 and 100 ▪ Estimating and approximating to gain an indication of the size of a solution to a calculation or problem

Domain	Content Area	Skills
		▪ Understanding and using common fractions, decimal fractions, and percentages, and exploring the relationships among them ▪ Understanding and using negative numbers in context
	Patterns, relationships, and sequences in number	▪ Exploring and predicting patterns and sequences of whole numbers; following and devising rules for generating sequences ▪ Understanding and using multiples and factors and the terms prime, square, and cube; understanding inverse operations ▪ Interpreting, generalizing, and using simple relationships expressed in numerical, spatial, and practical situations; understanding and using simple function machines ▪ Understanding that a letter can stand for an unknown number
	Operations and their applications	▪ Developing strategies to add and subtract mentally ▪ Knowing the multiplication facts up to 10×10 ▪ Engaging in a range of activities to develop understanding of the four operations of number; understanding the use of brackets; adding and subtracting decimals with up to two decimal places; multiplying and dividing decimals by whole numbers; using these operations to solve problems
	Money	▪ Using the four operations to solve problems involving money ▪ Discussing the value of money, how to keep money safe, ways to pay for goods, and the need for budgeting ▪ Learning to plan and think ahead in terms of saving and spending money ▪ Prioritizing spending with a limited supply of money; understanding how to assess best buys ▪ Discussing foreign currency, including the Euro
Measures		▪ Developing skills in the estimation of length, weight, volume/capacity, time, area, and temperature ▪ Understanding important concepts of measurement, including the continuous nature of measurement and the need for appropriate accuracy ▪ Understanding the relationship among units of measurement and converting one metric unit to another; using the four operations to solve problems ▪ Calculating perimeter, area, and volume of simple shapes ▪ Understanding and using scale in the context of simple maps and drawings ▪ Recognizing times on analog and digital clocks and understanding the relationship between 12-hour and 24-hour clocks; using timetables
Shape and Space	Exploration of shape	▪ Constructing a range of regular and irregular two-dimensional shapes; classifying these shapes by examining angles and sides; recognizing line and rotational symmetry; reflecting shapes in a line; exploring tessellations; naming and describing common two-dimensional shapes ▪ Beginning to understand congruence in two-dimensional shapes; constructing three-dimensional shapes; investigating the number of faces, edges, and vertices on these shapes; naming and describing common three-dimensional shapes; exploring the relationship between two-dimensional and three-dimensional shapes

Domain	Content Area	Skills
	Position, movement, and direction	▪ Understanding the concept of angle in the context of turning; recognizing right angles; understanding clockwise and anticlockwise; knowing the eight points of the compass; using Logo to understand movement and turning; learning about a programming language and using it to create pictures and patterns and to generate shapes ▪ Developing language associated with lines and angles; recognizing properties of acute, obtuse, and reflex angles; investigating angles in triangles and quadrilaterals; measuring and drawing angles up to 360 degrees ▪ Using coordinates to plot and draw shapes in the first quadrant
Handling Data	Collecting, representing, and interpreting data	▪ Collecting, classifying, recording, and presenting data drawn from a range of meaningful situations, using graphs, tables, diagrams, and Information and Communications Technology (ICT) software ▪ Explaining work orally and/or in writing and drawing conclusions; interpreting a wide range of tables, lists, graphs, and diagrams; creating and interpreting frequency tables, including those for grouped data ▪ Designing and using a data collection sheet; interpreting the results; entering information in a database or spreadsheet, and interrogating and interpreting the results ▪ Understanding, calculating, and using the mean and range of a set of discrete data
Introduction to Probability		▪ Becoming familiar with and using the language of probability ▪ Understanding possible outcomes of simple random events ▪ Understanding that there is a degree of uncertainty about the outcome of some events, while others are certain or impossible ▪ Placing events in order of likelihood; understanding and using the idea of evens in probability (i.e., neither likely nor unlikely) and knowing whether events are more or less likely

For Key Stage 3, the 2007 Order specifies nine areas of learning and includes mathematics and numeracy as one area of learning. The minimum content for mathematics and numeracy at Key Stage 3 is as follows.[12]

Mathematics and numeracy include the contributory elements of mathematics and financial capability. Students should have opportunities through specified contexts to develop the following competencies.

- Knowledge and understanding of:
  - Number
  - Algebra
  - Shape, space, and measures
  - Handling data
- Knowledge and understanding of personal finance issues and skills to enable competent and responsible financial decision making
- The application of mathematical skills in real life and work situations

- The creative use of technology to enhance mathematical understanding, demonstrating:
  - Creative thinking in solving mathematical problems
  - Increasing competence in mental mathematics skills
  - Increasing competence using pencil and paper methods
  - Increasing confidence in the use of mathematical language and notation
  - Practical skills using technology

The 2007 Order sets out the contexts in which these opportunities should be provided, organized around three main objectives [see Part 5 of the Order for details]:

- Helping students develop as individuals
- Helping students develop as contributors to society
- Helping students develop as contributors to the economy and the environment

The 2007 Order also specifies learning outcomes. At the end of Key Stage 3, students should be able to:

- Demonstrate mental mathematical capability with simple problems
- Select appropriate methods and tools for solving problems (i.e., performing mental or written calculations, using a calculator or mathematical instruments, or a combination of these)
- Demonstrate capability with financial problem solving in a range of relevant everyday contexts
- Research and manage information effectively to investigate and solve mathematical problems, using ICT where appropriate
- Show deeper mathematical understanding by thinking critically and flexibly, solving problems and making informed decisions, using ICT where appropriate
- Demonstrate creativity and initiative when developing ideas, and follow through on them
- Work effectively with others
- Demonstrate self-management by working systematically, persisting with tasks, and evaluating and improving their own performance
- Communicate effectively in oral, visual, written, mathematical, and ICT formats, showing clear awareness of audience and purpose

Using Mathematics is embedded as a cross-curricular skill throughout the Northern Ireland Curriculum at each key stage.[13,14] The CCEA provides guidance and additional resources to support teachers in implementing the curriculum.[15]

The Science Curriculum in Primary and Lower Secondary Grades

The science curriculum for students assessed in TIMSS 2019 was the Northern Ireland Curriculum, introduced in the 2007–2008 school year. The Education (Northern Ireland) Order 2006 and the Education (Curriculum Minimum Content) Order (Northern Ireland) 2007 provide the legislative basis for the curriculum. The curriculum for Key Stages 2 and 3 is outlined below.

For Key Stage 2, the 2007 Order specifies seven areas of learning and includes The World Around Us as one area of learning. The minimum content for The World Around Us is explained below.[16]

Through the contributory elements of history, geography, and science and technology, teachers help students develop knowledge, understanding, and skills through exploring the following:

- Interdependence
  - How one interacts with others in the world
  - How living things rely on each other within the natural world
  - The interdependence of people and the environment, and how it has been accelerated over time by advances in transport and communications
  - The effect of people on the natural and built environment over time
- Place
  - How place influences the nature of life
  - Ways in which people, plants, and animals depend on features and materials in places and how they adapt to their environment
  - Features of and variations among places, including physical, human, climatic, vegetation, and animal life
  - Our place in the universe
  - Change over time in places
  - Positive and negative effects of natural and human events upon places over time
- Movement and Energy
  - Causes and effects of energy, forces, and movement
  - Causes that affect the movement of people and animals
  - How movement can be accelerated by human and natural events such as wars, earthquakes, famine, or floods
  - Positive and negative consequences of movement and its impact on people, places, and interdependence

- Change Over Time
  - How change is a feature of the human and natural world and may have consequences for our lives and the world around us
  - Ways in which change occurs over both short and long periods of time in the physical and natural worlds
  - The effects of positive and negative changes globally, and how we contribute to some of these changes

For Key Stage 3, the 2007 Order specifies nine areas of learning, and includes science and technology as one area. Science and technology comprises two subject strands: (1) Science and (2) Technology and Design. The minimum content for Science is described below.[17] Students should have opportunities through specified contexts to meet the following objectives.

- Develop the following skills in scientific methods of inquiry to further scientific knowledge and understanding:
  - Planning for investigations
  - Obtaining evidence
  - Presenting and interpreting results
- Develop creative and critical thinking in their approach to solving scientific problems
- Research scientific information using a range of sources
- Develop a range of practical skills, including the safe use of science equipment
- Learn about organisms and health:
  - Interdependence of plants and animals
  - Cells, genes, and reproduction
  - Healthy body and mind
- Learn about chemical and material behavior:
  - Atoms and chemical changes
  - Structures, properties, and uses of materials
  - Elements, compounds, and mixtures
- Learn about forces and energy:
  - Forces and energy transfer
  - Using electricity
  - Sound and light
- Learn about Earth and the universe
  - The environment and human influences
  - The solar system and the universe

The 2007 Order sets out the contexts in which these opportunities should be provided, organized around three main objectives:

- Helping students develop as individuals
- Helping students develop as contributors to society
- Helping students develop as contributors to the economy and the environment

The 2007 Order also specifies learning outcomes. At the end of Key Stage 3, students are expected to be able to:

- Demonstrate a range of practical skills in undertaking experiments, which include implementing scientific equipment safely and performing mathematical calculations appropriately
- Use investigative skills to explore scientific issues, solve problems, and make informed decisions
- Research and manage information effectively, using mathematics and ICT where appropriate
- Show deeper scientific understanding by thinking critically and flexibly, solving problems, and making informed decisions, using mathematics and ICT where appropriate
- Demonstrate creativity and initiative when developing ideas and following through on them
- Work effectively with others
- Demonstrate self-management by working systematically, persisting with tasks, and evaluating and improving their own performance
- Communicate effectively in oral, visual, written, mathematical, and ICT formats, showing clear awareness of audience and purpose

The CCEA provides guidance and additional resources to support teachers in implementing the curriculum, which they may follow if they wish.[18]

Professional Development Requirements and Programs

The competencies expected of teachers that underpin all teacher professional development programs are set out in Teaching: The Reflective Profession.[19]

Newly qualified teachers are required to follow a one-year induction program involving mentoring and professional development activities, followed by a two year Early Professional Development (EPD) program. The aims of the EPD program are to assist beginning teachers to develop, expand, and consolidate their capabilities as reflective practitioners and to develop personal competencies.

There is no legally required minimum length of time for teachers to spend on continuing professional development (CPD). However, the performance of all teachers is reviewed annually

in accordance with a structured framework, the Performance Review and Staff Development Scheme (PRSD), which aims to ensure that training and development needs are identified and that corresponding opportunities for professional development are made available.[20]

Providers include senior staff within schools who provide ongoing professional guidance and development for their colleagues; the Education Authority (EA), which provides support for beginning teachers; and the Department of Education, which funds the Literacy and Numeracy Key Stage 2 and Key Stage 3 CPD Project, a professional development program for teachers of English and mathematics in these key stages.[21]

Monitoring Student Progress in Mathematics and Science

Statutory assessment requirements apply from the start of the Foundation Stage to the end of Key Stage 3 in each area of learning and each cross-curricular skill (communication, using mathematics, using ICT).[22] The legislative framework for student assessment is provided by the Education (Northern Ireland) Order 2006.

In the Foundation Stage (Years 1 and 2), the manner of assessment is determined by the school. From Year 3 to Year 10, assessment of cross-curricular skills (CCS) must be carried out using Levels of Progression. Levels of Progression are can-do statements that set out a continuum of skills that students should be able to demonstrate and that will help them to function effectively in life and in the work world. There are also summative assessments at the end of Key Stages 1, 2, and 3. These assessments are based on teachers' judgments, supported by assessment tasks and a system of external moderation. Outcomes of summative assessments are reported to parents and the Department of Education using numerical levels.

Diagnostic assessments of literacy and mathematics using computer based standardized instruments were phased in beginning in 2007 for Years 4, 5, 6, and 7. They were mandatory from 2007 to 2012, then optional until they were withdrawn in 2017.[23]

Children may take transfer tests based on the Northern Ireland curriculum for English and mathematics, in the final year of primary education, if their parents chose for them to do so. The purpose of the tests is to select students for admission to academically selective post-primary schools. Since 2009, the tests have been unregulated. However, the law does not prohibit schools from selecting students on this basis.[24]

For school benchmarking and accountability, the key measures for primary schools are the statutory assessments taken at the end of Key Stages 1 and 2. For post-primary schools (which provide secondary education), the key measures are the external qualifications taken at ages 16 and 18 (most commonly GCSEs and GCE A levels, respectively).

Exhibit 3 provides an overview of the use of assessment in mathematics and science in Years 1 to 10.

Exhibit 3: Assessment in Mathematics and Science in Northern Ireland, Years 1 to 10

	Foundation		Key Stage 1		Key Stage 2			Key Stage 3		
Year	1	2	3	4	5	6*	7	8	9	10*
Age	4	5	6	7	8	9*	10	11	12	13*
Type of Assessment										
Ongoing teacher assessment of all areas of learning (manner of assessment and reporting determined by school)	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc	M/Sc
Ongoing teacher assessment of CCS (manner of assessment and reporting determined by school)	M	M								
Ongoing teacher assessment of CCS against LoP			M	M	M	M	M	M	M	M
End of key stage teacher assessment of CCS against LoP (moderated and reported using numerical outcomes)				M			M			M
Transfer tests (taken by students applying to selective post-primary schools)							M			

M = Mathematics; Sc = Science; CCS = cross-curricular skills; LoP = Levels of Progression.

* In Northern Ireland, TIMSS Grade 4 is equivalent to Year 6 (age 9), and TIMSS Grade 8 is equivalent to Year 10 (age 13). In 2019, Northern Ireland participated in TIMSS testing in Grade 4 (Year 6) only.

Special Initiatives in Mathematics and Science Education

Mathematics is a major focus of education in Northern Ireland, along with literacy. The Department of Education's 2011 strategy for these subjects, Count, Read: Succeed,[25] aims to raise overall standards in literacy and numeracy and close the gap between the highest and lowest achieving students and schools. Actions include emphasizing literacy and numeracy across the school curriculum and its assessment arrangements; supporting high quality teaching to meet the needs of all students, with early intervention to support students who may be having difficulty; strengthening links with parents and communities; and facilitating more effective sharing of best practice. Building on established policies for school self-evaluation and the use of system-level data for benchmarking purposes, the strategy set system-level targets for achievement in the 2011–2012 and 2014–2015 school years, and long-term targets for 2020. In Key Stages 1 to 3, targets are set in terms of the prescribed Levels of Progression.[26]

Science education was a focus of the 2011 strategy, Success Through Science, Technology, Engineering, and Mathematics (STEM),[27] developed in response to the 2009 Report of the STEM Review, undertaken from 2007 to 2009.[28] The strategy included recommendations for the Department of Education,[29] such as:

- Addressing the disparity in STEM performance among schools
- Making STEM learning more inquiry-based
- Increasing the focus on the core sciences and mathematics
- Developing a STEM continuing professional development framework
- Increasing the emphasis on STEM careers advice and guidance
- Increasing the number of applications for physical sciences and mathematics places in initial teacher education courses

The CCEA STEMWorks website was set up as a direct result of these recommendations. Aimed primarily at students and teachers in Key Stage 3, the website includes classroom resources and case studies with the goal of stimulating innovative learning and teaching opportunities, encouraging students to make connections across subjects, and helping students relate STEM to the work world.[30]

The DfE, and its predecessor, the Department for Employment and Learning, launched other STEM-related initiatives, including the Skills Barometer, intended to provide students and their parents with information on the current and future labor market opportunities.[31] STEM-related initiatives have also been launched with additional support from the business and charity sectors. They include Sentinus, a not-for-profit educational charity funded by the Department of Education, which works with schools and colleges to deliver STEM educational programs.[32]

Suggested Readings

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