Research Report DCSF-RW048

Comparison of the Core Primary Curriculum in England to those of Other High Performing Countries

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National Foundation for Educational Research

department for
children, schools and families

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Foreword by Professor John Gray

The context

What should be taught in primary schools as part of the National Curriculum and how? Until fairly recently England used to rely largely on its own history, debates and traditions to determine answers to such questions. About a decade ago this somewhat insular approach started to change as interest began to grow in the approaches adopted in other countries.

Such interest was stimulated, in part, by England's performance in various international comparisons of pupil achievement. In line with expectations for a well-developed educational system, the country almost always performed respectably, sometimes did well and, more occasionally, performed exceptionally. But, at the same time, there was a developing sense, supported to some extent by the survey evidence, that some of our competitors had been doing better - and consistently so. What could be gleaned from greater understanding of approaches and practices adopted elsewhere?

The major problem with many of the early forays into this territory was that the methods of investigation adopted were often partial and fairly unsystematic. Too much weight was probably placed on single country comparisons and too little attention was paid to how the parts made up the whole. Some countries' apparent 'under-performance' in one area of the curriculum or another could often been explained by suggestions that a topic was not emphasised to the same extent in that country. In the absence of systematic and detailed comparisons it was often difficult to know.

The research presented here seeks to address some of the problems inherent in earlier comparisons. First, by looking simultaneously at several countries at the same time rather than just one or two. Second, by seeking to form judgements about breadth and depth in *all* areas of the national curricula under review in the core subjects of Maths, Science and Literacy rather than just isolated components. And third, by attempting to understand the inter-connectedness between the various parts.

Given the relative paucity of previous research in this area, the agenda was always going to be challenging for the National Foundation for Educational Research (NFER) and its international collaborators. The team have responded by making their methods and assumptions clear and accessible. Their report, in my view, represents a considerable step forward in getting to grips with the issues.

Methodological foundations

The methodological precedents for this kind of work have been forged in the technical committees which have met to determine the content of the tests that are administered in international surveys, such as Trends in International Mathematics

and Science Study (TIMSS) and Programme for International Student Assessment (PISA). Over the years such groups have become skilled at winnowing down the vast array of content that could potentially be assessed into more manageable numbers.

What has to emerge is a considerable degree of agreement amongst the experts that the international tests reflect what pupils in their own countries are taught and that the test items make a reasonable stab at assessing the underlying knowledge and skills embodied in each national curriculum. This is not an exact science and stereotypes of other countries' approaches can persist. The internationally 'tested' curriculum is inevitably therefore a reflection of what the curricula of the participating countries share in common rather than the ways in which they differ.

Building on expertise

The research presented here makes use of the considerable expertise that has been built up over the years in these international test setting and curriculum related exercises but puts it to wider and different uses. It started with the granular elements of the national curricula of each participating country and sorted them into three groups: (a) components which were similar in the two curricula; (b) components which were present in the English National Curriculum but not the comparison country; and (c) those present in the comparison country but not in England. Then two judgements were formed. First, were the various domains which made up the curriculum for each subject in the comparison country 'broader' in terms of content covered, 'similar' or 'narrower' than in the English case? And second, were they 'harder', 'similar' or 'easier'? This series of judgements were then summated into more global assessments of the 'breadth' and 'difficulty' of each country's overall curriculum in the three subjects. These provide the basis for the report's main conclusions.

The research has involved tackling systematically a considerable number of paired country comparisons. As the report makes clear, although the basic methodology remained the same in all cases, some countries presented more challenges than others. For each comparison a member of the NFER team in England was paired with an expert from the relevant country; in some cases, however, it was not possible to identify someone with the relevant expertise within the time-scale of the project and, in these instances, alternative but acceptable procedures had to be adopted.

I was asked by the Department for Children Schools and Families (DCSF) to look with a fresh pair of eyes at some of the comparisons and was given access to the range of detailed spreadsheets produced by the research team. I audited five country comparisons in considerable detail as well as looking at specific sub-areas of several more. In every case I generated similar (but not always identical) judgements to those which had been reached by the NFER and international judges. If I differed, this was almost always in the degree of certainty I attached to particular comparisons. It is an unusual strength of this report that those making the judgements clearly and systematically signal the 'confidence' with which they formed their views. Of course, the NFER research team were better placed than I was to

make the calls - each country expert will have brought additional contextual knowledge to the discussions.

Problems and challenges

Some of the comparison judgements were relatively straightforward. Many components of national curricula read (even in translation) as if they have been constructed by groups of curriculum designers with similar concerns and similar understandings of pupils' development. This is scarcely surprising. Many aspects of Maths and Science, for example, transcend differences of country and cultural context and there is often considerable agreement amongst educationists about the ways in which the rudiments of understanding are best instilled. However, there was greater variation across the countries with respect to guidance about developing Literacy, doubtless reflecting the different traditions and difficulties associated with learning their languages.

Some other issues which need to be factored into the equation are also worth mentioning. The English National Curriculum is towards one end of a continuum; six of the countries reviewed are not dissimilar in the high levels of specificity and detail they provide to their schools. The Dutch and Swedes, by comparison, seem to rely mainly on 'broad generalisations and eschew specificity', especially in the area of Literacy. Where the fine detail is absent it can be more difficult to establish what precisely is being taught and to whom. Local experts can compensate to some extent by using their knowledge to fill in some of the gaps but a degree of uncertainty inevitably affects the comparisons.

This point relates to a bigger issue that emerges when national curricula are compared. There is considerable unevenness in the ways in which these documents have evolved over time. One must work with the documents without knowing much about how they came into existence, how they have subsequently been modified and why. Some curriculum designers seem to content themselves with relatively broad, all-encompassing statements about what should be taught in a particular area; others go to great lengths to spell out the details. Furthermore, there is little sense that different areas of the curriculum should be handled in similar ways. Indeed, occasionally, whilst some areas of the curriculum can seem over-specified, on other issues guidance can seem relatively sparse. The silences and omissions can sometimes be difficult to interpret.

In brief, what is strikingly revealed by the research is that practices regarding the nature, extent and specificity of curricular guidance can vary substantially *within the same country* when different subjects are being compared. Fortunately the NFER team seem well aware of such difficulties, are quick to identify the limitations they encountered and are at pains to be even-handed in the conclusions they draw as a result.

Key findings

Bearing in mind these caveats, some of the report's findings are extremely interesting. There are considerable similarities, it seems, in the ways in which the comparator countries hand out guidance in the core areas of Maths, Science and Literacy and in terms of what they choose to emphasise. But there are also some notable differences.

In the Maths area, for example, roughly two thirds of the elements of the Number curriculum seem to be shared in common with most of the other high performing countries; indeed there is only one topic which is covered in the English curriculum that is apparently uncommon elsewhere. Bearing in mind the granular level at which these comparisons were being made, very high levels of match would be unlikely. In other areas of the Maths curriculum, however, there do seem to be differences of emphasis. There is considerably less match, for example, in the ways in which 'Shape, space and measures' and 'Handling data' are tackled across the different systems.

These factors, in turn, affect the general conclusions the report draws about the 'breadth' and 'difficulty' of the various components of the Maths curricula under comparison. With respect to 'Number' four of the participating countries (Singapore, Chinese Taipei, Hong Kong and Latvia) seem to expect more than England; only the Netherlands and Ontario expect less. A different picture emerges in relation to 'Shape, space and measures'; here only one country (Hong Kong) definitely has higher expectations, whilst Chinese Taipei may have. Meanwhile, with respect to 'Handling data', England seems to demand more of its pupils and on a broader front than most of the other high performing countries; only Ontario seems similar.

The picture with respect to Reading also merits comment. As in England, primary-aged children elsewhere are encouraged to develop different reading strategies (phonics, word recognition, grammar and contextual understanding), to read for information, to look at the features of non-fiction and non-literary texts, to decode language structures, to engage with a range of different types of literature and so on. Given the extent of variations in approach, however, the comparisons in this area were often more difficult to pin down. Nevertheless, the researchers tentatively conclude that expectations for English pupils in this area may be somewhat higher than elsewhere.

Comparisons were somewhat easier to make in the four areas of the Science curriculum and the research team's higher 'confidence' ratings reflect this state of affairs. Of the five comparator countries involved only one (Latvia) seemed to expect more than England in the area of 'Scientific Enquiry'. On the other hand, in the area of 'Life processes and living things' three of the countries (Singapore, Chinese Taipei and Latvia) demanded more. With respect to 'Materials and their properties' only one country (Chinese Taipei) definitely expected more whereas for 'Physical processes' three did so (Chinese Taipei, Latvia and Ontario). One gets the sense that in the area

of Science curricular expectations for English pupils compared to those from internationally high performing countries are somewhere in the middle of the pack.

Closing thought

All the high performing countries involved in the research had developed different traditions for offering guidance to their schools. What general lessons are revealed by this benchmarking exercise of national curricula? In broad terms the picture that emerges is a largely reassuring one - most countries teach the same sorts of things as we do and to the same sort of depth. In the main, the English primary curriculum is strongly aligned to those of its international comparators. Interestingly, no *single* country in the study had curricula in all three areas under investigation (Maths, Science and Literacy) which were simultaneously, across the board, broader in content and more demanding than those on offer to their English counterparts. The patterns were invariably more uneven. On the other hand, the research points to a number of areas where other countries are clearly expecting more knowledge and understanding than we do in England amongst pupils of similar ages. At a minimum, the forthcoming Rose Review of the Primary curriculum in England will find value in revisiting the justifications for the various differences in curricular emphasis and approach. In a minority of instances these approaches might also benefit from some rethinking.

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July 2008

1 Key Findings

England's mathematics, science and literacy curricula for Key Stage 2 have been compared with those of countries with a high level of performance in international comparative surveys in the primary years. Some systematic differences between England's curricula and the others have been identified:

Mathematics

The structure of England's mathematics curriculum, by content, is similar to most of the others in comparator countries.

The basic division into number, geometry and data handling is common amongst the curricula.

The emphasis on process is shared by most of the other curricula.

England's curriculum for number is judged to be narrower and less demanding than the majority of the other curricula. [1]

In data handling, by contrast, the curriculum in England is broader and more demanding than those elsewhere.

In geometry the emphasis in England on visualization and transformational geometry is not shared by the other countries.

Overall much of the content of England's mathematics curriculum is also included in the other curricula.

Science

The structure of England's science curriculum, Scientific enquiry and then divided by content, is just one of a variety of structures seen in the comparator countries. Thematic structuring is one of the alternatives found.

The basic division of content into biology, chemistry and physics (with other nomenclature) was not widely shared, with several curricula breaking content down into more discrete areas.

The emphasis on scientific enquiry is shared by all of the other curricula, but not all have it as a structural element.

England's curriculum for Physical processes is judged to be narrower and less demanding than the majority of the other curricula.

England's curriculum for Life processes and living things is judged to be narrower than those elsewhere, but not always less demanding.

[1] Number in the England national curriculum comprises 4 sections, Using and applying number, Numbers and the number system, Calculations and Solving numerical problems.

For both Scientific enquiry and Materials and their properties the tendency is for the level of demand to be similar to most of the other curricula.

Overall much of the content of England's science curriculum is also included in the other curricula.

Literacy

The structure of England's literacy curriculum by language mode - speaking and listening, reading, writing - is not replicated exactly in any of the comparator countries, though some have similar categories. Structuring by purposes/uses of literacy is one of the alternatives found.

The literacy curricula in the comparator countries are much more likely to include an elaboration of their underlying philosophy and rationale than England, where this is extremely brief.

Some of the comparator literacy curricula are expressed in general terms which make it difficult to compare difficulty and breadth reliably. Others break down the skills and understandings into specific objectives in a similar way to England.

In reading, the requirement for an analytic approach to the study of texts in England is judged more demanding than the full comprehension of texts found in other curricula.

No other overall patterns could be detected, given the differences of approach across countries. Broadly, the coverage of England's literacy curriculum appears similar to that in the other curricula.

Differentiation: Accommodating a Wide Spread of Ability

Only one country, Singapore, was found to have a system with differentiation built in. This cuts in in the equivalent of Year 5 in England and takes the form of streaming. In the later primary years the lowest attaining pupils take a curriculum with reduced content. This system, however, is being changed. Singapore also has a special programme for the gifted and those requiring extra help.

The other systems regard it as the role of the teacher to deal with pupils of different ability. Several systems, including Hong Kong, stress that their curriculum is for everybody - "one curriculum framework for all".

Practice in England is similar to all of the other countries studied except for Singapore.

Implementation

Several countries were found to have mandatory or recommended time allocations for mathematics, science and literacy. For mathematics around 3 hours per week was the most common time allocation, but Singapore gave more time to mathematics, rising to 5.5 hours by the end of the primary years. Science allocations were lower than for mathematics, substantially so in some countries. Literacy allocations tended to be higher than those for mathematics, but this was sometimes because pupils were not being taught in their native languages. Interestingly, no consistency was found in whether the time allocated to subjects increased with time, stayed the same or decreased.

None of the curricula examined were accompanied by mandatory instructions on how mathematics, science or literacy were to be taught. England is not unusual in this respect.

2 Introduction and Policy Background

At a time when the primary curriculum in England is being reviewed and revised one way of informing this work is to look at other curricula. This gives different views of, for example, how a curriculum can be structured, what it should contain, and how detailed it should be.

This study looks at the curricula for mathematics, science and literacy. Selection of the countries to compare England's curricula with was based on performance in international comparative surveys. For mathematics and science the data used was from the 2003 Trends in International Mathematics and Science Study, TIMSS. For literacy the 2006 Progress in Reading literacy Study (PIRLS) provided the data. Factors such as average performance in these studies, improved performance to a high standard and narrow spread of achievement at a high level were sought out. Consideration was given to also using data from the Programme for International Student Assessment (PISA) but checks on the relationship between performance of older students in PISA and younger ones in TIMSS or PIRLS revealed that a high level of performance in PISA was not always associated with a similar level of performance by younger students. For literacy the data available covers only reading but it was decided to compare both reading and writing curricula to get a fuller picture.

The final selection of countries and subjects for comparison was:

Science	Mathematics	Literacy
Singapore	Singapore	Singapore
Chinese Taipei	Chinese Taipei	Chinese Taipei
Hong Kong	Hong Kong	
	Netherlands	Netherlands
Latvia	Latvia	Latvia
Ontario	Ontario	Ontario
		British Columbia
		Italy
		Sweden

3 Objectives

There were three objectives. The main objective was to answer the question

How does the content of the Primary Curriculum in England at Key stage 2 compare in literacy, maths and science to a range of high performing countries?

This includes detail such as

- The detail of what is taught and at what age, in what order and how much time is devoted to each area;
- The relative difficulty of the content that children are expected to be able to do, learn and understand at ages 7 to 11;
- The degree of interaction and overlap between the subjects, if any. (As opposed to, for example, the subjects being always taught and thought of separately)

There were also 2 important secondary questions to answer. These were:

How do good curricula deal with and accommodate a wide spread of ability, and what lessons could be learnt and transferred to England?

Including

- What measures and flexibilities, if any, do high performing countries include in their curricula that impact on the spread of their performance?
- To what extent can the detailed content of national curricula be specified such that they are suitable to be taught or tailored to a wide range of abilities?
- In high performing countries with a small spread of performance, to what extent can this be explained by the detailed curriculum content?

and

How are the curricula of a range of high performing countries implemented in practice?

Including

- To what extent do the curricula in high performing countries have allocated or mandatory time for particular subjects and areas of study within those subjects?
- To what extent are there prescribed, or heavily guided, ways of teaching their detailed topic areas?
- To what extent are teachers with a subject specialism used to teach their subjects?

Methodology

There are two basic strands to the methodology employed, how the comparison is made and by whom. The strategy has been to make each comparison twice, once at NFER and again in the country concerned. The selected countries were contacted and the contacts were asked to suggest a local expert to undertake the work. This was possible for 14 of the 19 comparisons, but for the other 5 the agreed back-up plan, making the comparison twice in England, has had to be used. The local expert was able to provide extra information, particularly on local circumstances and provided a cross-check of the work done in England.

The comparisons were made using Excel spreadsheets. The programme of study for England was entered with each element having its own row. The curriculum of the comparison country was matched up with England where possible but was also entered if no match was found. There were thus three types of row, ones where a match had been made, ones with the England curriculum only and ones with the comparison country's curriculum only.

Some elements of the England curriculum specify several objectives. An example from the mathematics curriculum is given below:

Ma2.2b

recognise and describe number patterns, including two and three-digit multiples of 2, 5 or 10, recognising their patterns and using these to make predictions; make general statements, using words to describe a functional relationship, and test these; recognise prime numbers to 20 and square numbers up to 10 * 10; find factor pairs and all the prime factors of any two-digit integer

This was not confined to the England curriculum and where this occurred in the comparison country's curriculum the different objectives were matched separately to the England curriculum. There were, therefore, elements of the England curriculum matched to several parts of the comparison country's curriculum and vice versa.

For each element of the England curriculum a judgment was made as to whether the comparison country's curriculum was broader, similar or narrower. A similar judgment was made as to whether the comparison country's curriculum was more demanding, similar in demand or less demanding. Elements of the comparison country's curriculum not matched to the England curriculum were also considered and rated as part of this process.

As these are value judgments a rating was made in each case of the degree of confidence in the judgment. This rating was very confident, quite confident or not confident.

An example is given below.

English National Curriculum Programme of Study	English National Curriculum Reference Number	Comparison country Programme of Study nearest equivalent	Is Comparison country Easier (E) or Harder (H) or Similar (S)	How sure are we about the difficulty comparison?	Is the Comparison country curriculum Narrower or Broader?	How sure are we about the breadth and depth comparison?
to recognise differences between solids, liquids and gases, in terms of ease of flow and maintenance of shape and volume.	3/1e	groups the substances according to their aggregate state (solid, liquid, gasiform)	Similar	Very confident	Similar	Very confident

For each attainment target in the England curriculum the number of elements rated as broader, similar or narrower was reviewed and an overall judgment made as to the relative breadth of the comparison country's curriculum compared with England's. A similar process was used to provide a judgment of relative difficulty.

The following sections outline the outcomes from this process.

4 Mathematics: Summary of Comparisons

4.1 Basic Structure

Six curricula were compared with England's Key Stage 2 mathematics curriculum, those of Chinese Taipei, Hong Kong, Singapore, the Netherlands, Ontario and Latvia. The comparisons have revealed a range of similarities and differences.

At the most general level the Chinese Taipei, Hong Kong, Singapore and Ontario mathematics curricula can, like England, be described as being objective driven, specifying detailed objectives for students but with little ethos projected. The Netherlands, on the other hand, can be described as ethos driven, without detailed objectives. Latvia falls somewhere between these two approaches. The Netherlands also differs in being much shorter, with all subjects presented in one document.

Table 4.1, below, summarises the structure of the curricula in terms of the way the content is divided up, the level of detail and the approach to mathematical process (Ma1). All the curricula are structured by content except for Latvia's, but even here there is some limited structuring by content at a lower level.

Table 4.1 Basic Structure of the Mathematics Curricula Being Compared

England	Chinese Taipei	Hong Kong	Singapore	Netherlands	Latvia	Ontario
Level of detail compared with England	Greater	Greater	Greater	A lot less	Less	Similar
Structure Number	Number and quantity	Number	Whole numbers Fractions Decimals Ratio/proportion Percentage	Numbers and calculations	Formation of mathematical set of instruments Use of mathematics in analysis of natural and social processes	Number sense and numeration
Shape, space and Measures	Algebra Geometry	Algebra Shape and space Measures	Geometry Money, measures and mensuration	Measuring and geometry		Patterning and algebra Geometry and spatial sense Measurement
Handling data	Statistics and probability	Data handling	Statistics Average rate, speed	Mathematical insight and operation	Formation of mathematical models and study with methods characteristic for mathematics	Data management and probability
Process Strong emphasis in objectives	Theme called connections which goes across	Only in introduction	Only in introduction	Strong emphasis throughout	Strong emphasis throughout	Strong emphasis throughout

As would be expected, all curricula organized by content have sections on number, with variations in nomenclature, but Singapore breaks number up into five areas. Unlike England, three of the curricula, from Chinese Taipei, Hong Kong and Ontario, have algebra as a separate content category. Ontario includes patterning in with algebra, reminiscent of the approach in England where algebra is subsumed in number at this level.

Geometry / shape and space features in all the curricula. The Netherlands, like England, includes measures with geometry, but three of the curricula have measures as a separate category. In Chinese Taipei measures is incorporated into number. There are variations in the approach to handling data, with probability sometimes overtly included. Unusually, the Netherlands does not feature this topic as a heading in its primary curriculum.

The England curriculum features process strongly in its objectives, and both Latvia and Ontario stress mathematical process across their curricula. Chinese Taipei has process as a theme going across content, but Hong Kong and Singapore stress process only in their introductions.

In summary, the variations in structure found are those that might be expected. With what to combine measures or whether to keep it separate, for example, has been an issue in primary mathematics curriculum design for many years. Similarly, whether to feature algebra separately in the late primary years has been a matter for debate, as has the degree to which data handling should feature and whether probability should be left to the secondary phase. The structure of the England curriculum is not unusual, while the emphasis on process is shared with several of the other countries.

4.2 Comparison of Content

4.2.1 Number

As part of the comparison work we have matched the content of the England curriculum to those from the comparison countries. This was done using the components of the England curriculum as a yardstick against which to judge the others. So, for example, a match was sought for:

Ma2.1e - make mental estimates of the answers to calculations; check results.

However, many elements of the England curriculum define multiple objectives:

Ma2.2b - recognise and describe number patterns, including two- and three-digit multiples of 2, 5 or 10, recognising their patterns and using these to make predictions; make general statements, using words to describe a functional relationship, and test these; recognise prime numbers to 20 and square numbers up to 10 * 10; find factor pairs and all the prime factors of any two-digit integer

In such cases the match might be to part of a similar multi-stranded objective or to a series of smaller scale objectives. To summarise the degree of match an *all or most, some, none* classification was made in relation to the degree of match with the England curriculum. The match was then quantified using a 2, 1, 0 scoring system to identify the highest and lowest degrees of match. To simplify the presentation of the degree of match, table 4.2 shows those parts of the England curriculum for number with the highest degree of match, generally representing a match of *all or most* for all the comparison countries or all but one.

Table 4.2 Number topics common to all or most of the curricula

Ma2 Number 1 Using and applying number *Reasoning*	Understand and investigate general statements [for example, 'all prime numbers greater than 2 are odd', 'wrist size is half neck size']	Ma2.1j
Ma2 Number 2 Numbers and the number system *Number patterns and sequences*	Recognise and describe number patterns, including two- and three-digit multiples of 2, 5 or 10, recognising their patterns and using these to make predictions; make general statements, using words to describe a functional relationship, and test these; recognise prime numbers to 20 and square numbers up to 10 * 10; find factor pairs and all the prime factors of any two-digit integer	Ma2.2b
Ma2 Number 2 Numbers and the number system	Solve simple problems involving ratio and direct proportion	Ma2.2h
Ma2 Number 2 Numbers and the number system *Decimals*	Understand and use decimal notation for tenths and hundredths in context [for example, order amounts of money, round a sum of money to the nearest £, convert a length such as 1.36 metres to centimetres and vice versa]; locate on a number line, and order, a set of numbers or measurements; then recognise thousandths (only in metric measurements)	Ma2.2i
	Round a number with one or two decimal places to the nearest integer or tenth; convert between centimetres and millimetres or metres, then between millimetres and metres, and metres and kilometres, explaining methods and reasoning.	Ma2.2j
Ma2 Number 3 Calculations *Number operations and the relationships between them*	Develop further their understanding of the four number operations and the relationships between them including inverses; use the related vocabulary; choose suitable number operations to solve a given problem, and recognise similar problems to which they apply	Ma2.3a
	Understand the use of brackets to determine the order of operations; understand why the commutative, associative and distributive laws apply to addition and multiplication and how they can be used to do mental and written calculations more efficiently	Ma2.3c

Ma2 Number 3 Calculations *Mental Methods*	Recall all addition and subtraction facts for each number to 20	Ma2.3d
	Recall multiplication facts to 10 * 10 and use them to derive quickly the corresponding division facts	Ma2.3f
	Double and halve any two-digit number	Ma2.3g
	Multiply and divide, at first in the range 1 to 100 [for example, 27 x 3, 65 divided by 5], then for particular cases of larger numbers by using factors, distribution or other methods	Ma2.3h
Ma2 Number 3 Calculations *Written Methods*	Use written methods to add and subtract positive integers less than 1000, then up to 10000, then add and subtract numbers involving decimals; use approximations and other strategies to check that their answers are reasonable	Ma2.3i
	Use written methods for short multiplication and division by a single-digit integer of two-digit then three-digit then four-digit integers, then of numbers with decimals; then use long multiplication, at first for two-digit by two-digit integer calculations, then for three-digit by two-digit calculations; extend division to informal methods of dividing by a two-digit divisor [for example, 64 divided by 16]; use approximations and other strategies to check that their answers are reasonable	Ma2.3j
Ma2 Number 4 Solving numerical problems	Choose, use and combine any of the four number operations to solve word problems involving numbers in 'real life', money or measures of length, mass, capacity or time, then perimeter and area	Ma2.4a
	Estimate answers by approximating and checking that their results are reasonable by thinking about the context of the problem, and where necessary checking accuracy [for example, by using the inverse operation, by repeating the calculation in a different order]	Ma2.4c

It can be seen that a large proportion of the England number curriculum was in common with that of the other countries. There are 22 elements to Ma2, and 15, 68%, appear in Table 4.2. Ratings were regarded as low if the match was some coverage in no more than three countries or lower. Only one element of the England number curriculum scored a low rating. It is shown in table 4.3.

Table 4.3 Number topics covered in the England curriculum but uncommon elsewhere

Ma2 Number 4 Solving numerical problems	Read and plot coordinates in the first quadrant, then in all four quadrants [for example, plot the vertices of a rectangle, or a graph of the multiples of 3]	Ma2.4e

This topic could be argued not to be number, but there were other sections of the England number curriculum not well represented elsewhere. Section 1 of number, using and applying number, found less resonance with other curricula. The main reason for this was the use of only general references to process in several of the other curricula, giving less chance of matching to the more specific content in England. Use of a calculator produced only a moderate match.

4.2.2 Shape, space and measures

In comparison with number, shape space and measures showed a lower level of match between England's curriculum and those of the comparison countries. Only 5 of the 24 topics, 21%, are included in Table 4.4 which shows the topics with a high level of match.

Table 4.4 Shape, space and measures topics common to all or most of the curricula

Ma3 Shape, space and measures 4 Understanding measures	Recognise the need for standard units of length, mass and capacity, choose which ones are suitable for a task, and use them to make sensible estimates in everyday situations; convert one metric unit to another [for example, convert 3.17kg to 3170g]; know the rough metric equivalents of imperial units still in daily use	Ma3.4a
	Recognise that measurement is approximate; choose and use suitable measuring instruments for a task; interpret numbers and read scales with increasing accuracy; record measurements using decimal notation	Ma3.4b
	Recognise angles as greater or less than a right angle or half-turn, estimate their size and order them; measure and draw acute, obtuse and right angles to the nearest degree	Ma3.4c
	Read the time from analogue and digital 12- and 24-hour clocks; use units of time - seconds, minutes, hours, days, weeks - and know the relationship between them	Ma3.4d
	Find perimeters of simple shapes; find areas of rectangles using the formula, understanding its connection to counting squares and how it extends this approach; calculate the perimeter and area of shapes composed of rectangles.	Ma3.4e

It can be seen that the topics common to the curricula are about measures rather than shape and space. A number of geometry topics, 5 out of 24 (21%) showed a low level of match, as shown in Table 4.5:

Table 4.5 Shape, space and measures topics covered in the England curriculum but uncommon elsewhere

Ma3 Shape, space and measures 1 Using and applying shape, space and measures *Problem solving*	Approach spatial problems flexibly, including trying alternative approaches to overcome difficulties	Ma3.1c
	Use checking procedures to confirm that their results of geometrical problems are reasonable	Ma3.1d
Ma3 Shape, space and measures 1 Using and applying shape, space and measures Communicat*ing*	Organise work and record or represent it in a variety of ways when presenting solutions to geometrical problems	Ma3.1e
Ma3 Shape, space and measures 3 Understanding properties of position and movement	Transform objects in practical situations; transform images using ICT; visualise and predict the position of a shape following a rotation, reflection or translation	Ma3.3b
	Identify and draw 2-D shapes in different orientations on grids; locate and draw shapes using coordinates in the first quadrant, then in all four quadrants [for example, use coordinates to locate position in a computer game].	Ma3.3c

Most of the process elements of this part of the England curriculum (Section 1) did not find many echoes elsewhere. Similarly the England emphasis on visualisation and movement in geometry was found to be unusual, the other curricula, except Ontario's, not stressing transformational geometry or visualisation.

4.2.3 Handling data

No aspect of the England curriculum for handling data received a high level of match with the other curricula. The best matches were for Ma4.2b and Ma4.2c, interpretation and drawing of basic graphs, as might be expected. The absence of data handling in the Netherlands curriculum obviously contributes to the lower ratings but is not the sole cause, the majority of the other ratings were for *some* content to match rather than *all or most*.

In consequence, a variety of topics received low ratings for match with England's curriculum. These are shown in table 4.6, and the 7 topics represent 54% of the total of 13.

Table 4.6 Handling data topics covered in the England curriculum but uncommon elsewhere

Ma4 Handling data 1 Using and applying handling data *Problem solving*	Approach problems flexibly, including trying alternative approaches to overcome any difficulties	Ma4.1b
	Check results and ensure that solutions are reasonable in the context of the problem	Ma4.1e
Ma4 Handling data 1 Using and applying handling data *Communicating*	Decide how best to organise and present findings	Ma4.1f
	Use the precise mathematical language and vocabulary for handling data	Ma4.1g
Ma4 Handling data 1 Using and applying handling data *Reasoning*	Explain and justify their methods and reasoning.	Ma4.1h
Ma4 Handling data 2 Processing, representing and interpreting data	Know that mode is a measure of average and that range is a measure of spread, and to use both ideas to describe data sets	Ma4.2d
	Recognize the difference between discrete and continuous data	Ma4.2e
	Draw conclusions from statistics and graphs and recognise when information is presented in a misleading way; explore doubt and certainty and develop an understanding of probability through classroom situations; discuss events using a vocabulary that includes the words 'equally likely', 'fair', 'unfair' and 'certain'	Ma4.2f

Again the process elements of data handling appear in the table, as do the more complex aspects of representing and interpreting data. It is very apparent from this part of the exercise that the England curriculum requires more handling of data than most of

the other curricula. The curricula of Chinese Taipei, Hong Kong, Singapore and the Netherlands all showed low coverage compared with England's. Latvia and Ontario are the exceptions, providing virtually all of the *all or most* covered ratings in this area.

4.3 Difficulty and breadth

As part of the comparison work we have compared the difficulty and breadth of the England curriculum and that of the comparison countries. We have also made confidence ratings of each judgment. The scale used was:

3	Very confident
2	Quite confident
1	Not confident.

Table 4.7 shows how the curriculum of each country was rated for breadth and difficulty against England's.

For number, with the exception of the Netherlands and Ontario, the other curricula are judged to be harder and somewhat broader. The opposite was judged to be the case for data handling, where, again with the exception of Ontario, the comparison curricula were seen to be both easier and narrower. No clear pattern emerged for difficulty in Space, Shape and Measures, and for breadth only Hong Kong's curriculum was considered to be broader, with half of the other curricula rated as similar in breadth.

The ratings for confidence on judgments of difficulty and breadth were around 2 for the Pacific Rim countries and Ontario, representing quite confident. These are detailed curricula and this was found to facilitate matching of content and comparison of both difficulty and breadth. The opposite is the case for the Netherlands, where the brevity of the curriculum was found to make matching and comparison difficult, and the average rating was close to *not confident.* The rather different format and generality of the Latvian curriculum accounts for its lower confidence ratings.

Table 4.7 Breadth and Difficulty of the Curricula Compared

England Attainment Target	The Singapore curriculum is:	The Chinese Taipei curriculum is:	The Hong Kong curriculum is:	The Netherlands curriculum is:	The Latvia curriculum is:	The Ontario curriculum is:
Number: ***Difficulty***	Harder	Harder	Harder	Easier	Harder	Easier
Breadth	Broader	Slightly broader	Broader	Narrower	Broader	Narrower
Shape, space and measures: ***Difficulty***	Easier	Harder	Harder	Similar	Easier	Similar
Breadth	Narrower	Similar	Broader	Similar	Narrower	Similar
Handling data: ***Difficulty***	Easier	Easier	Easier	Easier	Easier	Similar
Breadth	Narrower	Narrower	Narrower	Narrower	Narrower	Slightly broader
Confidence: ***Difficulty***	1.9	2.0	2.1	1.1	1.3	1.9
Breadth	2.0	1.9	2.1	1.1	1.3	1.9

4.4 Differentiation

Local experts in the comparison countries were asked about differentiation and tailoring content to ability. The most extreme form of differentiation was reported from Singapore, where pupils are streamed at the end of primary 4 (Year 5 in England). More detail of how this works is given in the section 5.4, on differentiation in science.

In Latvia apart from the provision of a range of programmes for pupils with special needs, it is regarded as for the teacher to deal with the range of abilities within a class. The philosophy is one curriculum for all. In Hong Kong this is also the case, and teachers are expected "*to use different teaching approaches and select appropriate enrichment topics to meet the needs of pupils… spare periods have been reserved at each level for teachers to design the teaching materials with varying breadth and depth of treatment according to the actual situation and the strengths and weaknesses of pupils. In this way, teachers can provide opportunities for pupils to fully utilize their strengths to achieve the standards at the end of Key Stages 2*". Chinese Taipei did not comment other than on provision for special needs.

4.5 Implementation

Latvia has a mandatory time allocation for mathematics, in periods per week. A period usually being 40 minutes:

Year	G1	G2	G3	G4	G5	G6
Periods	4	4	4	5	5	5
Hours	2.7	2.7	2.7	3.3	3.3	3.3

Other countries have recommended times. In Hong Kong, for example, 3.3 hours per week are devoted to mathematics teaching in the earlier years. There is also a recommended allocation of time for different content areas. This is shown below and suggests that, taken together, number and algebra occupy around half of the time.

Dimensions	**Suggested Percentages**
Number	41 %
Shape & Space	13 %
Measures	16%
Data Handling	10%
Algebra	7%
Spare Periods	13%
Total	100%

Chinese Taipei has recommended ranges in percentage terms. These are quite wide, that for mathematics being between 10% and 30%. Using this, the minimum time rises from 1.3 hours for grade 1 to 1.8 hours for grade 6. The corresponding maxima are 4.0 hours and 5.4 hours.

In Singapore the allocations in hours are:

Year	P1	P2	P3	P4
Hours	3.5	4.5	5.5	5.5

After P4 the streaming cuts in and the allocations vary by stream, 4.5 hours for EM1, 5 hours for EM2 and 6.5 hours for EM3.

None of the comparator curricula are accompanied by mandatory instructions on how to teach mathematics. All, however, suggest approaches or principles, and some offer suggested activities.

No evidence of specialist teachers was found.

4.6 Conclusions

With the exception of Latvia all the curricula examined are structured by content, and a good deal of communality was found in the structural elements selected. Number and geometry are components of all of the content-structured curricula, and data handling of all but one. Variations were apparent in whether to leave measures separate and, if not, with what to combine it. Similarly algebra is a separate structural element in some curricula but subsumed into number in others. The England mathematics curriculum does not stand out as unusual. Similarly England's emphasis on process is shared by most of the other curricula examined. The Netherlands curriculum stands out because of ts brevity.

In Number a high proportion of the England curriculum was also present in the other curricula, but it noticeable that, apart from the Netherlands and Ontario, the other curricula were all judged to be harder than England's. Further, three of the curricula were also judged to be significantly broader. The countries all performed well in the TIMSS survey, and it seems that they are able to implement a harder and broader curriculum in number successfully. As number comprised 40% of the 2003 TIMSS survey at grade 4 the emphasis on number in these countries may have contributed to their success. It cannot be assumed that making England's number curriculum more demanding and wider would lead to similar success. For this to happen, successful implementation would also be required.

Data handling, on the other hand, was found to be more strongly represented in the England curriculum than elsewhere. For this topic all the other curricula were judged to be both narrower and less demanding.

For Shape, space and measures no clear pattern emerged from the comparisons, of breadth and difficulty but the emphasis in England on visualising and transformations is not widely shared.

5 Science: Summary of Comparisons

5.1 Basic Structure

Five curricula were compared with England's Key Stage 2 science curriculum, those of Chinese Taipei, Hong Kong, Singapore, Ontario and Latvia.

Like England, the curricula of Chinese Taipei, Hong Kong, Singapore and Ontario discuss the ethos of science. Latvia is the exception in this respect. The same division into ethos driven and objectives driven curricula made for mathematics does not apply to science. It seems that the nature of the subject encourages countries to discuss the ethos of science in their primary curricula. Integration with technology is an obvious option for science curricula and Ontario, Chinese Taipei and Hong Kong, to an extent, have taken this route.

In mathematics all but one of the countries organize their primary curriculum by content areas, and there are many similarities between the structures. In science, however, far greater diversity is apparent. Table 5.1 outlines the basic structure of each curriculum, comparing it with the structure of England's.

Table 5.1 Basic Structure of the Science Curricula Being Compared

England	Hong Kong	Latvia	Ontario	Chinese Taipei	Singapore
Level of detail compared with England	Less	Greater	Greater	Greater	Greater
Structure					
Scientific enquiry	Scientific Investigation	Basics of Research Work	*(present)*	*(present)*	Process Skills
				The Composition of the Nature	
Life processes and living things	Life and Living	Nature's Systems and Processes	Life Systems	The Role of Nature	Diversity
Materials and their properties			Matter and Materials		Cycles
				Evolution and Continuity	
	Energy and Change		Energy and Control		Energy
				Life and the Environment	
Physical processes	The Material World		Structures and Mechanisms		Interactions
	The Earth and Beyond			Sustainable Development	
					Systems
	Science, Technology and Society				
Integration with technology	(Yes)	No	Yes	Yes	No

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Singapore's structure is a thematic one with content fitting into the themes, and Chinese Taipei's structure is similar. Latvia has two broad structural elements, which can be seen as process and content. Ontario's structure is content based, as is Hong Kong's.

The equivalent of Scientific enquiry in the England curriculum is present in some form in all of the others, but is not a structural element in Ontario and Chinese Taipei. In these curricula the approach to this aspect of science is spread across the content. In some senses this approach is like that used in the mathematics curriculum in England which differs from England's science curriculum in this respect.

In the area of biology, no consistency is apparent when the structures of the curricula are compared. Materials appears as a structural element in England and Ontario, while energy is structural in Hong Kong, Singapore and Ontario, although with different slants.

The variety of structures indicate a lack of consensus about the best way to structure a primary science curriculum and what the basic building blocks should be. This is not to say that the content is totally different, it is not, but the way it is structured varies considerably.

5.2 Comparison of Content

5.2.1 Scientific enquiry

As part of the comparison work we have matched the content of the England curriculum with those from the comparison countries. This was done using the components of the England curriculum as a yardstick against which to judge the others. So, for example, a match was sought for:

Sc2/5e - about how nearly all food chains start with a green plant.

However, many elements of the England curriculum define multiple objectives:

Sc3/1a - to compare everyday materials and objects on the basis of their material properties, including hardness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials.

In such cases the match might be to part of a similar multi-stranded objective or to a series of smaller scale objectives. To summarise the degree of match an *all or most, some, none* classification was made in relation to the degree of match with the England curriculum. The match was then quantified using a 2, 1, 0 scoring system to identify the highest and lowest degrees of match. To simplify the presentation of the degree of match, Table 5.2 shows those parts of the England curriculum for scientific enquiry with the highest degree of match, generally representing a match of *all or most* for all the comparison countries or all but one.

Table 5.2 Scientific enquiry topics common to all or most of the curricula

Sc1 Scientific enquiry Investigative skills *Obtaining and presenting evidence*	Make a fair test or comparison by changing one factor and observing or measuring the effect while keeping other factors the same	1/2d
	Use simple equipment and materials appropriately *and take action to control risks*	1/2e
	Make systematic observations and measurements, including the use of ICT for datalogging	1/2f

Only three out of the 21 possible topics (14%) appear in the table, all covering how to conduct experiments. The sections of the England curriculum on ideas and evidence in science and planning are not represented, and neither is the breadth of study section. The ideas and evidence in science section and breadth of study section do appear in Table 5.3, which shows the four elements of the England scientific enquiry curriculum with a very low degree of match, some coverage in no more than two countries or lower. The majority of topics in Sc 1, 14 (67%) fell between the extremes in terms of the level of match between England's curriculum and those of the comparison countries

Table 5.3 Scientific enquiry topics covered in the England curriculum but uncommon elsewhere

Sc1 Scientific enquiry Ideas and evidence in science	That it is important to test ideas using evidence from observation and measurement.	1/1b
Sc1 Scientific Enquiry Investigative skills *Obtaining and presenting evidence*	Check observations and measurements by repeating them where appropriate	1/2g
Breadth of study	*During the Key Stage, pupils should be taught knowledge, skills and understanding through:* a range of domestic and environmental contexts that are familiar and of interest to them	BoS 1a
	Using a range of sources of information and data, including ICT-based sources	BoS 1c

The match in life processes and living things was at a higher level. Eleven out of the 24 topics (46%) showed a high level of match. Topics concerning green plants are well represented in Table 5.4, but a range of topics from other sections of Sc2 are also included.

Table 5.4 Life processes and living things topics common to all or most of the curricula

Sc2 Life processes and living things Life processes	That the life processes common to humans and other animals include nutrition, movement, growth and reproduction	2/1a
Sc2 Life processes and living things Humans and other animals *Nutrition*	About the need for food for activity and growth, and about the importance of an adequate and varied diet for health	2/2b
Sc2 Life processes and living things Humans and other animals *Circulation*	That the heart acts as a pump to circulate the blood through vessels around the body, including through the lungs	2/2c
Sc2 Life processes and living things Humans and other animals *Growth and reproduction*	About the main stages of the human life cycle	2/2f
Sc2 Life processes and living things Green plants *Growth and nutrition*	The role of the leaf in producing new material for growth	2/3b
	That the root anchors the plant, and that water and minerals are taken in through the root and transported through the stem to other parts of the plant	2/3c
Sc2 Life processes and living things Green plants *Reproduction*	About the parts of the flower [for example, stigma, stamen, petal, sepal] and their role in the life cycle of flowering plants, including pollination, seed formation, seed dispersal and germination.	2/3d

Sc2 Life processes and living things Variation and classification	How locally occurring animals and plants can be identified and assigned to groups	2/4b
Sc2 Life processes and living things Living things in their environment	About ways in which living things and the environment need protection	2/5a
	About the different plants and animals found in different habitats	2/5b
	How animals and plants in two different habitats are suited to their environment	2/5c

The two topics with a low level of match (13%) concern pulse rate, not covered in any of the other curricula, and the importance of assigning plant and animals to groups.

Table 5.5 Life processes and living things topics covered in the England curriculum but uncommon elsewhere

Sc2 Life processes and living things Humans and other animals *Circulation*	About the effect of exercise and rest on pulse rate	2/2d
Sc2 Life processes and living things Variation and classification	That the variety of plants and animals makes it important to identify them and assign them to groups.	2/4c

For Materials and their properties, 5 out of 17 topics (29%) were assessed as having a high level of match. Two of the sections of Sc3, Grouping and classifying materials and Changing Materials are represented in Table 5.6. The third section of Sc3, Separating mixtures of materials appears only in Table 5.7, topics covered in England but uncommon elsewhere. Three topics of the five in this section are included. Only knowledge that some solids will dissolve in water was at all common in the other curricula.

Table 5.6 Materials and their properties topics common to all or most of the curricula

Sc3 Materials and their properties Grouping and classifying materials	To compare everyday materials and objects on the basis of their material properties, including hardness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials	3/1a
	To recognise differences between solids, liquids and gases, in terms of ease of flow and maintenance of shape and volume.	3/1e
Sc3 Materials and their properties Changing materials	To describe changes that occur when materials [for example, water, clay, dough] are heated or cooled	3/2b
	That temperature is a measure of how hot or cold things are	3/2c
	The part played by evaporation and condensation in the water cycle	3/2e

Table 5.7 Materials and their properties topics covered in the England curriculum but uncommon elsewhere

Sc3 Materials and their properties Separating mixtures of materials	How to separate insoluble solids from liquids by filtering	3/3c
	How to recover dissolved solids by evaporating the liquid from the solution	3/3d
	To use knowledge of solids, liquids and gases to decide how mixtures might be separated.	3/3e

For Physical processes 4 out of 19 topics (21%) showed a high level of match. These are from two sections of Sc4, Types of Force and Everyday Effects of Light.

Table 5.8 Physical processes topics common to all or most of the curricula

Sc4 Physical processes Forces and motion *Types of force*	About the forces of attraction and repulsion between magnets, and about the forces of attraction between magnets and magnetic materials	4/2a
	That when objects [for example, a spring, a table] are pushed or pulled, an opposing pull or push can be felt	4/2d
Sc4 Physical processes Light and sound *Everyday effects of light*	That light cannot pass through some materials, and how this leads to the formation of shadows	4/3b
	That light is reflected from surfaces [for example, mirrors, polished metals]	4/3c

Only one topic received a very low rating, and is shown in Table 5.9. The use of symbols in electrical circuits was rare outside the England curriculum.

Table 5.9 Physical processes topics covered in the England curriculum but uncommon elsewhere

Sc4 Physical processes Electricity *Simple circuits*	How to represent series circuits by drawings and conventional symbols, and how to construct series circuits on the basis of drawings and diagrams using conventional symbols.	4/1c

5.3 Difficulty and breadth

As part of the comparison work we have compared the difficulty and breadth of the England curriculum and that of the comparison countries. We have also made confidence ratings of each judgment. The scale used was:

3 Very confident

2 Quite confident

1 Not confident.

Table 5.10 shows how the curriculum of each country was rated for breadth and difficulty against England's.

For Scientific enquiry three countries, Singapore, Hong Kong and Ontario were regarded as having narrower curricula which are similar in demand to England's. Latvia's curriculum, in contrast, was rated as both broader and more demanding. Chinese Taipei's curriculum was judged to be similar in breadth and demand.

For Life processes and living things, four curricula were seen as broader, with one judged to be of similar difficulty and three more demanding. Hong Kong's curriculum was regarded rather differently, as less demanding and easier.

For Materials and their properties the tendency towards greater breadth was seen in three countries, but only in one case was this viewed as being accompanied by a significantly higher level of demand. Again, Hong Kong's curriculum was regarded rather differently, as both less demanding and easier.

For Physical processes the pattern was for four curricula to be both broader and more demanding. Again, Hong Kong's curriculum was seen to have the same characteristics as for the other attainment targets.

The ratings for confidence on judgments of difficulty and breadth were generally higher than for mathematics, being above 2 in four cases, which represents *quite confident* with some towards 3, *very confident*. The exception was Hong Kong where a number of the statements in the curriculum are rather general, making comparisons of relative difficulty and breadth more challenging to make.

Table 5.10 Breadth and Difficulty of the Curricula Compared

England Attainment Target	The Singapore curriculum is:	The Chinese Taipei curriculum is:	The Hong Kong curriculum is:	The Latvia curriculum is:	The Ontario curriculum is:
Scientific enquiry:					
Difficulty	Similar	Similar	Similar	Harder	Similar
Breadth	Narrower	Similar	Narrower	Broader	Narrower
Life processes and living things:					
Difficulty	Harder	Harder	Easier	Harder	Similar
Breadth	Broader	Broader	Narrower	Broader	Broader
Materials and their properties:					
Difficulty	Similar	Harder	Easier	Similar	Slightly harder
Breadth	Similar	Broader	Narrower	Broader	Broader
Physical processes:					
Difficulty	Slightly Harder	Harder	Easier	Harder	Harder
Breadth	Broader	Broader	Narrower	Broader	Broader
Confidence:					
Difficulty	2.6	2.1	1.7	2.3	2.6
Breadth	2.6	2.8	1.8	2.6	2.8

5.4 Differentiation

Local experts in the comparison countries were asked about differentiation and tailoring content to ability. The most extreme form of differentiation was reported from Singapore, where pupils are streamed at the end of primary 4 (Year 5 in England). About 90% of pupils then go on to study the Standard science curriculum with the weakest students studying Foundation science with reduced content. Topics which are included in Standard Science, but are omitted from Foundation Science are: cell system, force in springs, energy conversion. The local expert also reports on provision for the gifted.

"As for the high-ability pupils in the Gifted Education Programme (GEP), there is an enrichment programme for them beyond the Standard science syllabus. Basically, they follow the Standard syllabus but the content is treated in more depth and breadth by introducing advanced content and relevant issues of interest for discussion. Differentiation is characterised by curriculum compacting, acceleration, programmatic augmentation, and interdisciplinary connections. For example, pupils learn about the traits and lives of famous scientists. They may learn advanced content such as dichotomous classification, generators and dynamos, the mathematical formula for 'work done', and interactions among organisms (e.g. mutualism, commensalism, predation, parasitism) which are taught in secondary school for pupils in the mainstream. They may also discuss issues in more detail (e.g. issues pertaining to deforestation when learning about photosynthesis, conservation of sharks when learning about food chains), and

debate ethical issues related to genetically modified foods and animal cloning when learning about the impact of science and technology on the environment."

In Latvia apart from the provision of a range of programmes for pupils with special needs, it is regarded as for the teacher to deal with the range of abilities within a class. The philosophy is one curriculum for all. Hong Kong takes a similar view, *"one curriculum framework for all"*. Again teachers are expected to be flexible and to adapt the curriculum to suit particular needs, interests and abilities. The local expert reports that "*Not everything in the textbook needs to be covered*" Chinese Taipei did not comment other than on provision for special needs.

5.5 Implementation

Latvia has a mandatory time allocation for science, in periods per week:

Year	G1	G2	G3	G4	G5	G6
Periods	2	2	2	2	2	2
Hours	1.3	1.3	1.3	1.3	1.3	1.3

In contrast to mathematics, the time allocated to science does not increase through the primary years, and the allocation for science is much lower.

Other countries have recommended times. In Hong Kong, for example, 3.1 hours per week are devoted to science teaching in the earlier years, slightly less than for mathematics. Chinese Taipei has recommended ranges in percentage terms. These are quite wide, that for science being between 10% and 30%. Using this, the minimum time rises from 1.3 hours for grade 1 to 1.8 hours for grade 6. The corresponding maxima are 4.0 hours and 5.4 hours. This range is the same as that given to mathematics.

In Singapore the allocations in hours are:

Year	P1	P2	P3	P4	P5	P6
Periods	0	0	1.5	2	2.5	2.5

As in Latvia, the time allocation for science is much lower than that for mathematics.

None of the comparator curricula are accompanied by mandatory instructions on how to teach science. Several suggest approaches or principles to help teachers.

No evidence of specialist teachers was found.

5.6 Conclusions

Unlike mathematics, little consensus was apparent when the basic structures of the science curricula were compared. Structure by theme was noted, as well as structure by content. Scientific enquiry is a structural element in some form of three of the other curricula and is present in all. Integration with technology is the option chosen by three countries. The England curriculum has scientific enquiry and content, dividing this into biology, chemistry and physics, although not using that nomenclature. Latvia also has process and content, with the latter undivided. The other curricula have content divided into more elements than England's, but in different ways. England's overall format is similar to several of the others, and does not stand out as unusual.

The highest level of similarity in content between England and the other countries was found in Life processes and living things, but there was less similarity here than in the number area of mathematics.

When breadth and difficulty are considered, Hong Kong's curriculum stood out, being seen as easier and narrower in the content attainment targets. When compared with the other four curricula, Physical processes produced a clear pattern of judgments, all four curricula being judged to be broader and three of these distinctly more demanding. For Life processes and living things the other four curricula were again seen as broader, and of similar difficulty or more demanding. For Materials and their properties the tendency in the other four curricula was towards similarity in difficulty and greater broadness. This tendency towards similarity in difficulty was also judged to be present in scientific enquiry, but three curricula were judged to be narrower.

In summary, with the exception of Hong Kong's, the other curricula tended to be regarded as broader except in Scientific enquiry, while in Physical processes the tendency was for the comparator curricula to be seen as more demanding.

6 Literacy: Summary of Comparisons

6.1 Basic Structure

Eight curricula were compared with England's Key Stage 2 programmes of study for reading and writing: those from British Columbia (Canada), Chinese Taipei, Italy, Latvia, the Netherlands, Ontario (Canada), Singapore and Sweden. Of these, British Columbia, Ontario and Singapore are English-language curricula and the others relate to literacy in their national languages.

The curricula for mathematics and science have two basic components, content and process. Curricula for literacy, however, tend to be process orientated and this leads to a wider variation in structure across countries than for the other subjects. As with mathematics, a distinction can be observed at the most general level between curricula that can be described as 'objective driven', specifying detailed objectives for students rather than an overall philosophy, and others that are 'ethos driven', without detailed objectives. Amongst the eight countries under consideration, Italy, the Netherlands and Sweden frame their curricula in a form that could be described as ethos driven, although Italy also includes specific objectives. The other five curricula, British Columbia, Chinese Taipei, Latvia, Ontario and Singapore consist of detailed objectives in a way that is more similar to the England curriculum. However, a clear ethos also emerges from some of these: Chinese Taipei includes attitudinal and aesthetic statements, while the Latvia curriculum is pervaded by a strong ethos of national identity.

As a broad generalisation, it is apparent that the England curriculum pays less attention to the philosophy and rationale underpinning the development of literacy than other countries. One short paragraph, *The importance of English,* precedes the detailed programmes of study. In other countries the centrality of language and literacy to the child's social, emotional and intellectual development, or to shared cultural and aesthetic experience, is likely to be elaborated in greater depth and detail.

The England curriculum is structured according to the four language modes of speaking and listening (treated together), reading and writing. The other countries' curricula adopt a very wide range of structures, none of them identical to this. Table 6.1 lists the top-level divisions structuring each curriculum document.

Table 6.1 Structure of the curricula

British Columbia	Comprehend and respond Communicate ideas and information Self and society
Chinese Taipei	Abilities to use Mandarin phonetic symbols Listening abilities Speaking abilities Literacy [spelling] and handwriting abilities Reading abilities Writing abilities
Italy	Listening Speaking Reading Writing Grammar (morpho-syntactic, semantic, phonological, historical)
Latvia	Language (communicative competence, language competence, socio-cultural competence) Literature (as an art of writing, comprehension of a literary work, literature as part of culture)
Netherlands	Oral education Written education Linguistics, including strategies
Ontario	Writing Reading Oral and visual communication
Singapore	Language for information Language for literary response and expression Language for social interaction
Sweden	No division, on principle

In Table 6.1, a categorisation by speaking, listening, reading and writing is evident in Chinese Taipei, Ontario and Italy, and can also be discerned in British Columbia and the Netherlands, where the two receptive modes of listening and reading are treated together, and distinguished from the two productive modes of speaking and writing. The study of the language - grammar or linguistics - which is a sub-section of each programme of study in England, has its own section in Italy and the Netherlands. In

British Columbia, a separate section describes personal development and community collaboration, a category echoed in Singapore. Ontario is the only curriculum to mention visual communication specifically in these high-level headings. Chinese Taipei recognises the particular qualities of the Mandarin language with separate sections on phonetic symbols and on spelling and handwriting. Both Latvia and Singapore have structures which have little in common with any other.

The nature of language and literacy, and its centrality to the curriculum and to education and adult life, underlie the considerable differences described above. Unlike mathematics and science, the subject is less susceptible to be structured according to content. In the absence of this organising principle, language modes, literacy skills or the purposes of literacy might all structure the classification within the curriculum. Moreover, there is a notable difference between six of the countries, which break down the skills and content into specific objectives, and those of the Netherlands and Sweden, which consist of broad generalisations and eschew specificity. This makes the comparison of content which follows a particularly difficult undertaking.

6.2 Comparison of Content

As part of the comparison work we have attempted to match the content of the England curriculum with those from the comparison countries using the components of the England curriculum as a yardstick, as was done for mathematics and science. However, because of the differences in structure, distinct 'topics' cannot always be identified in the comparator curricula.

For example, the Netherlands curriculum has a goal *rules for spelling,* applicable to both reading and writing. In the 'reading strategies' section of the England curriculum, the objectives are much more specific: *phonemic awareness and phonic knowledge; word recognition and graphic knowledge,* and again in the 'spelling strategies' section: *sound out phonemes, analyse words into syllables and other known words; apply knowledge of spelling conventions.* It is not entirely accurate to say that each of these has a match in the Netherlands curriculum; yet the general idea of tackling unknown words through these strategies can be discerned. Particularly in the case of the Netherlands and Sweden, therefore, a note of caution is necessary in interpreting the tables below; rarely, if ever, will such a specific requirement appear in those curricula, although it could be regarded as covered by a more general requirement.

6.2.1 Reading

Bearing in mind the caveats above, Table 6.2 lists those parts of the England curriculum for reading with the highest degree of match, generally representing a match of all or most countries.

Table 6.2 Reading topics common to all or most of the curricula

Reading strategies	Phonemic awareness and phonic knowledge	En2 1a
	Word recognition and graphic knowledge	En2 1b
	Knowledge of grammatical structures	En2 1c
	Contextual understanding	En2 1d
Reading for information	Obtain specific information through detailed reading	En2 3c
	Use organisational features and systems to find texts and information	En2 3e
	Distinguish between fact and opinion	En2 3f
Literature	Recognise the choice, use and effect of figurative language, vocabulary and patterns of language	En2 4a
	Identify how character and setting are created, and how plot, narrative structure and themes are developed	En2 4c
	Express preferences and support their views by reference to texts	En2 4g
	Read stories, poems and plays aloud	En2 4i
Non-fiction and non-literary texts	Understand the structural and organisational features of different types of text [for example, paragraphing, subheadings, links in hypertext]	En2 5e
Language structure and variation	To read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology	En2 6
Literary breadth (Note: this range is implied, rather than specified)	A range of modern fiction by significant children's authors	En2 8a
	Long-established children's fiction	En2 8b
	A range of good-quality modern poetry	En2 8c
	Classic poetry	En2 8d
	Texts drawn from a variety of cultures and traditions	En2 8e
	Myths, legends and traditional stories	En2 8f
	Playscripts	En2 8g
Breadth of study: non-fiction and non-literary texts	Print and ICT based reference and information materials [for example, textbooks, reports, encyclopaedias, handbooks, dictionaries, thesauruses, glossaries, CDROMs, internet]	En2 9b

In many cases, the specificity of the England curriculum is not echoed in the comparator documents, but the range is clearly implied there.

Where topics are not shared between all or most of the curricula analysed, the findings become more complex. The following tables are organised by reading topics, and once again attempt to codify a set of documents that is very varied in structure and approach.

Skills for reading literature

Table 6.3 lists these skills, with the countries in which an equivalent can be found.

Table 6.3 Skills for reading literature

British Columbia Latvia	Evaluate ideas and themes that broaden perspectives and extend thinking	En2 4e
British Columbia Italy Latvia Ontario	Consider poetic forms and their effects	En2 4f
British Columbia Latvia Singapore Sweden	Respond imaginatively, drawing on the whole text and other reading	En2 4h

These countries specify in detail the skills involved in response and analysis of literary texts. By contrast, Sweden and the Netherlands stress enjoyment and emotional response, whilst Chinese Taipei mentions ‘styles and themes’ in relation to all text types, not just literature. British Columbia and Latvia are consistently similar to England in their approach to these skills.

Range of non-fiction and non-literary texts

There is more variety across countries in relation to non-fiction texts than literary texts. Broadly, a range of stories and poems is specified for literary reading across all countries, but for non-literary texts there is less consistency.

Table 6.4 Breadth of study: non-fiction and non-literary texts

Singapore	Diaries, autobiographies, biographies, letters	En2 9a
Chinese Taipei Singapore	Newspapers, magazines, articles, leaflets, brochures, advertisements.	En2 9c

These countries specify a wide range of non-fiction and non-literary texts, whereas others adopt a more general formulation.

Understanding texts

Table 6.5 lists the countries that share with England a concern to break down and specify the skills involved in full comprehension of a text, rather than requiring 'understanding' in general terms.

Table 6.5 Understanding texts

British Columbia Singapore Ontario	Use inference and deduction	En2 2a
British Columbia Latvia	Look for meaning beyond the literal	En2 2b
British Columbia Italy Latvia Ontario	Make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing]	En2 2c
British Columbia Chinese Taipei Ontario Netherlands Singapore	Use their knowledge of other texts they have read	En2 2d

Skills in reading for information

In a similar way, Table 6.6 lists the countries that specify the skills involved in information reading.

Table 6.6 Skills in reading for information

British Columbia Ontario Singapore	Scan texts to find information	En2 3a
British Columbia Ontario Singapore	Skim for gist and overall impression	En2 3b
Netherlands Sweden	Draw on different features of texts, including print, sound and image, to obtain meaning	En2 3d
British Columbia Latvia Ontario	Identify the use and effect of specialist vocabulary	En2 5a
Chinese Taipei	Recognise phrases and sentences that convey a formal, impersonal tone	En2 5c
British Columbia	Engage with challenging and demanding subject matter	En2 5g

It is clear from Tables 6.3-6.6 that the curricula with which England has most in common are those for British Columbia and Singapore. In others, the differing emphases, philosophies and formulations lead to a poorer match. There are a number of topics in the England curriculum for which no close matches were found in other curricula and these are listed in Table 6.7. Once again, this seems to be a matter of much greater specificity in the England document.

Table 6.7 Reading topics in the England curriculum not shared with other countries

Non-fiction and non-literary texts	Identify words associated with reason, persuasion, argument, explanation, instruction and description	En2 5b
	Identify links between ideas and sentences in non-chronological writing	En2 5d
	Evaluate different formats, layouts and presentational devices [for example, tables, bullet points, icons]	En2 5f

All other countries' curricula require the reading and understanding of informational texts in some sense, but none at this level of analytical detail.

There are a number of topics found in the curricula of other countries which have no direct equivalent in England. Broadly, these can be seen as related to the philosophical ethos pervading the other curricula, which is not replicated in England. For example, there may be statements about the use of language and communication in relationships with others, or the need for individuality and creativity, or the importance of language and literature to national identity, or an awareness of cultural variation. Some examples of these are:

Demonstrate awareness of how to use language and communications technologies to maintain relationships with others (British Columbia)

Derive pleasure from reading (Netherlands)

Be personally creative and search on their own for meaningful reading, as well as take part in cultural identity (Sweden)

Recognises the themes from the folklore of different nations within literary works. (Latvia)

6.2.2 Writing

The analysis for writing paralleled the analysis for reading, with different structures and approaches introducing complexity into the matching process. Table 6.8 lists those parts of the England curriculum for writing with the highest degree of match, generally indicating all or most countries.

Table 6.8 Writing topics common to all or most of the curricula

Composition	Choose form and content to suit a particular purpose [for example, notes to read or organise thinking, plans for action, poetry for pleasure]	En3 1a
	Broaden their vocabulary and use it in inventive ways	En3 1b
	Use language and style that are appropriate to the reader	En3 1c
	Use and adapt the features of a form of writing, drawing on their reading	En3 1d
	Use features of layout, presentation and organisation effectively	En3 1e
Planning and drafting (Note: these points are often implied rather than specified)	Plan - note and develop initial ideas	En3 2a
	Draft - develop ideas from the plan into structured written text	En3 2b
	Revise - change and improve the draft	En3 2c
	Proofread - check the draft for spelling and punctuation errors, omissions and repetitions	En3 2d
	Discuss and evaluate their own and others' writing.	En3 2f
Punctuation	Use punctuation marks correctly in their writing, including full stops, question and exclamation marks, commas, inverted commas, and apostrophes to mark possession and omission.	En3 3
Spelling	To apply knowledge of spelling conventions	En3 4c
	To use knowledge of common letter strings, visual patterns and analogies	En3 4d
Handwriting	Write legibly in both joined and printed styles with increasing fluency and speed	En3 5a
Language structure	Word classes and the grammatical functions of words, including nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, articles	En3 7a
Purposes for writing	To imagine and explore feelings and ideas, focusing on creative uses of language and how to interest the reader	En3 9a
	To inform and explain, focusing on the subject matter and how to convey it in sufficient detail for the reader	En3 9b
	To persuade, focusing on how arguments and evidence are built up and language used to convince the reader	En3 9c
Forms of writing	The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries.	En3 12

As with reading, the skills and understandings in this table may be expressed with different degrees of specificity in the varied curricula, but are identifiable or clearly implied in all or most of the countries.

Where the topics are not widely shared, there are less clear patterns than for reading. Tables 6.9-6.13 explore this by sub-categories of the curriculum.

Spelling

The requirements for spelling vary widely, partly because of differences in the orthographical structure of the languages. Table 6.9 lists the countries in which an equivalent can be identified.

Table 6.9 Spelling topics

Spelling strategies

Chinese Taipei Latvia Ontario Singapore	To sound out phonemes	En3 4a
Latvia Ontario Singapore	To analyse words into syllables and other known words	En3 4b
Chinese Taipei Italy Ontario Singapore Sweden	To check their spelling using word banks, dictionaries and spellcheckers	En3 4e
Italy Singapore	To revise and build on their knowledge of words and spelling patterns	En3 4f

Morphology

Italy Latvia Ontario	Meaning, use and spelling of common prefixes and suffixes	En3 4g
Latvia Netherlands (partial)	Spelling of words with inflectional endings	En3 4h
Italy Latvia Netherlands (partial)	Relevance of word families, roots and origins of words	En3 4i
Italy Latvia Netherlands (partial)	Use of appropriate terminology, including vowel, consonant, homophone and syllable.	En3 4j

The complex pattern here is not straightforward to interpret. The country whose spelling curriculum is most similar to that in England is Latvia. Singapore's curriculum is for the English language, and shares with England a specificity about spelling strategies but not morphological patterns. Italy and Latvia tend to include morphological spelling patterns, with a general indication of the same skills found in the Netherlands.

Presentation

Table 6.10 Presentational topics

No other country	Present - prepare a neat, correct and clear final copy	En3 2e
British Columbia Chinese Taipei Latvia	Use different forms of handwriting for different purposes [for example, print for labelling maps or diagrams, a clear, neat hand for finished presented work, a faster script for notes].	En3 5b

Although most other countries list the writing processes of drafting, checking and revising, they do not mention the production of a final copy. All countries mention legible handwriting, but only the three countries listed are specific in requiring different forms of writing for different purposes.

Standard English

Table 6.11 Standard English topics

British Columbia Italy Latvia Singapore	How written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display]	En3 6a
British Columbia Italy Sweden	Some of the differences between standard and non-standard English usage, including subject-verb agreements and use of prepositions.	En3 6b

Table 6.11 demonstrates that formality of communication is a clear concern in some countries, whereas an analysis of the difference between standard and non-standard usage is required in others. In this area, the countries with the best match to England are British Columbia and Italy.

Language structure

Table 6.12 Language structure topics

British Columbia (partial) Chinese Taipei Italy Latvia Ontario Singapore	Features of different types of sentence, including statements, questions and commands, and how to use them [for example, imperatives in commands]	En3 7b
British Columbia (partial) Chinese Taipei Italy Latvia Ontario Singapore	Grammar of complex sentences, including clauses, phrases and connectives	En3 7c
Chinese Taipei Latvia Ontario Singapore	Purposes and organisational features of paragraphs, and how ideas can be linked.	En3 7d

Chinese Taipei, Latvia, Ontario and Singapore are consistent in requiring these grammatical topics, with some match with Italy and Latvia. Sweden and the Netherlands have no specific requirements for grammar teaching.

Purposes and forms of writing

Table 6.13 Topics in purposes and forms

Chinese Taipei Latvia	Review and comment on what has been read, seen or heard, focusing on both the topic and the writer's view of it.	En3 9d
Chinese Taipei Italy Latvia Ontario Sweden	Pupils should also be taught to use writing to help their thinking, investigating, organising and learning	En3 10
Ontario Singapore	Range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers.	En3 11

The writing of review or critique at this age is a less common purpose than imagining, informing and persuading, which are present in the curricula of most countries. The function of writing in organising thought is recognised in five countries in addition to England. Whilst most countries specify a variety of purposes and forms for their writing, only Singapore and Ontario in addition to England specify the variety of readers. Two countries, however, Chinese Taipei and the Netherlands, include a mention of correspondence with real readers.

6.3 Difficulty and breadth

Comparisons of difficulty and breadth across the curricula are much more difficult in literacy than in mathematics and science, for a number of reasons. Firstly, the difference in curriculum structure across countries has made it difficult to match the content itself. Some curricula are simply much too generalised in their expression to attempt any close match. Further, the difficulty in terms of the age at which different skills and understandings are taught is not discernible in many cases. There is an additional factor in literacy, however, which is that the difficulty of a reading task depends upon what is read, and this, too, is undefined in most parts of most curricula.

In response to these difficulties, a table such as the ones that appear for mathematics and science has not been attempted here. Instead, Tables 6.14 and 6.15 note any points that seem to emerge in relation to the main curriculum topics in England. It also has to be assumed that the reading comments relate to pupils' reading material which is generally designed to be appropriate for their age-group.

Table 6.14 Differences in difficulty and breadth: reading

Reading strategies	Word recognition in Singapore appears less demanding.
Understanding texts	England is more specific and perhaps more demanding.
Reading for information	England is more specific and perhaps more demanding. British Columbia places stress on the fact/opinion distinction, whereas this receives less attention in Latvia and Chinese Taipei.
Literature	England is more specific in defining skills and has more analytic requirements. Italy and Latvia place greater stress on reading aloud well. Singapore places less stress on literature and more on non-fiction.
Non-fiction and non-literary	England is more specific in defining skills and has more analytic requirements.
Language structure and variation	Italy places more stress on linguistic variety and evolution.
Breadth – literature	Italy appears narrower (but may just be less specific). Latvia places greater stress on folk culture.
Breadth - non-fiction and non-literary	Broadly comparable

Table 6.15 Difficulty and breadth - writing

Composition	Chinese Taipei appears slightly less challenging.
Planning and drafting	Broadly comparable
Punctuation	Latvia appears slightly less demanding.
Spelling	Broadly comparable
Handwriting	Chinese Taipei includes more detail and appears more demanding.
Standard English	Chinese Taipei appears less demanding.
Language structure	Grammar receives greater stress in Singapore and Italy.
Purposes for writing	Chinese Taipei and Latvia appear slightly narrower.
Audiences for writing	Broadly comparable
Forms of writing	Latvia, Italy and Singapore appear narrower (but may just be less specific).

6.4 Differentiation

In the curricula reviewed, a tendency emerged for the literacy curriculum to be seen as inclusive and integrated rather than highly differentiated. This section summarises these findings.

In British Columbia, teachers are encouraged to include all pupils in an integrated language programme with modifications and adaptations where necessary for special needs.

In Chinese Taipei there are general references to teachers planning to suit individual differences.

In Italy, there is a requirement upon teachers to choose and adapt the contents of the curriculum to the needs of individual pupils.

In Latvia, the curriculum is grade-related, with no specific guidance on differentiation according to pupils' abilities.

In the Netherlands, there is no specific guidance on differentiation, but a generally child-centred ethos which implies a need to match children's needs.

In Ontario, the curriculum is grade-related. There is a general expectation that teachers will select materials and methods to match the students' needs and make appropriate adaptations for exceptional students.

In Singapore, pupils are streamed, with the same literacy curriculum for streams EM1 and EM2, but a differentiated one for EM3.

6.5 Implementation

Latvia has a mandatory time allocation for Latvian, in periods per week:

Year	G1	G2	G3	G4	G5	G6
Periods	6	6	6	6	5	4
Hours	4	4	4	4	3.3	2.7

In contrast to mathematics, the time allocated to Latvian does not increase through the primary years but decreases. The allocation for Latvian is higher than for mathematics for the first four years

Other countries have recommended times. Chinese Taipei has recommended ranges in percentage terms. These are quite wide, that for Mandarin being between 20% and 30%, the minimum being 10% higher than for mathematics and the maximum being the same. Using this, the minimum time rises from 2.7 hours for grade 1 to 1.8 hours for grade 6. The corresponding maxima are 4.0 hours and 5.4 hours.

In Singapore the allocations in hours are:

P1	P2	P3	P4	P5	P6
8	8	5.5	5.5	6	6

The allocation for the first two years is high, reflecting the fact that although English is the language of instruction, it is not the first language of most children. For P3 and P4 the allocation is the same as for mathematics. Sweden allocates 22% of compulsory school time to the teaching of Swedish.

None of the comparator curricula are accompanied by mandatory instructions on how to teach literacy.

No evidence of specialist teachers was found.

6.6 Conclusions

Generalisations can be made only with great caution, for all the reasons set out in the rest of this chapter.

In the area of reading, however, one very broad message would seem to emerge from the findings outlined above. A review of all the tables, and particularly Tables 6.6, 6.7, 6.14 and 6.15, seems to suggest that the England curriculum is in one sense more demanding than those of other countries for these years of schooling. The difference is partly a matter of the greater degree of specificity of skills and understandings required in England. As explained above, this difference makes it impossible to ascertain what level of demand is masked by the more general statements in other curricula.

There is, however, a particular aspect of this specificity which is rarely matched in other curricula and which seems to constitute a greater demand in England. In our initial analysis we noted that in Italy and Singapore the emphasis seemed to be on the text rather than the author. This point bears some elaboration. The distinction here is between, on the one hand, a requirement to *understand* and interpret a text in all its richness and subtlety, and on the other a requirement to *analyse* the authorial techniques with which the text was crafted. Tables 6.6 and 6.7 make it clear that few other countries include the analytic demands of En2/5 concerning non-fiction and non-literary texts. Although there is a better match for En2/4 concerning literature, the exact phrasing of the parallel demands in most cases reveals a stress on understanding the text in the other curricula, as against the stress on analysis evident in England.

A suggestion from this review, therefore, is that these comparator countries emphasise that in the primary school years children should be taught to read, understand, enjoy and respond to their reading, whereas in England the requirements are more likely to move beyond this and into analysing authorial techniques.

In terms of assessment, it should be borne in mind that, in the PIRLS assessment, only 20 per cent of the marks are awarded for the reading process ‘Examine and evaluate content, language and textual elements’, with all the other marks given for understanding and response. Experience with the Key Stage 2 national tests also suggests that questions requiring analysis of authorial techniques (assessment focuses 4-6) are often found difficult by pupils even at the end of Key Stage 2.

Overall, then, the forthcoming revision of the primary curriculum may wish to consider whether the strong emphasis on analytic skills remains appropriate for Key Stage 2 pupils. In addition, consideration could be given to whether the rationale and aims underpinning the literacy curriculum could be elaborated in more detail.

7 Mathematics Comparison: Chinese Taipei

This report has been written using the Chinese Taipei mathematics curriculum document and the England Key Stage 2 programme of study for mathematics as source materials.

In particular, the Key Stage 2 programme of study for mathematics in England has been compared with the mathematics curriculum for Grades 2 to 5 in Chinese Taipei, which is the equivalent age group (i.e. 7 to 11-year-olds

7.1 Structure of the Chinese Taipei Curriculum

The Chinese Taipei curriculum in mathematics is a nine-year programme divided into four mathematical stages:

Stage I Grades 1 to 3

Stage II Grades 4 and 5

Stage III Grades 6 and 7

Stage IV Grades 8 and 9

Grades 1 to 6 correspond to primary school, while Grades 7 to 9 correspond to junior high school.

The content of the curriculum is divided into four main ‘themes’, which relate to each Grade. These ‘themes’ are:

Number and Quantity

Geometry

Algebra

Statistics and Probability

There is a further theme in the Chinese Taipei curriculum entitled ‘Connections’, comparable to the attainment target ‘Using and applying mathematics’ in England, which permeates across the four main themes. Connections is further sub-divided into: Recognition, Transformations, Solving Problems, Communication, and Evaluation and Analysis. It is through this structure that process is integrated with content. Reference is made through Connections to encouraging pupils to develop an awareness of the use of mathematics in ‘other fields’. However, throughout the Chinese Taipei mathematics curriculum document there is little in the way of explicit examples about the use of mathematics within other school subjects such as science.

The Chinese Taipei curriculum specifies ‘ability indicators’ for each theme for each mathematical stage. These ‘ability indicators’ are then given further explanation in what are called ‘detailed items’, which together describe the content of the curriculum

suggested to be taught during each academic year. The ‘detailed items’ can be considered as comparable to the programme of study in the England curriculum. There are also several broader ‘curriculum targets’ for the primary and junior high school phases. For example: ‘In the second stage (Grades 4–5), be able to be skilled in four fundamental admixture operations of arithmetic of non-negative integer to develop the smooth sense of figures.’

One section (VI. Appendix) of the Chinese Taipei mathematics curriculum document provides information and suggestions about aspects of teaching and learning of content described earlier by the ‘ability indicators’ and ‘detailed items’. There are separate sub-sections for primary schools and junior high schools. A term used in this section to describe what pupils are specifically expected to learn is ‘curriculum objectives’.

7.2 Content

The ‘detailed items’ in each academic year for Grades 2 to 5 of the Chinese Taipei curriculum have been used for the analysis in the spreadsheet, as Grades 2 to 5 in Chinese Taipei correspond to Years 3 to 6 in England.

The overwhelming majority of the content of the Chinese Taipei mathematics curriculum at Grades 2 to 5 can be found in the England mathematics curriculum at Key Stage 2, and vice versa. However, there are a few examples where content in Chinese Taipei Grades 2 to 5 is mainly addressed in England Key Stage 3, and a few examples where content in England Key Stage 2 is mainly addressed in Chinese Taipei Grades 6 onwards. Tables 1.1 and 1.2 give brief details about these mismatches.

The assumption can be made that for content listed in Table 7.1, the Chinese Taipei curriculum is more demanding relative to England. Likewise, for Table 7.2, the England curriculum is relatively more demanding.

Table 7.1

Content within Chinese Taipei curriculum at Grades 2 to 5 that is mainly addressed in England Key Stage 3
Properties of circles (e.g. sector)
Area of triangle and parallelogram
Volume of cuboid
Conversions between area measures (cm^2 and m^2)
Conversions between volume measures (cm^3 and m^3)

Table 7.2

Content within England curriculum at Key Stage 2 that is mainly addressed in Chinese Taipei from Grade 6 onwards
Negative integers (mainly introduced from Grade 7)
Prime numbers (<20) and prime factors of two-digit integers (mainly introduced from Grade 6)
Co-ordinates in all four quadrants (mainly introduced from Grade 7)

7.3 Personal, Social and Emotional Development

A main rationale of the Chinese Taipei mathematics curriculum is stated as: 'Mathematics is one of the most important aspects of humanity', with the subject seen as 'a foundation for science, technology and the development of thinking', and a 'driving force of the civilisation evolution'. Linked with this are the goals, among several such goals, that the curriculum should reflect the concepts of:

- Mathematical ability being an important indicator of national quality

- Students' positive attitudes towards mathematics should be cultivated as an important element towards advancing human civilisation

Encouraging positive attitudes to mathematics learning is stressed with regard to any guidance provided in the home by parents in guiding their children in studying mathematics. For instance, the Chinese Taipei mathematics curriculum states: *'When the children encounter bottlenecks or have low performance in studying, parents should not be excessively anxious. When they supervise children to study, parents should try to avoid negative emotions, not to force children to learn more unreasonably.'* A positive attitude from parents to their children overcoming difficulties in learning material is regarded as a way of helping the children to develop positive attitudes and so leading to improved performance.

Furthermore, a specific *'curriculum target'* throughout all Grades in both primary and junior high school education is *'To develop the appreciative attitude and ability to mathematics'.*

The 'theme' 'Connections' permeates across all content areas of the Chinese Taipei mathematics curriculum. It is largely through 'Connections' that reference is made to aspects of personal, social and emotional development that would impact on teaching and learning. For instance, two sub-sections of 'Connections' are as follows:

Career planning and lifelong learning	• Master basic knowledge of mathematics required for a lifelong learning • Cultivate habits of trying to use mathematics viewpoint or method to intercept when doing everything
Respecting, caring and teamwork	• Help each other to solve problem • Respect peer's multivariate ideas of solving mathematics problems • Care peer's learning of mathematics

7.4 Difficulty and Coverage

Detailed analysis of the curriculum has revealed that the match with the England curriculum varies by attainment target. A curriculum area as used below is either an element of the National Curriculum or an area of the Chinese Taipei curriculum not covered in England. The comparison can be summarized as:

Number, difficulty	The Chinese Taipei curriculum is regarded as:
more demanding in	30 curriculum areas
of similar demand in	23 curriculum areas
less demanding in	13 curriculum areas

Number, breadth	The Chinese Taipei curriculum is regarded as:
broader in	36 curriculum areas
similar in breadth in	0 curriculum areas
narrower in	30 curriculum areas

The Chinese Taipei curriculum is therefore viewed as more demanding and slightly broader in number.

Shape, space and measures, difficulty The Chinese Taipei curriculum is regarded as:

more demanding in	28 curriculum areas
of similar demand in	17 curriculum areas
less demanding in	6 curriculum areas

Shape, space and measures, breadth The Chinese Taipei curriculum is regarded as:

broader in	26 curriculum areas
similar in breadth in	0 curriculum areas
narrower in	25 curriculum areas

The Chinese Taipei curriculum is seen as more demanding than England's but similar in breadth in Shape, space and measures.

Handling data, difficulty		The Chinese Taipei curriculum is regarded as:
more demanding in	1	curriculum area
of similar demand in	7	curriculum areas
less demanding in	3	curriculum areas

Handling data, breadth		The Chinese Taipei curriculum is regarded as:
broader in	1	curriculum areas
similar in breadth in	0	curriculum areas
narrower in	10	curriculum areas

The Chinese Taipei the curriculum is regarded as slightly less demanding and narrower than in England in Handling data: .

The average rating for confidence in the judgment of difficulty was 2.0, *quite confident*, while that for breadth was 1.9, just below *quite confident*.

At the structural level a further contrast between the two curricula is that in Chinese Taipei there is a separate 'theme' for Algebra, whereas in England Number and Algebra is combined into a single attainment target for Key Stages 3 and 4, while for Key Stages 1 and 2, the attainment target is called Number (and so has no explicit focus on algebra). It may be that by having Algebra as a separate 'theme' gives this area of mathematics greater prominence in the Chinese Taipei curriculum and significantly more teaching focus in comparison with practice in England.

There is a total of 26 distinct 'detailed items' for Grade 2, 26 for Grade 3, 30 for Grade 4, and 33 for Grade 5. For each Grade there are several 'detailed items' in Number and Quantity that would be classified under Shape, space and measures in the England programme of study.

Table 7.3 Number of distinct 'detailed items' for Grades 2 to 5 of the Chinese Taipei mathematics curriculum matched to the Key Stage 2 Programme of Study for England

	Grade in Chinese Taipei Curriculum			
Main section of the Key Stage 2 Programme of Study for England	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
Numbers and the number system	6	5	6	7
Calculations	5	5	5	5
Solving numerical problems	4	3	5	4
Understanding properties of shape	5	3	6	6
Understanding properties of position and movement	0	0	1	0
Understanding measures	6	8	5	8
Processing, representing and interpreting data	0	2	2	3
TOTAL	26	26	30	33

There is only one 'detailed item' that matches to Understanding properties of position and movement. This is an area in the England programme of study that would include material on rotations, reflections and translations, and using coordinates. It may be the case that more work is covered in England primary schools than in Chinese Taipei primary schools on this content area.

It is also apparent that that for each Grade, around half the 'detailed items' correspond to Number sections (Numbers and the number system, Calculations, Solving numerical problems) in the England programme of study. This may indicate that roughly half the school time for mathematics in Chinese Taipei schools during Grades 2 to 5 is spent on number work.

We have compared the 'detailed items' for Grades 2 to 5 with the detailed programme of study for Key Stage 2 for England. A strong impression from this analysis is that in Number, considerably more work in mental methods is carried out in England primary schools during Key Stage 2 than in Chinese Taipei primary schools for equivalent age groups. It should be noted that in Chinese Taipei Grade 1 there is work on developing pupils' mental arithmetic skills, but it may be the case that it is not thought necessary to revisit this in subsequent academic years.

A further impression, formed from this analysis alongside information in the Chinese Taipei mathematics curriculum document, is that in Chinese Taipei primary schools there is some caution about the use of computers and calculators, and this is done only when teachers are confident that pupils have a good grasp of number operations, and the relationships between these operations, through written methods. One possibility is that there is a greater emphasis on written methods in Chinese Taipei primary schools, especially for the younger age groups.

7.5 Order of Teaching and When Taught

The Chinese Taipei mathematics curriculum sets out recommendations as to the order of teaching content throughout the primary and junior high school phases on an academic year basis in *'Appendix II Interpretation of detailed items in every grade'*. In some cases, for particular topics, there are suggestions as to what to teach in each semester of an academic year. Mathematics is seen as being different from other subjects in that it has *'accumulated structure layers'*, which enable the subject to have an order of teaching and learning. The order of teaching particular topics would almost certainly be acceptable and familiar to teachers in England. There is also a small amount of material in Appendix II that teachers are invited to use flexibly, if time permits, to help ease pupils' transition to the curriculum of the junior high school.

It is emphasised in the Chinese Taipei mathematics curriculum document that when introducing new material teachers should link it carefully with pupils' earlier learning experiences so that effective learning takes place. Teachers are advised to consider the difficulties that some pupils may have when mathematics becomes more abstract and when new mathematical terminology is introduced, and to take account of this in their teaching.

7.6 Integration of Subjects

The Chinese Taipei mathematics curriculum states: 'Specifically, the design of curriculum should focus on inherent structural links of mathematics and links of mathematics in everyday life situations (such as science) links.' Elsewhere in this document appears: 'Teachers should avoid empty or meaningless open-ended questions'.

Many of the examples in Appendix II are set in everyday contexts. However, there are few examples where there is an explicit reference made to integration with science or other subject area. An example where there is this explicit reference to science relates to 5-n-08, a 'detailed item' for the Number and Quantity 'theme' at Grade 5. Here, it is suggested that teachers teach pupils to read the fourth digit after the decimal point. The suggestions for teaching continue: *'Teachers may also use the actual example in science and let students know that decimals come in handy in the world of tininess, for example, bacteria is probably 0.0003cm long, and smaller virus is probably 0.00001cm long.'* Another example is 4-d-01, a 'detailed item' for the Statistics and Probability 'theme' at Grade 4. Here, it is stated: *'The interpretation of information should be combined into the teaching of "Society" and "Science and Life Technology" fields.'*

In fact, it is in the Statistics and Probability 'theme' that there is a strong emphasis on developing skills that would be useful across a range of subjects and also beyond school. As expressed in the mathematics curriculum document: *'In the new century of technology, highly developed people need to face various kinds of information. Therefore, how to retrieve meaningful information and read, analyze, transform them into useful assets are important capability in the great era of pursuit of knowledge-bases economy. Therefore, cultivating nationals to have basic statistical quality should be one of the focal points in the field of mathematics learning on the stage of national education.'*

7.7 Differentiation

The Chinese Taipei mathematics curriculum document states: 'The formation of mathematical ability is a very complicated process, and it often varies from person to person. So any single teaching textbook and single teaching method cannot arbitrarily give consideration to each one's study, even each period of development for individual.'

The approach taken throughout the curriculum appears to be is that the teacher should use a range of skills (e.g. observation, questioning, assessment techniques) to become aware of each pupil's ability and learning styles, and so adapt provision accordingly to address the differences within any class.

This is expressed on page 76 of the document:

'Teaching should be student-centred and consider students' mathematics ability development. The speed of learning mathematics often varies from person to person. Teachers should avoid treat the whole class students as the same level, through the assessment of teaching, analyze students' learning problems, diagnose, guide and solve appropriately.'

In 'Appendix II Interpretation of detailed items in every grade', there are some examples of the more common errors and misconceptions that pupils are likely to have with particular content, along with suggestions as to how to address these learning difficulties. A particular concern, raised elsewhere in the document, is regarded as the development of mathematical thinking from the concrete to the more abstract, and the help that some pupils may need with this transition.

The local experts report that about 3% of primary pupils are taught in special schools.

7.8 Pedagogy and Time Allocations

The Chinese Taipei mathematics curriculum document states that there are currently three or four teaching periods each week for mathematics in primary and junior high schools. The local experts indicated that a typical teaching period in primary schools is approximately 40 minutes.

There is clearly a recognition that effective use has to be made of the time available for mathematics in school, along with the use of worthwhile homework activities, in order that pupils achieve the 'curriculum targets'. No time allocations for the use of teaching

time available are set out with regard to the teaching and learning of the four main 'themes' (Number and Quantity, Geometry, Algebra, and Statistics and Probability) or for topics within each 'theme'.

7.9 Guidance / Compulsion of Teaching Methods

There is no rigid framework for the teaching of the mathematics curriculum in Chinese Taipei. This is set out on page 76 of the Chinese Taipei mathematics curriculum document:

> *(4) No specific teaching methods are established for ability indicators of curriculum syllabus. Teachers are expected to use teaching methods appropriate and easily dealt with to teach smoothly, according to students' age, pre-experience, characteristics of teaching subjects and situation of teaching on-site.*
>
> *(5) Teaching activities should be designed to focus on style of learning on different stages of, in accordance with teaching goals.*

Essentially, teachers are directed to the extensive information and advice in *'Appendix II Interpretation of detailed items in every grade'* of the mathematics curriculum document. This sets out ideas as to classroom activities and teaching methods, along with how learning might develop, in relation to each 'detailed item' at each Grade.

8 Mathematics Comparison: Hong Kong

8.1 Structure

This analysis is based on the 2000 Hong Kong mathematics curriculum as this is presented in the Mathematics Curriculum Guide, accessible to download from http://www.edb.gov.hk/index.aspx?langno=1&nodeID=2899. This document starts with three brief introductory sections explaining the aims and objectives and the curriculum structure. These are followed by a 40-page Contents of Curriculum, presenting the material to be covered divided into five 'learning dimensions' as shown below.

Table 8.1 Basic structure of the Hong Kong mathematics curriculum

Dimensions	**Number (N)**	**Shape and Space (S)**	**Measures (M)**	**Data Handling (D)**	**Algebra (A)**
Contents	Whole number Nature of number Fractions, decimals & percentages Calculating devices	Three dimensional shapes Lines Two dimensional shapes Angles Directions	Money Length Time Weight Capacity Perimeter Area Volume Speed	Statistics	Algebraic symbols Equations

As the Hong Kong Mathematics Curriculum Guide explains,

'In designing the learning objectives of various learning dimensions, relevant and inter-related topics are grouped into units. Each unit is further divided into learning objectives which progress from easy and concrete to difficult and abstract according to pupils' cognitive development. Basic concepts in mathematics will first be learnt, and gradually be deepened and enriched. Pupils then learn how to apply the acquired mathematical knowledge to observe, think and solve problems.'
(p 6)

These learning objectives provide a detailed year-by-year and term-by-term structure for the primary mathematics curriculum.

8.2 Aims and rationale for the curriculum

As the Introduction to the *Mathematics Curriculum Guide* explains,

'The revised curriculum not only aims at providing pupils with basic mathematical knowledge and skills, but also emphasizes the process of learning in order to develop pupils' abilities in inquiring, communicating, reasoning, conceptualizing and problem solving. Through the learning of mathematics, pupils' abilities in thinking and interpersonal communication can be enhanced and the skills for lifelong learning can be acquired.
p 1

This being the case,

'The curriculum does not only aim at achieving the goals in learning mathematical knowledge and skills, but also emphasizes on the developing of pupils' positive learning attitudes, such as being serious in doing mathematics, being careful and having an exploring mind. Apart from that, pupils are required to cultivate good learning habits like careful calculating, clear describing, independent thinking and self-checking.'
p 2

However, there is little indication in the detailed *Contents of Curriculum* in the *Mathematics Curriculum Guide* of the way in which the process skills of 'inquiring, communicating, reasoning, conceptualizing and problem solving' are to be developed. In Chapter 5 of the *Mathematics Curriculum Guide*, which offers *Teaching Suggestions*, teachers are urged to

'provide enough time for pupils to inquire, communicate, reason, conceptualize, formulate and solve mathematical problems, appreciate the beauty of mathematics and apply mathematics in different contexts. Pupils should be able to understand thoroughly what they have learnt, master problem solving skills confidently and develop a positive learning attitude.'
p 50

'Problem solving' is mentioned for every year group in the *Contents of Curriculum,* but the focus is on the level of complexity of the problems rather than on the nature of problem solving itself. So, for example, pupils in Hong Kong Year 2 (England Year 3) 'Solve simple problems' involving addition, subtraction or basic multiplication, and then two years later they 'Solve problems involving mixed operations'. On the other hand, there is no clear indication that they should 'find different ways of approaching a problem in order to overcome any difficulties' or 'explain their reasoning' in any area of the mathematics curriculum.

In contrast to this, the way in which routine computations should be taught is specified in detail. So, for example, pupils should 'Perform subtraction within two places, including decomposition' in the first term of Hong Kong Year 2 (England Year 3), then 'Perform subtraction within three places, including decomposition' in the second term. The following year they should 'Perform addition and subtraction within four places', and so

go on in Hong Kong Year 5 (England Year 6) to ‘Perform the addition and subtraction of decimals up to two places of decimals and for sums involving at most three operations’. At no point, however, does the *Contents of Curriculum* indicate that pupils should ‘choose and use an appropriate way to calculate and explain their methods and reasoning’ (Ma2.4b).

Again, the *Teaching Suggestions* offered in Chapter 5 of the *Mathematics Curriculum Guide* include a section on the *Application of Information Technology*, which explains that

‘The methods of teaching and learning have changed with the society and the rapid development of information technology. Teachers' role changes from a transmitter of knowledge to a facilitator of learning. Therefore, they should make appropriate use of information technology such as calculators, computers and ETV to design diversified learning activities that are related to pupils' daily life. It should facilitate the learning of pupils and hence enhance their level of mathematics.’
p 55

However, here again the general advice is not reflected in the more detailed *Contents of Curriculum*, where although pupils are required to 'Be familiar with modern calculating devices' (4N3.1), there are no further references to the use of ICT.

8.3 Content

The detailed Hong Kong primary mathematics syllabus, which is presented in the section on *Suggested Learning Objectives* in the *Contents of Curriculum* on pages 20 to 45 of the *Mathematics Curriculum Guide*, describes the content to be covered term by term each year from Hong Kong Year 1 (England Year 2) to Hong Kong Year 6 (England Year 7). The mapping of the Hong Kong to the English curriculum relates to the material covered during Hong Kong Years 2 to 5 (England Key Stage 2, Years 3 to 6).

The stronger emphasis in the English curriculum on mathematical processes, the use and application of mathematics, and the use of ICT, and in the Hong Kong curriculum on procedural skills, has been mentioned above. In addition to these there are some specific differences in the coverage of particular content areas.

In the detailed Learning Objectives in the Hong Kong Mathematics Curriculum Guide:

- Negative numbers are not mentioned.
- Pupils are not required to 'develop an understanding of percentages' until Year 6 (England Year 7).
- Position and movement is not specifically referred to, and there is no reference to coordinates.
- The concept of a degree, its relationship to a whole turn, and the measurement or estimation of angles is not mentioned.

- There is no reference to the visualisation of 3-D shapes from 2-D drawings, or to the visualisation of transformations.
- The use of mathematical symbols and notation is mentioned in relation to Number and Algebra, but not to Shape and space.
- The use of 'precise mathematical language and vocabulary for handling data' is not mentioned.
- There is little mention of problem solving in the context of Data handling.
- Data representations and their interpretation is limited to pictograms, block graphs and bar charts. In England pupils are introduced to pictograms (and other 'simple lists, tables and charts') in Key Stage 1, and a wider range of representations are used at Key Stage 2.
- Probability is not covered, and issues relating to the misuse of information are not mentioned.

In the Key Stage 2 mathematics national curriculum in England,

- Calculations with fractions are not mentioned.
- The solution of equations does not appear.
- The properties of cones, pyramids and spheres are not specifically mentioned.
- The number of days in each month and the number of days in a year are not specifically mentioned.
- Area and perimeter is limited to rectilinear shapes, and volume is not covered.

Furthermore, the approach taken to aspects of data handling in the two curricula are different. In England, pupils start with a problem and identify the data needed to solve it. In Hong Kong, the pupils 'formulate and solve problems' relating to data that has already been collected.

The two curricula cover different concepts relating to 'average'. The Hong Kong primary curriculum covers the estimation of the mean from block graphs and bar charts, but it does not cover the mode and the median.

8.4 Difficulty, Depth and Breadth

The relatively high emphasis that is placed on computational skills in the Hong Kong primary mathematics syllabus, and the lower significance placed upon the development of pupils' ability to reason and to communicate about mathematics, provides an interesting platform when considering relative difficulty. As indicated above, some types of calculation, including those relating to the areas of non-rectilinear shapes and to volume, are covered in more detail in Hong Kong and calculation in general is more demanding in the Hong Kong curriculum. Handling data, in particular, seems to be covered in significantly less depth in the Hong Kong primary curriculum, with little emphasis on problem solving or the application of data-handling concepts in a wide range of contexts.

By attainment target the comparison between the England and Hong Kong curricula can be summarised as:

Number, difficulty The Hong Kong curriculum is regarded as:

more demanding in	33	curriculum areas
of similar demand in	22	curriculum areas
less demanding in	14	curriculum areas

Number, breadth The Hong Kong curriculum is regarded as:

broader in	33	curriculum areas
similar in breadth in	20	curriculum areas
narrower in	16	curriculum areas

Number: The Hong Kong curriculum is regarded as broader and more demanding.

Shape, space and measures, difficulty The Hong Kong curriculum is regarded as:

more demanding in	15	curriculum areas
of similar demand in	8	curriculum areas
less demanding in	11	curriculum areas

Shape, space and measures, breadth The Hong Kong curriculum is regarded as:

broader in	16	curriculum areas
similar in breadth in	7	curriculum areas
narrower in	11	curriculum areas

Shape, space and measures: The Hong Kong curriculum is estimated to be broader and more demanding.

Handling data, difficulty The Hong Kong curriculum is regarded as:

more demanding in	0	curriculum areas
of similar demand in	5	curriculum areas
less demanding in	15	curriculum areas

Handling data, breadth	The Hong Kong curriculum is regarded as:	
broader in	1	curriculum areas
similar in breadth in	5	curriculum areas
narrower in	14	curriculum areas

Handling data: In contrast, the Hong Kong curriculum is viewed as narrower and less demanding.

The average rating for confidence in the judgment of difficulty was 2.1, just above *quite confident*, while that for breadth was 2.1, just above *quite confident*.

8.5 Order of Teaching and when Taught

As the Introduction to the Hong Kong Mathematics Curriculum Guide explains,

A spiral approach is adopted in the curriculum. It enables pupils to construct new knowledge on the basis of acquired knowledge and experiences. Pupils are guided to link relevant knowledge which can help them understand new concepts and skills. This hence lay a foundation for pupils to study mathematics in secondary schools. p3

So, for example, pupils 'Perform multiplication with multiplier 1 digit and multiplicand 2 or 3 digits' in Hong Kong Year 3 (England Year 4), then in Hong Kong Year 4 (England Year 5) they go on to 'Perform multiplication with multiplier 2 digits and multiplicand 2 or 3 digits', and in Hong Kong Year 5 (England Year 6) they 'Multiply decimals by whole numbers' and 'Multiply decimals by decimals'. This may be compared to the similarly 'spiral' approach in England, where, for example, pupils 'Develop and use written methods to record, support and explain multiplication and division of two-digit numbers by a one-digit number' in Year 4, and then in Year 6 'Use efficient written methods to ...multiply and divide integers and decimals by a one-digit integer, and to multiply two-digit and three-digit integers by a two-digit integer'.

8.6 Integration of Subjects

The Introduction to the Hong Kong Mathematics Curriculum Guide explains that

'The curriculum emphasizes on the linkage of topics in the mathematics curriculum and pupils' experiences through activities and real life examples. It aims at enabling pupils to apply mathematical knowledge in daily life and enhancing their interest in studying mathematics.'
pp 2-3

However, there is no indication in the detailed Contents of Curriculum, or in the Teaching Suggestions in Chapter 5 of the Mathematics Curriculum Guide, of how this should be done.

8.7 Comparison with a newer version of the curriculum

As the *Mathematics Curriculum Guide* explains, the 2000 Hong Kong mathematics curriculum was 'Based on the *Primary Mathematics Syllabus* (1983) and the *TOC Programme of Study for Mathematics* (1995)', so the current analysis is based on the most recent version of the curriculum.

8.8 Differentiation

The Introduction to the Hong Kong Mathematics Curriculum Guide explains that

'In response to the goals of basic education, differences in pupils' abilities and disposition had been taken into consideration, hoping that it can help more pupils make achievements in mathematical study. In view of this, the new curriculum allows teachers rooms for flexible treatment of the curriculum.' p3

This being the case, teachers are advised in the chapter on *Teaching Suggestions* in the *Mathematics Curriculum Guide*,

'To cater for the needs of pupils with different abilities, teachers can grade teaching materials according to their abilities. Challenging activities can be designed for the more able pupils to explore and discover mathematical rules, so as to broaden their exposure, strengthen their thinking abilities and enhance their interest in learning mathematics. For the academically less able pupils, teaching materials, which are relatively easier and appropriate in quantity, can be designed to facilitate their understanding of the required basic knowledge and arouse their interest in learning.'p51

Thus teachers are given the flexibility to differentiate the curriculum according to their pupils' needs. However, the overall structure provided in the term-by-term *Units* and *Learning Objectives* given in Chapter 4, *Contents of Curriculum,* is common to all pupils.

At the higher end of the ability range teachers are encouraged to offer 'enrichment topics' to higher-achieving pupils. As the *Introduction* to the *Mathematics Curriculum Guide* explains,

'To broaden pupils' view and arouse their interest, enrichment topics are suggested in the curriculum. Teachers can select some of these topics on the basis of the abilities and interest of pupils and the time available. Teachers can also select their own enrichment topics or some existing units for further discussion. Since enrichment topics are optional, they are not suggested in tests or examinations.'P6 (1)

A range of such topics are suggested at the end of the *Contents of Curriculum* in the *Mathematics Curriculum Guide*. So, for example, in Hong Kong Year 2 (England Year 3) it is suggested that pupils work on 'Stories of ancient time-recording and timing devices', while in Hong Kong Year 5 (England Year 6) they may be introduced to 'Angles (degree)' and to 'Rotational symmetry'.

The local expert reports that 7800 pupils attend special schools.

8.9 Mandatory or Recommended Time for Subjects and Content Areas

8.9.1 Time Allocation

Chapter 3 of the Mathematics Curriculum Guide provides a short section on Time Allocation, which explains that

'The proposed number of teaching periods… is 160 in a school year. To facilitate the arrangement of teaching schedules, the curriculum provides a suggested time allocation for teaching. Since various units differ in length and level of difficulty, the suggested periods for every unit will be different as well. Teachers can adjust the number of periods for various units according to the needs of the school and pupils.' (p7)

This is followed by a table indicating the number and the percentage of the periods to be allocated in each Key Stage (Hong Kong Years 1 to 3 and Hong Kong Years 4 to 6, English Years 2 to 4 and England Years 5 to 7) to each of the five 'learning dimensions' which underlie the structure of the Contents of Curriculum.

Table 8.2 Time allocations in the Hong Kong mathematics curriculum

Dimensions Key Stages	Number	Shape & Space	Measures	Data Handling	Algebra	Spare Periods	Total number of suggested periods
1	221 (46 %)	74 (15 %)	97 (20 %)	12 (3 %)	0 (0 %)	76 (16 %)	480 (100 %)
2	196 (41 %)	63 (13 %)	78 (16 %)	46 (10 %)	33 (7 %)	64 (13 %)	480 (100 %)
Total	417 (44 %)	137 v (14 %)	175 (18 %)	58 (6 %)	33 (3 %)	140 (15 %)	960 (100 %)

There is thus some flexibility in the teachers' use of the available periods, with 20 or 30 periods being left 'spare' for each year group.

8.9.2 Guidance or Compulsion of Teaching Methods

Chapter 5 of the Mathematics Curriculum Guide, Teaching Suggestions provides advice and guidance on both teaching strategies and organisation, with further advice on the use of ICT and other resources. So, for example, it is suggested that

'To help pupils work towards the learning targets, teachers are encouraged to adopt different teaching methods so that pupils are provided with adequate opportunities for learning both mathematical contents and the ways of learning and applying knowledge. The following methods can be adopted:

- Exposition by teachers
- Discussion between teachers and pupils, and among pupils themselves
- Practical activities
- Consolidation and practice of fundamental skills
- Problem solving activities
- Exploring activities

‘As a foundation for further study, more opportunities should be provided for pupils to observe, analyze, understand and judge events/information, and to develop their elementary thinking abilities. Teachers should also provide opportunities for pupils to use mathematical language, such as explaining results and briefly describing the methods used in solving or investigating problems in oral or written form or with the help of diagrams.’
p 49

However, this advice is not well-supported by the Learning Objectives presented in the Contents of Curriculum, which make little mention of the processes of observation, analysis, understanding and judgement, and do not require pupils to describe their methods or to explain their results.

Reference

Francis K W Tsang and Tim Rowland, 2005, *The Subject Matter Knowledge of Hong Kong Primary School Mathematics Teachers* Paper presented at the European Conference on Educational Research, University College Dublin, 7-10 September 2005. Available at http://www.leeds.ac.uk/educol/documents/149990.htm

9 Mathematics Comparison: Latvia

9.1 Structure

Table 9.1 shows the age and English year group equivalents to the Latvian Grades 1-6.

Table 9.1: Age and English year group equivalents to the Latvian Grades 1-6

Latvia Grade	Age (years)	English year group equivalent
Grade 1	6/7 → 7/8	Year 2/3
Grade 2	7/8 → 8/9	Year 3/4
Grade 3	8/9 → 9/10	Year 4/5
Grade 4	9/10 → 10/11	Year 5/6
Grade 5	10/11 → 11/12	Year 6/7
Grade 6	11/12 → 12/13	Year 7/8

This analysis is based on a translation of the *Latvia Academic Discipline Standard*.

The *Latvia Academic Discipline Standard* does not use content categories such as Number, Shape or Handling data. Instead, it has three broad clusters[2] that can contain elements from all content areas of mathematics. The three clusters are:

- Formation of mathematical set of instruments
- Use of mathematics in analysis of natural and social processes
- Formation of mathematical models and study with methods characteristic for mathematics.

The contents of number and shape fall mainly within the first cluster, whereas the content of Handling data appears in cluster two. The third cluster covers a range of topics and has elements in common with the communication strand of the England mathematics curriculum.

The *Latvia Academic Discipline Standard* is split into three year cycles, in much the same way as the curriculum in England is structured around Key Stages. Pupils in Latvia start school in the Year they turn 7. Therefore, Year 3 pupils in Latvia match in age Year 5 pupils in England, and Year 6 pupils match Year 8 pupils in England.

[2] 'Cluster' is a word used in this report. The Latvia standards do not specify what term is used in Latvia.

At the end of Year 3, the Latvian mathematics statements related to number are further divided into the following categories:

- Natural numbers within the boundaries of the first hundred
- Natural numbers within the boundaries of the first thousand
- Regular fractions
- Decimal fractions.

At the end of Year 6, the Latvian mathematics statements related to number are further divided into the following categories:

- Natural numbers
- Regular fractions
- Definite decimal fractions
- Rational numbers.

The *Latvia Academic Discipline Standard* for mathematics was translated into English for the purposes of this analysis. The translation sometimes made it difficult to establish the exact meaning of each statement in the document, and some assumptions had to be made. For example, for

"Formation of mathematical set of instruments: using the regular fractions, can perform the following computations: calculate correlation of two numbers" (Latvia standards 10.2.7)

The word *'correlation'* was taken to mean *'comparison'* or *'finding the difference'*. This approach worked well whenever the Latvia standards mentioned the word correlation.

An end of Year 6 statement was more difficult to interpret. This stated that:

"Formation of mathematical set of instruments: using rational numbers, can perform the following computations: find a module of a number (algebraic and geometrical perception)" (Latvia standards 10.4.4).

As the meaning of this statement, and in particular of the term 'module', was not clear, it was not matched to any Program of Study references in the England Key Stage 2 mathematics curriculum.

9.2 Aims and rationale for the curriculum

The aims of the Latvia standards for mathematics are in line with those promoted in the Using and Applying strand of the England mathematics curriculum.

“The objective of the subject “Mathematics” is to form understanding in pupils about the mathematical methods and develop their skills of using them in learning about the world, in other academic subjects, and multiform activities.” Latvia Academic Discipline Standard - Mathematics

Furthermore, pupils are expected to master number and shape skills, use comparison and analytical methods, and develop dimensional perception. Pupils are also expected to master problem solving and information finding skills, forecast results and use mathematical models. The standards stress the importance of pupils making mathematically grounded decisions in order to develop their thinking skills.

The Latvia standards put stress on the application of mathematics in real-life contexts, such as health, social and natural processes, daily life, environment and natural sciences. The general way in which the statements are worded may enable planning a varied teaching program. On the other hand, the open-endedness may discourage teachers by not offering a structure on how to achieve the aims. It also seems that the mathematical content somewhat lacks the variety of the Ma1 elements evident in the curriculum in England. For example, exploration of number patterns and properties of shapes is largely missing from the Latvia standards.

9.3 Content

Using and applying

Ma1 type references exist also in the Latvia standards, although there is less emphasis on pupils finding their own ways of recording and organising work than in the England curriculum. In the communication strand, England focuses on pupils being able to make their own views known, whereas the Latvia standards includes additional references to listening to others’ views, working in groups and group presentations.

Learning facts

Latvia standards do not mention the teaching of ‘facts’ - such as addition, subtraction, multiplication, division or angle facts. However, these may well be included in the coverage of the related statements even if not explicitly stated.

Number

The Latvia standards cover more content in number computations, such as work with exponents, calculating with fractions, opening brackets with a minus sign in front, and finding reciprocal numbers. On the other hand, the Latvia standards do not stress number patterns and sequences as much as the England curriculum does. The England

curriculum also has more detailed statements about ratio and proportion than the Latvia standards.

Negative numbers are probably covered in Latvian Years 4 to 6 (England Years 6 to 8). The Latvia standards do not explicitly mention negative numbers either in the primary or the secondary years. However, work on rational numbers is mentioned in the basic requirements for end of Latvian Year 6 (England Year 8), temperature is visited by the end of Latvian Year 3 (England Year 5), while opposite numbers (additive inverse) and a minus sign in front of brackets are mentioned by the end of Latvian Year 6 (England Year 8).

Shape, space and measures

The England curriculum has considerably wider coverage of transformations, symmetry, 3-D shapes and visualisation than the Latvia standards. Also, the Latvia standards do not explicitly require pupils to identify identical shapes, whilst the England curriculum does state this. There are very few references in the Latvia standards to the use of visual or spatial strategies, with visual estimation of the size of an object being a rare exception.

In general, the Latvia standards approach shape topics through the context of measurement. This is often taken to a more advanced level than shown in the England curriculum. For example, primary school pupils in Latvia are expected to know what to measure and what computations to carry out in order to find the circumference of a circle. This is a level 6 skill in the England curriculum and appears at Year 9 in the 2001 National Strategy. Also, finding perimeters of triangles, volumes of cubes and working with speed are all topics that school children in Latvia are expected to master by the end of Latvia Year 6 (England Year 8). In England, volumes of cuboids is considered level 6 work (NS Year 8) and compound measures, such as speed, is pitched at level 7 (NS Year 9).

In England, the concept of angle as a measure of turn is introduced via quarter turns, half turns and full turns. This leads to related vocabulary of obtuse and acute angles. In the Latvia standards, the coverage is narrower and angles are mentioned only briefly in the context of making accurate measurements.

The Latvia standards have a stronger focus on such abstract concepts as line segments, whereas the England curriculum tends to explore polygons and other shapes to cover shape topics. This could indicate that the approach to teaching shape concepts is more abstract in Latvia than in England.

Handling data

The data handling references in Latvia standards are similar in coverage to those in the England curriculum, but overall somewhat narrower. The Latvia standards include mean, whereas they do not explicitly mention mode or range. Probability is covered in the secondary years in the Latvia standards, whereas in the England curriculum the idea of likelihood is introduced in the primary years.

9.4 Difficulty, Depth and Breadth

The statements in the Latvia standards are worded in more general terms than those in the England curriculum. This makes it challenging to judge whether one is more difficult than the other, and how broad the scope of each statement is.

Some of the number and measurement work seems to be more difficult in Latvia than in England, whereas the opposite is the case for some of the shape and space work.

In summary, the relationship between the two curricula are viewed as:

Number, difficulty	The Latvia curriculum is regarded as:
more demanding in	10 curriculum areas
of similar demand in	30 curriculum areas
less demanding in	0 curriculum areas

Number, breadth	The Latvia curriculum is regarded as:
broader in	10 curriculum areas
similar in breadth in	29 curriculum areas
narrower in	1 curriculum areas

Number: The Latvia curriculum is regarded as broader and more demanding.

Shape, space and measures, difficulty	The Latvia curriculum is regarded as:
more demanding in	5 curriculum areas
of similar demand in	7 curriculum areas
less demanding in	9 curriculum areas

Shape, space and measures, breadth	The Latvia curriculum is regarded as:
broader in	5 curriculum areas
similar in breadth in	7 curriculum areas
narrower in	10 curriculum areas

Shape, space and measures: The Latvia curriculum is estimated to be narrower and less demanding.

Handling data, difficulty	The Latvia curriculum is regarded as:
more demanding in	0 curriculum areas
of similar demand in	15 curriculum areas
less demanding in	3 curriculum areas

Handling data, breadth	The Latvia curriculum is regarded as:
broader in	0 curriculum areas
similar in breadth in	15 curriculum areas
narrower in	3 curriculum areas

Handling data: Again the Latvia curriculum is estimated to be narrower and less demanding.

The average rating for confidence in the judgment of difficulty was 1.3, just above *not confident*, while that for breadth was 1.3, just above *not confident*. These ratings are low because of the general nature of the Latvia curriculum.

9.5 Order of Teaching and when Taught

The Latvia standards follow a spiral structure. For example, by the end of Latvia Year 3 (England Year 5) pupils are expected to read and write natural numbers up to one thousand. By the end of Latvia Year 6 (England Year 8), they are expected to read and write natural numbers up to one billion. Similarly, by the end of Latvia Year 3 (England Year 5) pupils are expected to use the four number operations with numbers up to one hundred. By the end of Latvia Year 6 (England Year 8), they should have expanded these skills with larger natural numbers, as well as demonstrating the ability to raise a number to the power of two or three and work with algebraic expressions.

9.6 Integration of Subjects

About one sixth of the statements in the Latvia standards make explicit mention of real-life situations. In addition, the general text at the beginning of the standards mentions links to other school subjects. However, the document does not give specific examples of how the content should be linked to cross-curricular work. The only specific reference made is the use of ICT, but even there, the phrasing is less detailed than in a similar reference found in the England curriculum.

9.7 Differentiation

In Latvia apart from the provision of a range of programmes for pupils with special needs, it is regarded as for the teacher to deal with the range of abilities within a class.

9.8 Mandatory or recommended time for Subjects and Content Areas

The local expert gives the time allocations for mathematics as:.

Basic of technologies and science	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade	7th grade	8th grade	9th grade
Mathematics	4	4	4	5	5	5	6	5	5
Student' s work load (Total)	21	21	24	25	27	30	31	33	33

9.9 Guidance or Compulsion of Teaching Methods

Although explicit guidance on teaching methods is not given, some standards references are highlighted as being particularly relevant to pupil attitudes. No other issues are highlighted in this way, which may indicate that this is intended as guidance to teachers to pay particular attention to pupil attitudes when planning their teaching. The key pointers include pupils taking part in group work, presentations, using mathematical notation carefully and correctly, understanding the importance of mathematics in real-life problems, and improving their mathematical understanding.

10 Mathematics Comparison: The Netherlands

10.1 Structure

This analysis of the Netherlands primary mathematics curriculum is based upon the relevant sections of the English language version of the a translation of the *Herzeine Kerndoelen Basisonderwijs* ('Revised Main Goals - Primary Education'), which may be downloaded from http://www.slo.nl/themas/00022/ This document covers all subjects that form part of the education of pupils aged four to twelve years in Netherlands primary schools.

In comparison to the English Key Stage 2 mathematics curriculum, the Netherlands primary mathematics curriculum is very brief. It starts with a general paragraph on 'characteristics', which states:

> 'In the course of primary education, the children will gradually acquire - in the context of situations that are meaningful to them - familiarity with numbers, measurements, forms, structures, and the relationships and calculations that apply to these. They will learn to use 'mathematical language' and gain 'mathematical literacy' and skills in calculus.'

This introduction is followed by eleven 'Core Objectives', divided into three sections: *Mathematical insight and operation*; *Numbers and calculations*, and *Measuring and geometry*. The Core Objectives in the first section are clearly related to process - so for example, Objective 25 states that 'The pupils learn to motivate [ie find] approaches for solving arithmetical/mathematical problems and learn to assess solutions'. Most of the Core Objectives in the other two sections are more content-related, but they are very general and each covers a wide area of the curriculum - so Objective 30, for example, states that 'The pupils learn to add, subtract, multiply and divide on paper, according to more or less contracted standard procedures', while Objective 33 states that 'The pupils learn to measure and calculate using units and measurements, such as time, money, length, circumference, surface area, volume, weight, speed, and temperature'. The whole Netherlands primary mathematics curriculum is presented in under 500 words in the Dutch language version, so there is too little detail for any indication of the year in which different aspects of each topic should be taught.

There is a clear expectation that the Netherlands primary curriculum should form a coherent whole, with mathematics being taught in the context of other subject areas. As the Preamble to the whole document 'Revised Main Goals - Primary Education' explains, across all subjects

> 'Content and objectives should be closely linked, be connected to everyday life, and presented in coherence with each other. In concrete education, objectives from different chapters are applicable simultaneously. For example, language is important in all subjects; culture does not only apply to the artistic domain; and information technology applies to all areas. '

So, for example, Core Objective 4 of the subject area 'Written education' states that

> 'The pupils learn to retrieve information from informative and instructive texts, including diagrams, tables and digital sources'.

Thus some aspects of mathematical communication are classified with textual understanding, which in England would come under the National Curriculum for English. As the section on mathematical Characteristics explains,

> 'The subjects according to which children develop their 'mathematical literacy' have different origins: everyday life, other development areas, and mathematics itself. When selecting and offering the subjects, the children's levels of knowledge and ability are kept in mind, as well as their other areas of development, their interests, and topicalities, so that children will feel challenged to carry out mathematical activity and be able to do maths at their own level, with satisfaction and pleasure, both independently and as a part of a group.'

10.2 Aims and rationale for the curriculum

The Preamble to the 'Revised Main Goals - Primary Education' starts by explaining that

> 'Primary education aims to broadly educate children. The education addresses their emotional and intellectual development, the development of their creativity, and their acquisition of social, cultural and physical skills.'

To this end,

> 'Attention should be given to objectives that are important for all learning areas: a good working attitude, use of learning strategies, reflection on one's own actions and learning, expression of one's own thoughts and feelings, respectful listening to and criticising of others' opinions, acquisition and processing of information, development of self-confidence, respectful and responsible dealing with each other, and care and appreciation for the living environment.'

Thus the focus is as much on the pupils' social and emotional development as on their academic achievement, and this is clearly reflected in the Characteristics and the Core Objectives for each curriculum area.

10.3 Content

As explained above, in section 1.1, the eleven Core Objectives of the Netherlands primary mathematics curriculum provide some indication of the mathematical topics to be covered during the eight years of primary education. These have been used as the basis for the mapping of the Netherlands to the English curriculum, but they do not go into any great detail. However, some specific differences in coverage or emphasis between the English and the Netherlands curricula may be noted.

Geometry

There is a strong emphasis on three-dimensional geometry in the Netherlands primary mathematics curriculum. So, as the Characteristics explain,

> 'Geometry concerns three-dimensional orientation, the description of phenomena in reality, and the ability to reason on the basis of images in two and three dimensions.'

Again, area and volume are both mentioned in Core Objective 33 - but area only in the context of 'surface area':

> 'The pupils learn to measure and calculate using units and measurements, such as …. surface area, volume…'

This contrasts with the English National Curriculum for Key Stage 2, in which there is no reference to either 'volume' or 'surface area', and the focus is on two-dimensional shapes.

Fractions and negative numbers

Both fractions and negative numbers appear in the Netherlands only in the secondary curriculum for mathematics, in Core Objective 22,

> 'The pupil learns to understand the structure and coherence of positive and negative numbers, decimal numbers, fractions, percentages and proportions, and learns to use these in meaningful and practical situations.'

Handling data

Handling data is an area in which a particularly heavy emphasis on Ma1, *Using and applying mathematics*, is found in the English national curriculum, since data generally have to be about something and this provides a context for its representation or analysis. In the Netherlands, however, there is no mention of data handling, statistics or probability in the primary mathematics curriculum. There is a brief reference to 'tables and graphs' as an aspect of 'mathematical language' in the Characteristics, and, as indicated above, 'tables' are mentioned in Core Objective 4 of Written Education as one source from which pupils should be able to retrieve information. Again, 'the measuring and processing of information in tables, timelines, graphs, etc.' form part of the Characteristics which introduce the Netherlands primary curriculum for Personal and World Orientation. However, the first clear reference to data appears in Core Objective 27 of the secondary mathematics curriculum, which states:

> 'The pupil learns to systematically describe, structure and visualise data, and learns to critically assess data, representations and conclusions'

Personal, social and emotional development

A strong emphasis is placed in the Characteristics which introduce the Netherlands primary mathematics curriculum on mathematics as a socially-negotiated construct. So, for example,

> '[Children] learn to give and receive mathematical criticism with respect for another person's point of view.'

One significant aspect of this is the children's ability to explain and justify their reasoning:

> 'During the arithmetic or maths lesson, the children learn to solve a problem in a mathematical way and explain to others the solution in mathematical language.'

This is echoed in the Core Objectives that cover *Mathematical insight and operation*, where in Objective 24, for example, 'The pupils learn to… clearly represent argumentation'. In this way, the mathematics curriculum supports the intention given in the Preamble to the 'Revised Main Goals - Primary Education', that

> 'Attention should be given to objectives that are important for all learning areas:… reflection on one's own actions and learning, expression of one's own thoughts and feelings, respectful listening to and criticising of others' opinions… respectful and responsible dealing with each other'.

Any difference here between the Netherlands primary and the English Key Stage 2 curriculum is one of emphasis rather than absolute. Many of the same points are addressed in AT1, Using and Applying mathematics, under Problem solving, Communicating and Reasoning. However, a greater proportion of the (very brief) Netherlands primary curriculum is devoted to these issues.

10.4 Difficulty, Depth and Breadth

The lack of detail in the Netherlands primary mathematics curriculum makes it difficult to judge the relative depth, breadth or difficulty level of the Netherlands and the English Key Stage 2 curricula. It has not been possible to judge relative difficulty and breadth with any great degree of confidence, but our best estimate is:

Number, difficulty	The Netherlands curriculum is regarded as:
more demanding in	0 curriculum areas
of similar demand in	32 curriculum areas
less demanding in	8 curriculum areas

Number, breadth	The Netherlands curriculum is regarded as:
broader in	0 curriculum areas
similar in breadth in	32 curriculum areas
narrower in	8 curriculum areas

Number: The Netherlands curriculum seems to be narrower and less demanding.

Shape, space and measures, difficulty The Netherlands curriculum is regarded as:

more demanding in	0	curriculum areas
of similar demand in	14	curriculum areas
less demanding in	2	curriculum areas

Shape, space and measures, breadth The Netherlands curriculum is regarded as:

broader in	1	curriculum areas
similar in breadth in	13	curriculum areas
narrower in	2	curriculum areas

Shape, space and measures: The Netherlands curriculum seems to be similar in both difficulty and breadth.

Handling data, difficulty The Netherlands curriculum is regarded as:

more demanding in	0	curriculum areas
of similar demand in	0	curriculum areas
less demanding in	14	curriculum areas

Handling data, breadth The Netherlands curriculum is regarded as:

broader in	0	curriculum areas
similar in breadth in	0	curriculum areas
narrower in	14	curriculum areas

Handling data: The Netherlands curriculum seems to be narrower and less demanding.

The average rating for confidence in the judgment of difficulty was 1.1, just above *not confident*, while that for breadth was 1.1, just above *not confident*. These ratings are low because of the general nature of the Netherlands curriculum.

10.5 Order of Teaching and when Taught

As observed above, in section 1.1, there is not enough detail in the Netherlands primary mathematics curriculum to make any comparison of the order or timing of teaching of individual topics possible.

10.6 Integration of Subjects

The coherent nature of the Netherlands primary curriculum as a whole has been remarked upon above, in sections 1.1 and 1.3. Some aspects of mathematics - such as the use and interpretation of tables and graphs - are introduced in the context of such curriculum areas as Personal and World Orientation. ‘Mathematical literacy’ is to be fostered throughout the curriculum.

10.7 Differentiation

The Characteristics and Core Objectives of the Netherlands primary mathematics curriculum are generally too broad to carry an indication of any differences to be made for pupils of different ability. However, Core Objective 27, which relates to mental calculation, states that

> 'The pupils learn to quickly carry out the basic calculations in their heads using whole numbers, at least to 100, whereby adding and subtracting up to 20 and the multiplication tables are known by heart.'

This might be taken to imply that some pupils, but not all, will calculate with whole numbers greater than 100 - and thus that some differentiation will be practised.

10.8 Mandatory or recommended time for Subjects and Content Areas

There are no obvious references to 'time for subjects or content areas' in the Netherlands primary mathematics curriculum.

10.9 Guidance or Compulsion of Teaching Methods

The introductory preamble to the 'Revised Main Goals - Primary Education' makes it clear that throughout the curriculum,

> 'The objectives describe the desired results of a learning process, not the way in which these are to be achieved. The core objectives do not prescribe any didactics. Considering the nature of primary education, teachers should address and stimulate the children's natural curiosity and their need for development and communication. By offering a structured and interactive educational programme, different forms of exploratory education, and interesting themes and activities, children are stimulated in their development.'

The focus on mathematical processes, including problem solving, reasoning and communication, might be held to imply a didactic approach which would encourage pupils to discuss ideas and explain their thinking. However, this is not overtly specified.

References

HERZIENE KERNDOELEN BASISONDERWIJS ('Revised Main Goals - Primary Education'), downloadable in English translation from www.slo.nl/themas/00022/Kerndoelen.doc/

11 Mathematics Comparison: Ontario

11.1 Structure, Aims and Rationale

This analysis is based on the *Ontario Curriculum Grades 1-8: Mathematics, 1997*, from the Ontario Ministry of Education and Training.

The *Introduction* to the *Ontario Curriculum* briefly explains its purpose and structure, and also discusses the roles of teachers, students and, unusually, parents, who 'have an important role to play in supporting their child's learning'. There is a strong emphasis on problem solving and on the development of students' metacognitive awareness of their own thinking processes, both in the rubric and in the detail of the curriculum. Four levels are specified for each of four overarching categories of process-based 'Knowledge and Skills': *Problem solving*, *Understanding of concepts*, *Application of mathematical procedures* and *Communication of required knowledge related to concepts*, *procedures, and problem solving*. This is followed by the detailed content which is divided into five 'strands': *Number Sense and Numeration*, *Measurement*, *Geometry and Spatial Sense*, *Patterning and Algebra* and *Data Management and Probability*. Up to ten 'Overall Expectations' and up to twenty-five or so 'Specific Expectations' are specified for each strand in each grade.

The first Ontario strand, *Number Sense and Numeration*, covers much the same subject matter as the England Key Stage 2 attainment target Ma2, *Number*, while the second and third, *Measurement*, and *Geometry and Spatial Sense*, relate broadly to the Key Stage 2 attainment target Ma3, *Shape, space and measures*. The *Data Management and Probability* strand, however, goes well beyond Key Stage 2 attainment target Ma4, *Handling data*, while the *Patterning and Algebra* strand is highly processed-based, crossing the boundaries of the all of the different attainment targets in the Key Stage 2 curriculum. It has a strong element of Ma1, *Using and applying mathematics*, and it focuses strongly on making connections between different mathematical concepts and between mathematics and daily life.

There is a strong emphasis on the use of concrete materials and drawings at all levels of the Ontario mathematics curriculum, not just in the lower grades. For example, students in Ontario Grade 5 (England Year 6) 'represent, and explore relationships between, decimals, mixed numbers, and fractions using concrete materials and drawings', and 'construct nets of cubes and pyramids using a variety of materials'. Similarly, students are expected to discuss mathematics and explain their reasoning throughout their mathematical education - so for example in Ontario Grade 2 (England Year 3) they 'explain a variety of strategies to find sums and differences of 2 two-digit numbers', while in Ontario Grade 5 (England Year 6) they 'solve problems involving decimals and fractions, and describe and explain the variety of strategies used'.

11.2 Content

The detailed Ontario primary mathematics syllabus, which is presented on pages 20 to 71 of the *Ontario Curriculum Grades 1-8: Mathematics, 1997*, describes the content to be covered each year from Ontario Grade 1 (England Year 2) to Ontario Grade 8 (England Year 9). The mapping of the Ontario to the English curriculum relates to the material covered during Ontario Grades 2 to 5 (England Key Stage 2, Years 3 to 6).

The strong emphasis on process and problem solving in the Ontario primary mathematics curriculum has been mentioned above. In particular, the Ontario curriculum requires students to pose problems as well as solving them, and to explain and justify their reasoning, at all levels and in all content areas. In addition to this there are some specific differences in the coverage of particular content areas.

Number

- The term ‘negative number’ is not mentioned in the Ontario primary mathematics curriculum. However, in Ontario Grade 3 (England Year 4) students ‘estimate, read, and record temperature to the nearest degree Celsius’, and this is likely to involve temperatures below 0.
- There is no specific mention of the symbols <, > and = in the Ontario primary mathematics curriculum, while the KS2 National Curriculum does not refer specifically to ordinal numbers which are covered in Ontario.
- The emphasis in Ontario is on the ability to explain equivalent fractions, but students are not required to 'simplify fractions by cancelling common factors' as they are in England.
- Students in Ontario are expected to understand the relationship between the decimal and fraction forms of numbers, but they are not introduced to the concept of percentages.
- Problems involving ratio and direct proportion appear to be limited to speed and distance in Ontario.
- The Ontario primary mathematics curriculum emphasises the development of the uncontextualised concept of decimal numbers (although this is based firmly on the use of appropriate models and equipment), while in England at Key Stage 2 pupils are expected to understand and use decimal notation only in contexts such as money or measures.
- The Ontario primary mathematics curriculum does not mention the rounding of decimal numbers.
- There is no clear reference to the use of brackets to order operations in the Ontario primary mathematics curriculum.
- There appears to be less explicit emphasis in Ontario on strategical mental calculation, such as multiplication and division involving three- or four-digit numbers using factors, distribution or other methods.

- The Ontario primary mathematics curriculum does not mention the construction and use of algebraic formulae.

Shape, space and measures

- The emphasis in Ontario is on understanding coordinates systems, rather than on the specific skills of reading and plotting coordinates.
- There is relatively little focus on angle properties in the Ontario primary mathematics curriculum.
- In the Ontario primary curriculum students are required to estimate, as well as measuring and calculating, areas.

Handling data

- There is a stronger emphasis on the Ontario primary mathematics curriculum on students' specification of their own data-handling problems, and on their collection of their own data.
- The Ontario primary curriculum introduces the mean as well as the mode and range of a set of data.
- There is no clear reference to the difference between discrete and continuous data in the Ontario primary curriculum.
- The Ontario primary mathematics curriculum covers probability to a significantly greater depth than the Key Stage 2 curriculum. For example, students in Ontario Grade 2 (England Year 3) 'investigate simple probability situations (e.g., flipping a coin, tossing dice)', while in Ontario Grade 5 (England Year 6) they 'predict probability in simple experiments and use fractions to describe probability', and 'use tree diagrams to record the results of simple probability experiments'. This goes well beyond the expected coverage of the Key Stage 2 curriculum.

11.3 Difficulty, Depth and Breadth

To a great extent the breadth of coverage in the Ontario primary mathematics curriculum matches that of the England Key Stage 2 curriculum quite closely, although some detailed differences have been noted above. In particular, the Ontario curriculum has a greater focus on students' specification, investigation and solution of their own data-handling problems. Probability is also covered in greater depth at an earlier stage in Ontario.

There is a strong emphasis on patterns and their recognition and analysis in the *Patterning and algebra* strand of the Ontario primary mathematics curriculum. This encompasses a wide range of contexts such as sound or recurring events, and goes well beyond the 'recognition and description of number patterns' or the 'making and drawing of 2-D and 3-D shapes and patterns', of the England Key Stage 2 curriculum. It gives a clear focus to the process-based approach of the Ontario curriculum.

In summary the comparison between England and Ontario's curricula is:

Number, difficulty	The Ontario curriculum is regarded as:
more demanding in	4 curriculum areas
of similar demand in	25 curriculum areas
less demanding in	8 curriculum areas

Number, breadth	The Ontario curriculum is regarded as:
broader in	3 curriculum areas
similar in breadth in	25 curriculum areas
narrower in	9 curriculum areas

Number: The Ontario curriculum is viewed as both narrower and less demanding.

Shape, space and measures, difficulty	The Ontario curriculum is regarded as:
more demanding in	3 curriculum areas
of similar demand in	14 curriculum areas
less demanding in	3 curriculum areas

Shape, space and measures, breadth	The Ontario curriculum is regarded as:
broader in	3 curriculum areas
similar in breadth in	13 curriculum areas
narrower in	3 curriculum areas

Shape, space and measures: In contrast the Ontario curriculum is regarded as similar in both breadth and demand.

Handling data, difficulty	The Ontario curriculum is regarded as:
more demanding in	1 curriculum area
of similar demand in	12 curriculum areas
less demanding in	1 curriculum area

Handling data, breadth	The Ontario curriculum is regarded as:
broader in	3 curriculum areas
similar in breadth in	10 curriculum areas
narrower in	1 curriculum areas

Handling data: The Ontario curriculum is regarded as similar in difficulty but slightly broader.

11.4 Order of Teaching and when Taught

The Ontario mathematics curriculum is specified in detail by grade, and teachers are expected to follow the given structure. There is a significant element of spiral structuring, so, for example, students 'read and print number words to twenty' in Ontario Grade 2 (England Year 3), and then gradually build up year by year until in Ontario Grade 5 (England Year 6) they 'recognize and read numbers from 0.01 to 100 000'.

11.5 Integration of Subjects

There is a strong emphasis in Ontario on the use and application of mathematics in everyday and real life contexts. Teachers are expected to emphasise this, and to 'plan programs in which connections are made between mathematics and other subjects to enable students to broaden their knowledge in other subject areas'. This approach is a significant aspect of the problem-solving basis which underlies the whole of the Ontario mathematics curriculum.

11.6 Comparison with a newer version of the curriculum

The *Ontario Curriculum, Grades 1-8: Mathematics, 1997* was replaced in September 2005 with the *Ontario Curriculum, Grades 1-8: Mathematic, Revised*. The latter document places even more emphasis on problem-solving skills, and on the development of metacognitive awareness. The content of the curriculum is still divided into five strands as before, but it is presented by grade rather than by strand as in the 1997 version. The *Introduction* has been extensively re-written and expanded, but most of the curriculum content appears to be quite similar. The overall impression is of a further strengthening of the process-based approach and the development of metacognitive awareness which was already clearly present in the 1997 curriculum.

11.7 Differentiation and Tailoring Content to Ability

The *Introduction* to the *Ontario Curriculum Grades 1-8: Mathematics, 1997* states that it 'is intended for use with all students, including exceptional students', although 'special programs' may be available for some of these. However, each of the four overarching categories of process-based 'Knowledge and Skills', *Problem solving*, *Understanding of concepts*, *Application of mathematical procedures* and *Communication of required knowledge related to concepts*, *procedures, and problem solving* is specified at four levels, and these would be relevant to students working at different levels in the same grade. Thus a student working at level 1 would be doing so 'with assistance', while a higher-achieving student would be working 'independently', whatever the content and level of the subject matter being taught.

11.8 Mandatory or recommended time for Subjects and Content Areas

There is no indication in the *Ontario Curriculum Grades 1-8: Mathematics, 1997* of the time to be spent on mathematics.

11.9 Guidance or Compulsion of Teaching Methods

The *Ontario Curriculum Grades 1-8: Mathematics, 1997* concludes with a five page section of *Notes for Teachers*. These emphasise the central role of reasoning and of problem solving, explaining that 'All the strands of mathematics learning require students to engage in problem solving'. It offers suggestions to encourage the development of effective problem solving strategies and the metacognitive 'ability to reflect on one's own thinking'. As the *Notes* explain, 'Even very young students can and must be taught to examine their own thought processes in this way'.

12 Mathematics Comparison: Singapore

12.1 Structure

This analysis is based on the 2001 Singapore mathematics curriculum as this is presented in the *Primary Mathematics Syllabus*, accessible to download from http://www.moe.gov.sg/cpdd/doc/Maths_Pri.pdf. This document starts with a 7-page introduction presenting the aims, the general framework, and the objectives of the curriculum. The introduction is followed by a very detailed 43-page specification of the material to be covered year-by-year, divided into 'topics' as shown below.

Table 12.1 Topics in the Singapore mathematics curriculum

England KS1		**England KS2**					*England KS3*	
Singapore Year	*P1*	**P2**	**P3**	**P4**	**P5/1,2**	**P5/3**	*P6/1,2*	*P6/3*
England Year	*Y2*	**Y3**	**Y4**	**Y5**	**Y6**	**Y6**	*Y7*	*Y7*
WHOLE NUMBERS	✓	✓	✓	✓	✓	✓	✓	
MONEY, MEASURES & MENSURATION	✓	✓	✓	✓	✓	✓	✓	✓
STATISTICS	✓	✓	✓	✓	✓	✓	✓	✓
GEOMETRY	✓	✓	✓	✓	✓	✓	✓	✓
FRACTIONS		✓	✓	✓	✓	✓		
DECIMALS				✓	✓	✓		
AVERAGE/RATE/SPEED					✓		✓	✓
RATIO/ PROPORTION					✓		✓	✓
PERCENTAGE					✓		✓	✓
ALGEBRA							✓	

Note that pupils in Singapore Years 5 and 6 (England Years 6 and 7) are split into streams, with a differentiated curriculum as shown above.

Individual 'Outcomes' are specified for each topic for each year group. These are accompanied by 'Remarks', which generally serve to specify more precisely the breadth to which the topic should be covered.

12.2 Aims and rationale for the curriculum

The introduction to the 2001 Singapore 'Primary Mathematics Syllabus' explains that,

> 'The focus of the syllabus is mathematical problem solving. The emphasis is the development of concepts, skills and its underlying processes. This, together with the explication of thinking skills and the integration of IT in mathematics teaching and learning, will give leverage to the development of mathematical problems solving.'
>
> Ministry of Education, Singapore, 2001, pg3

Again the 'Framework of the mathematics curriculum' commences with the statement,

'The primary aim of the mathematics curriculum is to enable pupils to develop their ability in mathematical problem solving. Mathematical problem solving includes using and applying mathematics in practical tasks, in real life problems and within mathematics itself. In this context, a problem covers a wide range of situations from routine mathematical problems to problems in unfamiliar contexts and open-ended investigations that make use of the relevant mathematics and thinking processes.'
Ministry of Education, Singapore, 2001, pg5

However, although a list of 'processes', divided into 'thinking skills' and 'heuristics for problem solving', is given (MoE Singapore, 2001, pg 5), these are not generally closely integrated with the detailed year-by-year curriculum which comprises the bulk of the document. Similarly, neither computers nor IT are mentioned again after the introductory sections. This lack of emphasis on the use of ICT, and on the use and application of mathematical processes, and a relatively greater focus on such procedural skills as formal long division, or the conversion of fractions to decimal numbers, is a major difference between the English and the 2001 Singapore primary mathematics curricula.

12.3 Content

The detailed Singapore primary mathematics syllabus, which is presented on pages 15 to 50 of the 'Primary Mathematics Syllabus', describes the content to be covered each year, from Singapore Year 1 (England Year 2), to Singapore Year 6 (England Year 7). The mapping of the Singapore to the English curriculum relates to the material covered during Singapore Years 2 to 5 (England Key Stage 2, Years 3 to 6).

The stronger emphasis in the English curriculum on mathematical processes, the use and application of mathematics, and the use of calculators and ICT, and in the Singapore curriculum on detailed procedural skills, has been mentioned above. In addition to these there are some specific differences in the coverage of particular content areas.

Algebra
In England, pupils are expected to '[use] patterns and relationships to explore simple algebraic ideas' (Ma B/c), to 'recognise, represent and interpret simple number relationships, constructing and using formulae in words then symbols' (Ma2.4d), and to

'read and plot coordinates in the first quadrant, then in all four quadrants' (Ma2.4e). However, Algebra does not appear in the Singapore primary curriculum until their Year 6 (equivalent to English Year 7).

Shape, space and measures

Vertically opposite angles, and the equality of an exterior angle of a triangle to the sum of the interior opposite angles, are covered in Singapore but not in England.

In Singapore, pupils are required to 'estimate the area of a square and a rectangle in standard unit' (P3/M6j), 'use formula to find the volume of a cuboid' (P4/M4e), 'use formula to find volume of liquid in a rectangular container' (P4/M4f), and 'solve up to 2-step word problems involving volume of a cube/cuboid and liquid' (P5/M2d). Estimation of area, and the calculation of volume, are not covered in the English primary national curriculum.

In England pupils are required to 'transform objects in practical situations; transform images using ICT; visualise and predict the position of a shape following a rotation, reflection or translation' (Ma3.3b), but transformations and the visualisation of movement are not mentioned in the Singapore curriculum. On the other hand, Singapore pupils make and draw tessellations in Year P5 (England Year 6), while tessellations do not appear in the English National Curriculum for Key Stage 2.

Handling data

The English primary national curriculum is more detailed than the Singapore in relation to handling data, and appears to cover a greater range of concepts and skills, including the use of ICT.

Probability is introduced in England, but not in Singapore.

Abacus

The use of the abacus (Soroban type, with one 5-unit bead and four 1-unit beads in each column) is covered in the 2001 Singapore Primary 2 and Primary 3 (English Year 2 and Year 3) curriculum (MoE Singapore, 2001, Appendix B, p52-53). Private tuition classes were also available - for example, see http://web.singnet.com.sg/~littlesq/SQAMClass.html The ability to 'visualise small sets of up to 5 objects instead of counting one by one' (P1/W2e), which is a key skill for the effective use of the abacus, is covered in the Singapore curriculum in Year 1 (equivalent to England Year 2).

12.4 Difficulty, Depth and Breadth

As explained above, there is a relatively greater emphasis on procedural knowledge in the Singapore curriculum, as opposed to the development of pupils' understanding of mathematical concepts. In this respect it has been judged that the Singapore primary mathematics curriculum is, in places, both narrower and less demanding than the English. However, the level of demand is higher in Singapore for computation.

Handling data, in particular, seems to be covered in significantly less depth in the Singapore primary curriculum, with less emphasis on problem solving, or the application of data-handling concepts in a wide range of contexts. Other areas of difference are given above. In summary the comparison between England and Singapore's curricula is:

Number, difficulty	The Singapore curriculum is regarded as:
more demanding in	35 curriculum areas
of similar demand in	11 curriculum areas
less demanding in	21 curriculum areas

Number, breadth	The Singapore curriculum is regarded as:
broader in	32 curriculum areas
similar in breadth in	10 curriculum areas
narrower in	24 curriculum areas

Number: The Singapore curriculum is viewed as both broader and more demanding.

Shape, space and measures, difficulty	The Singapore curriculum is regarded as:
more demanding in	2 curriculum areas
of similar demand in	4 curriculum areas
less demanding in	14 curriculum areas

Shape, space and measures, breadth	The Singapore curriculum is regarded as:
broader in	2 curriculum areas
similar in breadth in	4 curriculum areas
narrower in	14 curriculum areas

Shape, space and measures: In contrast the Singapore curriculum is regarded as narrower and less demanding.

Handling data, difficulty	The Singapore curriculum is regarded as:
more demanding in	0 curriculum areas
of similar demand in	1 curriculum areas
less demanding in	13 curriculum areas

Handling data, breadth	The Singapore curriculum is regarded as:
broader in	0 curriculum areas
similar in breadth in	1 curriculum areas
narrower in	13 curriculum areas

Handling data: Again the Singapore curriculum is regarded as narrower and less demanding.

12.5 Order of Teaching and when Taught

As the introduction to the 2001 Singapore Primary Mathematics Syllabus explains,

'In the syllabus, the spiral approach is adopted to ensure that each topic is covered at appropriate levels in increasing depth.'
Ministry of Education, Singapore, 2001 pg 3

So, for example, pupils work with the concept of place value in Singapore Year P2 (England Year 3) when they 'read and write numbers up to 1000 in numerals and in words' (P2/W1bThey develop their understanding further in Singapore Year P5 (England Year 6) when they 'multiply and divide numbers by tens, hundreds and thousands' (P5/ W2c). This approach is comparable to that found in the English curriculum, where, for example, pupils 'read, write and order whole numbers to at least 1000 and position them on a number line' in Year 3, and then go on to 'use understanding of place value to multiply and divide whole numbers and decimals by 10, 100 or 1000' in Year 5 (Primary Framework Learning Targets).

12.6 Integration of Subjects

No evidence of subjects being integrated was found.

12.7 Comparison with a newer version of the curriculum

In 2007, four years after the 2003 TIMSS survey was completed, Singapore introduced a new primary mathematics curriculum (downloadable from http://www.moe.gov.sg/cpdd/1_Primary%20maths%20syllabus%202007_for%20uploading%2024%20Jul.pdf). The introductory rhetoric again emphasises the importance of 'reasoning, applications, and use of technology' (MoE, Singapore,2007, p2). However, the new document appears to present a rather more coherent picture, with advice in the 'Mathematics Framework' on a pedagogical approach that is designed to support the development of problem solving process skills. For example, teachers might

Encourage students to think aloud the strategies and methods they use to solve particular problems.

Provide students with problems that require planning (before solving) and evaluation (after solving).

Encourage students to seek alternative ways of solving the same problem and to check the appropriateness and reasonableness of the answer.

Allow students to discuss how to solve a particular problem and to explain the different methods that they use for solving the problem.'
Ministry of Education, Singapore, 2001, pg 9

Calculators are still not used in Singapore until Year P5 (England Y6), but they do have a recognised role at that point. Other specific examples of the use of ICT in primary schools for the teaching and learning of mathematics, however, are scarce. Furthermore, the use of the abacus has apparently been abandoned.

12.8 Differentiation

Pupils in Singapore are divided after Singapore Year P4 (England Year 5) into three streams - EM1, EM2, and EM3. As the Introduction to the 2001 *Primary Mathematics Syllabus* explains,

'The content for the EM3 stream repeats some of the important topics covered in the foundation stage. This is to ensure that pupils have a good understanding of basic mathematical concepts covered in the foundation stage before they proceed to other topics in the orientation stage.'
Ministry of Education, Singapore, 2001, pg3

It should be noted that EM£ is being phased out from 2008.

12.9 Mandatory or recommended time for Subjects and Content Areas

In Singapore the recommended allocations, in hours, are:

P1	P2	P3	P4
3.5	4.5	5.5	5.5

After P4 the streaming cuts in and the allocations vary by stream, 4.5 hours for EM1, 5 hours for EM2 and 6.5 hours for EM3. It should be noted that the lower attaining pupils, EM3, are given more time for mathematics.

12.10 Guidance or Compulsion of Teaching Methods

The introductory section of the Singapore *Primary Mathematics Syllabus* provides a clear statement of the aims, objectives and framework of the primary mathematics curriculum. So, for example, for example, pupils should 'enjoy doing mathematics', and should 'develop an enquiring mind through investigative activities'. However, this section bears little relation to the syllabus itself that follows, giving very detailed 'outcomes' year by year, accompanied by 'remarks' on what to include or exclude. It is not clear how much freedom teachers have to adopt one or other of the broad approaches implied by these two sections of the document, although the Introduction does state that

'This syllabus is a guide for teachers to plan their mathematics programmes. Teachers need not be bound by the sequence of topics presented here but should ensure that hierarchy and linkages are maintained. Teachers should exercise flexibility and creativity when using the syllabus.'
Ministry of Education, Singapore, 2001, pg3

References

Ministry of Education, Singapore, 2001: Primary Mathematics Syllabus. Online at: http://www.moe.gov.sg/cpdd/pri_maths_links.htm

Ministry of Education, Singapore, 2007: Primary Mathematics Syllabus. Online at: http://www.moe.gov.sg/cpdd/pri_maths_links.htm

13 Science Comparison: Chinese Taipei

13.1 Structure

In Chinese Taipei, the school years are organised into Grades, with Grade 1 being the first year of compulsory primary education. The school year consists of two semesters. The first begins in early September and runs till late January or early February. Winter vacation typically runs from two to three weeks around the Lunar New Year. Spring semester begins following the Lantern Festival in mid February and ends in early June.

Table 13.1 shows the age and English year group equivalents to the Chinese Taipei Grades 1-6.

Table 13.1: Age and English year group equivalents to the Chinese Taipei Primary Grades 1-6

Chinese Taipei Grade	Age (years)	English year group equivalent
Grade 1	6-7	Year 2
Grade 2	7-8	Year 3
Grade 3	8-9	Year 4
Grade 4	9-10	Year 5
Grade 5	10-11	Year 6
Grade 6	11-12	Year 7

As Key Stage 2 in the English programme covers only years 3-6 inclusive, it is noteworthy that Grade 1 pupils in Chinese Taipei are age equivalent to year 2 pupils in England which is Key Stage 1. Similarly, Grade 6 pupils in Chinese Taipei are age equivalent to year 7 pupils in England which is Key Stage 3.

The Chinese Taipei science curriculum for Grades 1-6 includes a core teaching content which is structured in blocks of grades and includes the first three grades of junior high school as well (the three years that follow after Grade 6 at primary school). The primary Grades 1-6 are blocked in groups of two years, with core teaching content outlined together for the years grouped together as follows:

Grades 1 and 2

Grades 3 and 4

Grades 5 and 6

As a result of core teaching content being blocked together in groups of two years, it is not possible to know exactly when aspects of the Chinese Taipei curriculum are taught within the two year bands. This is noteworthy particularly when comparing what is taught in Grades 1/2 and Grades 5/6 in Chinese Taipei to what is covered at Key Stage 2 in

England as age equivalent English pupils may in fact be in Key Stage 1 or 3 as outlined above.

The spreadsheet associated with this review identifies which pieces of core content are taught in which English year group equivalents to the Chinese Taipei grade blocks.

13.2 Content

The science curriculum in Chinese Taipei is linked with technology and is termed 'The Study Fields of Science and Life Technology'. Table 1.2 outlines the core teaching content of Grades 1-6 and Grades 1-3 in junior high school.

There is broad overlap between the Chinese Taipei curriculum and the English curriculum in terms of generic topics. Basic elements of biology, physics and chemistry are covered in both countries, e.g. plants, animals, forces, earth and space, materials and their properties, light and sound. From a surface glance at the core teaching contents, it appears that the English curriculum is more explicit with regard to its approach to investigative science with a great emphasis on this part of the curriculum. However, although not largely covered in the core teaching contents of the Chinese Taipei curriculum, as outlined in section 1.3 of this review, the core contents of the Science and life technology curriculum in Chinese Taipei aims to foster eight key ability elements. These eight ability elements include a diverse range of investigative abilities as applied to science and technology. As well as this, these ability elements also include a further range of features not covered in the English curriculum, including technology development, scientific attitude, thinking intelligence and design and production. These will be outlined more explicitly in section 1.3.

Table 13.2: Main topics in the core teaching contents for Chinese Taipei 'Science and life technology' curriculum

Topic	Theme	Sub-theme	
The composition and characteristics of the nature	The earth environment	110	Substance composition (rock, water, air) on the earth
		111	The earth and space
	Creature on the earth	120	The intercommunity of life
		121	The diversity of life
	Composition and characteristics of substance	130	The structures and functions of substance
		131	The shapes and properties of substances
The role of nature	Change and balance	210	The changes of earth's surface and earth's crust
		211	Weather changes
		212	Day and night and four seasons
		213	The constancy and adjustment in animal body
		214	Temperature and thermal
		215	Motion and force
		216	Sound, light and wave
		217	The form and conversion of energy
		218	Chemical reaction
		219	Chemical equilibrium
	Interaction	220	Global changes
		221	The response and animal behaviour of creature stimulation to environment
		222	Electromagnetic action
		223	Gravity action
		224	Water and aqueous solution
		225	Oxidation and deoxidize
		226	Acid, alkali and salt
		227	Organic compounds
	Structure and function	230	The structure and function of plant
		231	The structure and function of animal
Evolution and continuity	The continuation of life	310	Reproduction, inheritance and evolution
	Earth's history	320	Stratum and fossil
Life and the environment	Life and technology	410	Food
		411	Material
		412	Machinery Application
		413	Electricity and application
		414	Information and information transmission
		415	Housing

Topic	Theme	Sub-theme	
	Environmental protection	416	Transportation
		420	Natural disaster and prevention
		421	Environmental pollution and prevention
Sustainable development	Ecological conservation	510	Creature and environment
		511	The relationship between human beings and nature
		512	The conservation and use of resource
		513	The development and use of energy
	Science and humanities	520	The development of science
		521	The beauty of science
		522	Ethics of science
	Creativity and civilization	530	Creativity and production
		531	Technology and civilization

The Chinese Taipei curriculum also dedicates itself largely to what it terms 'Earth Systems Education', incorporating many aspects that are more likely to be covered in England in the subject of geography or not at all. This will be more broadly explored under the aims and rationale section (1.3). As a result, and as there are other areas of study Chinese Taipei addresses which the English Key Stage 2 science curriculum does not, Chinese Taipei's broader teaching topics include weather, machinery, food, housing, transportation, natural disasters and prevention, (natural) resources, technology and civilisation, creativity and production, the beauty of science and the ethics of science.

13.3 Aims and rationale for the curriculum

As outlined in the previous section, the Chinese Taipei curriculum has a core teaching content which is broken down in the spreadsheet associated with this review, which aims to foster eight key abilities in pupils. These key ability elements are:

Process skills: Encourages skills of observation, comparison and classification, organisation and conjunction, induction, inference and deduction as well as conveyance, often in the context of investigative science.

Science and technology cognition: Encourages a level of cognition and summarises core knowledge requirements at different grades.

Essence of science: Encourages a range of abilities in investigative science.

Development of technology: Encourages a range of abilities concerning the essence of technology, its evolution and its application in society.

Scientific attitude: Encourages a range of abilities concerning the approach to science including exploring, the fun of discovering, carefulness and conscientiousness as well as seeking truth and reality.

Thinking intelligence: Encourages creative thinking, problem solving, critical thinking, comprehensive thinking and inferential thinking.

Scientific applications: Encourages thinking in an applied way about scientific principles including approach to problems and planning not only experimentally but in different aspects of life.

Design and production: Encourage creative thinking about design and production.

As well as these eight key ability elements, a further ten abilities form an umbrella over the science and life technology curriculum and are seen to be fostered through not only the science and life technology curriculum but also through the six other fields of study which are humanities and the arts, health and physical education, language, mathematics, social sciences as well as extracurricular activities. These ten abilities are:

Self-understanding and developing potential abilities

Appreciation, performance and innovation

Career planning and lifelong learning

Expression, communication and sharing

Respecting, caring and teamwork

Cultural learning and international understanding

Planning, organising and practising

Use of technology and information

Active exploration and research

Independent thinking and problem-solving

Over the past ten years, a range of experts have been working together to develop the Science and life technology curriculum in Chinese Taipei. Their aim has been to integrate elements of biology, chemistry, earth science, physics and life technology. The standards in the curriculum aim to provide a 'systematic way for developing students' understanding and appreciation of three interactions, including the individual and himself/herself, the individual and society, as well as the individual and nature' (Chang, 2005, p. 625).

Chang (2005) highlights how these fit in with the principles of 'Earth Systems Education' (ESE). The ESE theme forms the basis of the conceptual framework of the Science and life technology curriculum. A strong reasoning for a basis in this theme is that it 'motivates students to be concerned about environmental problems around the world such as acid rain, global warming and climate change, El Nino's influence, ozone depletion and groundwater pollution' (Chang, 2005, p. 627). By bringing together a range of elements into one field of study, the philosophy is that the amount of science content is

reduced but there is a promotion of the connection between science and the everyday lives of the pupils who study the topic. Chang (2005) describes empirical evidence that supports an ESE-oriented curriculum, showing higher achievement for pupils instructed in this philosophy than those who are not.

13.4 Difficulty and coverage

In terms of investigative science, the first of four core topics in the English curriculum (termed 'Knowledge, skills and understanding'); the spreadsheet compares the English curriculum with what is outlined in Chinese Taipei's core teaching contents. At first glance it appears this is more comprehensively covered in England. However, there are investigative strands within the eight abilities in the Chinese Taipei curriculum which this core contents aims to foster. These eight abilities are not direct teaching points. The spreadsheet outlines, in the notes section, references to parts of these abilities where it appears English areas are not covered in Chinese Taipei.

The eight abilities include, as outlined in the previous section, process skills. It is suggested the core teaching content should foster many investigative abilities which are also covered in the English curriculum. Examples include the range of skills required by simple investigative work such as forming ideas and assumptions, difficulties of collecting evidence, difficulties in controlling data, observing data, expressing observations, perceiving cause and effect as well as perceiving results should be similar in experiments conducted with similar methods. In fact, one of the abilities, 'scientific applications' talks about thinking in applied ways, not only about investigations but also different aspects of life.

It is important to remember these are not points in the core teaching contents of the Chinese Taipei curriculum but abilities it is hoped will be fostered by the core contents.

In terms of core teaching contents, in both countries different sources must be used to find evidence. However, in Chinese Taipei pupils must understand and assess if evidence is credible or not. Also in Chinese Taipei there is an explicit reference to being able to put forward arguments based on the evidence. This is not explicit in the curriculum in England.

In the English curriculum there is an emphasis on thinking about what might happen in an investigation, trying things out and selecting materials and/or equipment. It is difficult to ascertain from the Chinese Taipei core teaching contents if this is also expected. In the English curriculum there is also explicit reference to the ability to make systematic observation and measurements, including the use of ICT for datalogging. In Chinese Taipei there is a generic teaching point termed 'processing and handling', making it difficult to ascertain if this is similar to what has been described above in the English curriculum.

The expectations about the use of equipment are similar in both countries. In Chinese Taipei however, there is a specific emphasis on the theme of 'thermal', where the ability to use a thermometer is seen in line with this theme which looks at the sun, combustion and friction. The English curriculum is not integrated in this way.

The requirement for expressing results using text, tables and graphs is similar in both countries. However, in terms of expressing observations and patterns, the curriculum in England is more explicit about the ability to make comparisons and look at simple patterns. In Chinese Taipei's core teaching contents only one specific example is given which requires pupils to perceive the objects are different in weight.

In England the curriculum is very specific about the need for pupils to be able to review the work of others and describing its significance. In Chinese Taipei there is only a very generic reference termed 'improving function'. It is unclear exactly what this means.

In England the' Knowledge, skills and understanding' section of the curriculum is expected to be taught through a range of points outlined in what is termed 'Breadth of study'. For example, pupils are expected to learn about investigative science through a range of domestic and environmental contexts that are familiar and of interest to them. This is not explicitly mentioned in Chinese Taipei. However, another point in the English 'Breadth of study' is that pupils should look at the part science has played in the development of many useful things. This is addressed in the Chinese Taipei curriculum and it is very specific in stating that pupils should learn about Chinese and Western scientists, naming some as examples. The Chinese Taipei curriculum also requires pupils to understand lifestyles in different ages which are not addressed in England.

Also included in the 'Breadth of study' in England is that pupils should be using a range of sources of information and data. This is matched by requirements in Chinese Taipei. In England however, pupils are expected to use first and second hand data in their investigative work. This is not explicitly noted in the Chinese Taipei curriculum. Also explicit in England is a requirement for pupils to use appropriate scientific language and terms, including that for measurement. There is no match for this in Chinese Taipei.

A final point within the 'Breadth of study' is a point for pupils to recognise the hazards in all the work they do, be able assess risks and take appropriate action. In Chinese Taipei this is narrower as the requirement is only required of pupils in terms of electricity and conductivity.

A second umbrella theme in the English curriculum is 'Life processes and living things'. The function and care of teeth is a topic covered within this theme in England but not in the Chinese Taipei curriculum. In conjunction with this, in England there is an emphasis on the importance of good health, food and nutrients. This seems to be covered more broadly in Chinese Taipei under the notion of 'survival'. In Chinese Taipei, there is however, an emphasis on food preparation and learning about different spices, additives and food hygiene. These are topics not covered in the English science curriculum and are more likely to be covered in the subject of 'food technology' in England.

Expanding on the theme of good health, in England there are further topics covered which are not in the Chinese Taipei curriculum including personal health and the effect of tobacco, alcohol and other drugs on the body. In England pupils also study the heart specifically and the importance of exercise for good health including the effect of exercise on heart rate. This is not studied in Chinese Taipei.

In terms of the study of the human body, the two curricula seem similar. Both curricula require an understanding of the bones and muscles working together in the human body to allow movement. Similarly the stages of the human life cycle are covered in both England and Chinese Taipei. Life processes in humans is covered in both countries, however in Chinese Taipei this is covered more comprehensively. For example, different types of reproduction are covered in Chinese Taipei with pupils needing to know that animals can reproduce by oviparity and viviparity. Furthermore, in Chinese Taipei pupils are required to perceive that humans respond to changes of temperature outside (such as trembling in low temperature, sweating in high temperature) at this stage in the curriculum and need to know that animals need to maintain temperature within a scope, and pupils should know the methods used to maintain body temperature.

In England's curriculum there is a specific reference to needing to know the life processes common to plants and also to be able to make links between these in familiar plants and the environments in which they are found. Life processes linked to plants is not covered in the Chinese Taipei curriculum so their curriculum is narrower in this area.

In terms of plant growth and the effects of light and temperature on this: this is explicitly covered in England but not in Chinese Taipei where such effects are only considered in terms of creatures. However, in Chinese Taipei, pupils must know about the parts of the plant, be able to recognise local fruits and vegetables as well as know about aquatic plants. This aspect is therefore broader in Chinese Taipei whereas in England only the parts of the plant need to be known by pupils. Furthermore, in Chinese Taipei pupils need to know that plants can propagate by seeds or roots, stems and leaves. In England pupils are expected to know about the function of parts of the flower and their role in the life cycle of flowering plants (i.e. stigma, stamen, petal, and sepal).

In the English curriculum pupils are expected to be able to make and use keys as well as know how locally occurring animals and plants can be identified and assigned to groups. In Chinese Taipei this is described as 'making classifications'. In England the curriculum is broader in requiring pupils to know that the variety of plants and animals makes it important to identify them and assign them to groups.

The importance of protecting living things and the environment is in the English curriculum but in Chinese Taipei this is far broader, more difficult and more explicit. In Chinese Taipei pupils need to know specifically about water contamination, air pollution, natural resources, recycling, how waste disposal is linked to things like water pollution (and know if water is contaminated by observation), noise reduction, endangered species and the difficulty of recouping destroyed resources.

Pupils in both countries study how different animals are suited to their environment. In Chinese Taipei there is an explicit reference to aquatic animals and the structures they have which make it suitable for them to live in water. Although not explicit in the English curriculum, aquatic animals are also a likely topic for pupils to study. Food chains showing feeding relationships appear to be covered only in England with no reference to these in Chinese Taipei's curriculum. In Chinese Taipei however, pupils are expected to understand the basic divide of animal parts. This is covered earlier in England, at Key Stage 1.

Micro-organisms are studied in both countries although their specific benefits are studied only in England whereas how they are affected by light and temperature and air is studied in Chinese Taipei and not in England.

'Materials and their properties' is the umbrella theme for the third of the four main themes in the English curriculum. The first main point in the English curriculum is to compare everyday materials and objects on the basis of their material properties, including hardness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials. This aspect seems similar in both countries. However, in Chinese Taipei this theme is broader as pupils need to know about the deflection of a compass caused by the interaction of magnetic needle and a magnetic field (terrestrial magnetism or wire connected with current). Although this includes aspects of physical processes, it appears to be studied alongside materials in Chinese Taipei. They should also be able to give examples to illustrate every day materials such as plastic, metal, glass, ceramics etc and they must be able to recognize the impact of plastics, metals, glass and ceramics on life through information collecting as well as be able to recognize different clothing fibres.

In terms of thermal conduction, in England pupils must know what this means and when materials are good / bad thermal conductors. However, in Chinese Taipei pupils also have to know about the ways in which heat is spread (i.e. convection, conduction and radiation) which is not covered in England at this level. With regard to electrical conduction, both countries study similar concepts. In Chinese Taipei pupils are also taught about the pH of aqueous solutions.

Both English students and those in Chinese Taipei study rocks. However, in Chinese Taipei the students also cover minerals and they need to know that rocks are mostly made up of minerals. To recognize some common fossils and know they are remains of ancient creatures is a requirement in Chinese Taipei but not covered in England.

The study of solids, liquids and gases is broader in Chinese Taipei particularly with regard to changes of temperature with a need to understanding shrinking in hot / cold as well as dissolution quantity and diffusion speed. In England pupils simply describe what happens when materials are heated or cooled. Pupils in England however, learn about whether changes are reversible or not which is not mentioned in the Chinese Taipei core teaching contents.

Learning about the role of evaporation and condensation in the water cycle seems similar in both curricula. However, in Chinese Taipei there is an explicit reference to pupils needing to know that evaporation is endothermic which is not the case in England. Furthermore, in Chinese Taipei, pupils are expected to know that sea water is salty and that fresh water exists only in rivers, lakes and soil.

While in England pupils study dissolving, the effect of temperature on dissolving is expected to be known by pupils in Chinese Taipei. This may be covered in investigations surrounding dissolving in England but there is no explicit curriculum point on this.

With regard to separating mixtures and materials it appears that the English curriculum is more comprehensive. For example, pupils in England study how to separate insoluble solids from liquids by filtering, how to recover dissolved solids by evaporating the liquid from the solution and generally to use knowledge of solids, liquids and gases to decide how mixtures might be separated.

In Chinese Taipei however, they look at a range of concepts not covered in England. Pupils in Chinese Taipei need to know that substance is composed of particles (no mention of the concept of atoms) through activities such as observing the phenomenon of dissolution and diffusion, cutting substances and assembling building blocks.

Furthermore, in Chinese Taipei pupils study more broadly the changes in soil and sandstone, such as accumulation or loss, through observation and experiment. Pupils also need to know soil is a mote composed of organic substances caused by rock weathering or animals and plants. They also study changes of the earth's surface that are mainly caused by the process of weathering, erosion and deposition. Pupils also need to perceive that the activities of creatures can change the environment (for example, tree roots break wall, organic manure). Pupils also need to be able to produce oxygen and carbon dioxide in simple experiments, test the properties, and know air contains oxygen and carbon dioxide. These are broader and more difficult topics than those covered in England at this stage.

‘Physical processes’ is the fourth and final main umbrella topic in the English curriculum. Many aspects of physical processes are the same in both curricula: for example, building electrical circuits, although in Chinese Taipei the purpose of the type of circuits is made explicit, i.e. building circuits to make specific toys work. In England there are two broader aspects which are not covered in Chinese Taipei: these are changing the components in a circuit to make bulbs dimmer or brighter as well as representing components in a circuit diagram.

The forces involved in magnetism are covered in both curricula as well as the forces of gravity and friction. Coverage in these specific areas seems similar. In Chinese Taipei however, the study of forces generally is more extensive and more difficult at this stage. For example, students study the use of pressure to push objects; they need to know how much force is applied by observation of deformation. Also, they look at the calculation of speed and its relation to distance and time. They study this in relation to the ‘location’ of objects and that they should be presented with coordinates, distance and direction. They

must also perceive that regular movement can be used to measure time and direction (for example, changes of shade). Furthermore, students must perceive that objects affected by a few forces can still maintain balance and be static. Students also find out about the lever principle by experiment (such as using the seesaw principle to hang objects with different weight).

Both curricula study light although each country makes explicit some different points within this topic. For example, in England pupils are explicitly required to know that light comes from a source and that we only see things when light enters our eyes whereas in Chinese Taipei these are not explicitly mentioned. Both curricula do highlight the teaching of how shadows are formed. Overall however, the Chinese Taipei curriculum is more difficult and details that pupils are taught at this level about the direction of light reflection. Pupils must also perceive that light is refracted when passed through different media, that a rainbow can be seen after refraction at certain angles (and observe the rainbow by producing water fog), observe irradiated light and imaging (such as reflection and caustics of smooth flat and magnification effect of lens, etc) and explore the regulation of instruments and changes of pronunciation.

The topic of sound is covered in both curricula. As with the topic of light, different aspects of the study of sound are covered in each country although broadly speaking the difficulty of the topics studied are similar. In England pupils learn that vibrations are not always directly visible but this not covered in Chinese Taipei although the fact that sounds are made when things vibrate is similar in both curricula. In England pupils are expected to know how to change the pitch and loudness of sounds produced by some vibrating objects (for example, a drum skin, a plucked string) but this is not covered in Chinese Taipei. In terms of sound requiring a medium through which to travel, Chinese Taipei and England seem to approach this slightly differently, with England's reference indicating that vibrations from sound sources require a medium (for example, metal, wood, glass, air) through which to travel to the ear.

In Chinese Taipei pupils must perceive sound transmitting through substances (such as taut lines, water pipe, etc.). Additionally in Chinese Taipei students must perceive information about received sounds. This is not covered explicitly in the English curriculum.

The Earth, moon and space is a topic covered in both countries. Some aspects of this topic are only covered in one country. For example, the shape of the Earth, moon and sun being spherical is required to be known by pupils in England. How day and night are related to the spin of the Earth on its own axis is only an explicit requirement in the English curriculum as well as that the Earth orbits the Sun once each year and that the Moon takes approximately 28 days to orbit the Earth. None of these aspects are explicitly noted in the Chinese Taipei curriculum. The fact that the sun appears to move across the sky is a requirement in both countries, although the direction of this is included in Chinese Taipei, i.e. east/west. In Chinese Taipei pupils must also perceive that the moving of the sun has rules and that shadows will follow these changes so they can be used to measure time.

The Chinese Taipei curriculum is far broader and more difficult in terms of study points about the moon, sun and stars. Pupils in Chinese Taipei must:

perceive the moon rises in the east and sets in the west

observe and know the moon waxes and wanes (moon phase change)

know that the directions of the sun rising and falling in different seasons are different

perceive there are numerous stars in the sky, some light and some dark

observe and describe different stars (or constellations) you can see in the night of different seasons

identify important fixed stars and constellations

know the sun is a fixed star

perceive the length of day, night, and know that temperatures are different in each season.

The Chinese Taipei curriculum also includes a range of topics not included in the English science curriculum. These include:

weather

the form and conversion of energy

oxidation and reduction

water as a general topic

acid, alkali and salt

machinery

information and information transmission

natural disaster prevention

the development and usage of energy

the beauty of science

ethics of scientific activity.

A summary of the detailed comparison of the two curricula by attainment target is:

Scientific Enquiry, difficulty The Chinese Taipei curriculum is regarded as:

more demanding in	1	curriculum areas
of similar demand in	4	curriculum areas
less demanding in	3	curriculum areas

Scientific Enquiry, breadth The Chinese Taipei curriculum is regarded as:

broader in	3	curriculum areas
similar in breadth in	3	curriculum areas
narrower in	3	curriculum areas

Scientific Enquiry: Because of less direct references to Scientific Enquiry in the Chinese Taipei curriculum it is therefore viewed as similar in demand and breadth.

Life Processes and Living Things, difficulty The Chinese Taipei curriculum is regarded as:

more demanding in	6	curriculum areas
of similar demand in	7	curriculum areas
less demanding in	2	curriculum areas

Life Processes and Living Things, breadth The Chinese Taipei curriculum is regarded as:

broader in	18	curriculum areas
similar in breadth in	7	curriculum areas
narrower in	11	curriculum areas

Life Processes and Living Things: The Chinese Taipei curriculum is seen as more demanding and broader.

Materials and Their Properties, difficulty The Chinese Taipei curriculum is regarded as:

more demanding in	5	curriculum area
of similar demand in	6	curriculum areas
less demanding in	1	curriculum areas

Materials and Their Properties, breadth The Chinese Taipei curriculum is regarded as:

broader in	26	curriculum areas
similar in breadth in	5	curriculum areas
narrower in	6	curriculum areas

Materials and Their Properties: The Chinese Taipei curriculum is regarded as more demanding and broader.

Physical Processes, difficulty The Chinese Taipei curriculum is regarded as:

more demanding in	4	curriculum area
of similar demand in	7	curriculum areas
less demanding in	0	curriculum areas

Physical Processes, breadth The Chinese Taipei curriculum is regarded as:

broader in	33	curriculum areas
similar in breadth in	7	curriculum areas
narrower in	9	curriculum areas

Physical Processes: The Chinese Taipei the curriculum is regarded as more demanding and broader.

The average rating for confidence in the judgment of difficulty was 2.1. just above, *quite confident* (2.0), while that for breadth was 2.8, just below *very confident* (3.0).

13.5 Order of Teaching and when Taught

The core teaching content in the Chinese Taipei curriculum is organised in blocks of two grades in the years of interest for this study, as outlined in section 1.1. Core teaching contents are outlined for Grades 1 and 2 together, as well as for Grades 3 and 4 together and Grades 5 and 6 together. As highlighted before, it is not possible to know exactly when each point is taught within each of the bands of two years. This is especially noteworthy when considering teaching contents in Grades 1 and 2 as Grade 1 pupils in Chinese Taipei fall under Key Stage 1 in England, rather than Key Stage 2, the focus for this research. Similarly, for Grades 5 and 6, Grade 6 pupils would actually be in Key Stage 3 in England, rather than Key Stage 2. It is not possible to tease apart the specific points taught in each year so this is a general note of caution.

The topic of investigative science is taught across all the years 3-6 at Key Stage 2 in England. These skills are taught to pupils through a range of topics across the years. It is likely to be in a spiral fashion, with high order reasoning skills and the complex understanding of relationships between variables not being taught until the end of Key Stage 2. Simpler investigative points are taught earlier and built on throughout the four years.

It is difficult to ascertain if the same pattern of learning is adopted in Chinese Taipei or not as much investigative science is covered by the eight abilities rather than the core teaching contents as discussed previously. Looking at the Chinese Taipei core teaching points in this area however, it is possible to make some considerations. Pupils learn in Grades 1 and 2 about the topic of ‘thermal’, i.e. how the sun, combustion and friction can cause ‘thermal’ [sic] and how to use a thermometer. This is very specific. Pupils in Grades 1 and 2 also learn to perceive that objects are different in weight.

In Grades 3 and 4 in Chinese Taipei pupils learn to analyse the needs of investigations, select materials, consider the credibility of sources and put forward opinions based on this credible information. It is also in Grades 3 and 4 where pupils study scientists and inventors in Taiwan and China and look at science in applied situations. It is not until Grades 5 and 6 that pupils study Chinese and Western scientists together as well as technological innovations and inventions in history. Pupils then also learn about the

collation of information by a range of sources as well as the consideration of these resources, the utilization of tools, processing and handling and causal relationships.

Looking at the topics to be considered under the umbrella of ‘Life processes and living things’, the English curriculum again generally adopts a spiral approach, building on knowledge over the four year period of Key Stage 2.

Life processes in humans and other animals is covered in different ways across the years at Key Stage 2. This is similar in Chinese Taipei with the simple facts about animals needing certain things for growth being taught early. Subsequently in Grades 3 and 4 the life cycle is introduced. It is not until Grades 5 and 6 when life processes are explicitly taught including the more specific notions of oviparity and viviparity. Also taught at these grades are foraging and social behaviours of animals as well as information transmission between animals. Similarities between parents and descendants are also taught in these grades.

In terms of the study of green plants and flowers, pupils study this topic more broadly and with more difficult aspects in Chinese Taipei. Aspects of this are introduced in Grades 3 and 4 in Chinese Taipei with the basic parts of the plant and flower, including aquatic plants. The functions of the parts are not studied until Grades 5 and 6 as well as additional points including separating plants that blossom from those that do not and considering that plants can propagate in different ways. Flower parts are studied by English pupils in year 5 but the parts of the plant and their functions are not studied until year 6 according to the Schemes of work.

In terms of life processes common to plants including growth, nutrition and reproduction, this is not studied explicitly for plants in Chinese Taipei. However the need for water, sunlight, air, food and other resources for different creatures and how they are affected by these is studied in Grades 5 and 6. Some basics of this are taught in Grades 1-4 but more comprehensively in the later grades. In England this topic is taught in spiral in all years from 2 to 6.

Both countries use classification methods although this is only explicit for animals in Chinese Taipei whereas it is for both animals and plants in England. This topic is not studied in Chinese Taipei until Grades 5 and 6. In England, however, pupils look at different aspects of this topic starting in year 3 as well as in year 4 and year 6. The additional aspect studied in England, which is understanding why it is important to classify animals and plants, is introduced in year 3 and concluded in year 6. Interestingly, in Chinese Taipei recognising common plants and animals in the local environment is already studied in Grades 1 and 2, but not covered at all in England.

Pupils in both countries study adaption and about how different animals are found in different habitats and how they are suited to these. In England this is introduced in year 4 and built on in year 6 according to the Schemes of work. In Chinese Taipei some basics are taught in Grades 3 and 4 to do with comparing terrestrial and aquatic animals. This work is built upon in Grades 5 and 6.

Food chains, which are not studied in Chinese Taipei, are introduced in England in year 4 and followed on in year 6.

As highlighted previously, Chinese Taipei's study of environmental protection and dangers is more comprehensive than in England and is very specific. The English programme of study point is very generic and the schemes of work indicate pupils address environmental protection in year 3 and again in year 6. In Chinese Taipei aspects of this topic are taught across the years, starting with basic recycling in Grades 1 and 2, moving on to water contamination and air pollution in Grades 3 and 4. In Grades 5 and 6 pupils study the impact of environmental changes on animals and plants, are taught about sources of water pollution, the impact of air pollution on creatures, how to reduce garbage and how to recycle a range of materials. Pupils in these grades also study the impact on the Earth of a reduction of resources and the impact of deforestation. It is also in Grades 5 and 6 that pupils study some areas not covered in the English curriculum including noise pollution and the difficulty of recouping natural resources once destroyed.

Food hygiene in Chinese Taipei is taught in Grades 3 and 4, and food additives in Grades 5 and 6. Neither of these topics is covered in England.

Both countries study the skeleton and muscles and how they allow movement to take place. As highlighted earlier, in Chinese Taipei this is done in a broader and more difficult way. In Chinese Taipei this is not studied until Grades 5 and 6 whereas in England pupils learn about this in year 4, slightly earlier although as noted, at an easier level.

Assuming that 'the change history of biological growth' equates with the study of the life cycle in England, this is studied in Grades 3 and 4 in Chinese Taipei, and once in Grades 5 and 6, pupils learn that biological continuity relies on reproduction. In England the life cycle is first introduced in year 2 and then built upon in year 5. This is broadly similar to what occurs in Chinese Taipei.

The topics of the heart, the importance of exercise, exercise and pulse rate and the effects of alcohol and drugs on the body, which are not covered in Chinese Taipei, are covered in England predominantly in year 5 although exercise is introduced in year 2 before it is built upon in year 5.

Micro-organisms are studied with greater specificity in Chinese Taipei than England. In England this topic is not introduced until year 6. In Chinese Taipei, this topic in most of its depth is also left until Grades 5 and 6. However, the fact that creatures can alter the environment is introduced in Grades 3 and 4.

The third umbrella topic in the English curriculum is 'Materials and their properties'. Basic characteristics of different materials and substances such as colour, shape and hardness are studied in the younger years in both countries. Using this information to distinguish between materials is introduced in Grades 3 and 4 in Chinese Taipei including the concept that two materials may have some properties in common and other properties which are different from each other. Using experiments to find out how materials and

substances are different is not done until Grades 5 and 6. Also in these grades pupils study the impact of plastics, metals, glass and ceramics on life and the recognition of different clothing fibres.

In terms of thermal insulation, this is studied in year 4 in England according to the Schemes of work. The basic idea of thermal conduction is introduced in Grades 3 and 4 in Chinese Taipei and being able to conduct experiments to ascertain information about the thermal conductivity of different materials is not covered until the higher grades, 5 and 6. This is also when pupils are taught that heat can be spread by conduction, convection and radiation and how to apply these properties to daily life, such as heat preservation and heat dissipation. A similar programme of progress is seen with the teaching of electrical conduction with experimentation not done until Grades 5 and 6. Furthermore, it is in these higher grades that the pH of aqueous solutions is taught.

Rocks and soils and their characteristics are covered early on in England, in year 3. The fact that there are stones, sands and soil all over the world and that they all have characteristics is introduced in Grades 1 and 2 in Chinese Taipei. A range of other associated things are studied within this topic predominantly in Grades 3 and 4 (but not in England) which include observing changes in sandstone and soil and knowing soil is a mote composed of organic substances. Pupils also study that changes to the Earth's surface are mainly caused by weathering, erosion and deposition and that it is different when flow speed and rate is different. Several other teaching points which are also not covered in England are not studied in Chinese Taipei until Grades 5 and 6. These topics include knowing that rocks are mainly composed of various minerals and that these minerals have their own characteristics, as well as that rocks can be used for a range of different purposes. Fossils are also studied in Grades 5 and 6 in Chinese Taipei.

In England, the differences between the properties of solids, liquids and gases are studied in years 4 and 5. Similarly this is studied in Grades 3 and 4 in Chinese Taipei. In Chinese Taipei however, in Grades 5 and 6, pupils also learn about the expansion of substances in heat and shrinking when cold as well as dissolution quantity and diffusion speed.

Both curricula study materials and how they change. In most aspects, the points are covered in the curriculum at similar points in pupils' studies. For example in terms of temperature and what it is a measure of, in England this is taught in year 4 and in Chinese Taipei in Grades 3 and 4. Describing what happens when materials are heated or cooled is covered in year 5 in England and is spread amongst Grades 3-6 in Chinese Taipei.

Reversible changes, are taught in year 6 in England and changes to materials as described above in Grades 3 and 4 in Chinese Taipei. There is no explicit mention of reversible changes in the curriculum in Chinese Taipei. That non-reversible changes result in the formation of new materials is also studied in year 6 in England as well as that burning is an example of this. Although burning is covered in the Chinese Taipei curriculum in Grades 3 and 4, there is no mention of reversibility in relation to this.

The water cycle is studied in year 5 in England. Aspects of the water cycle are studied in Grades 3-6 in Chinese Taipei. In the earlier grades, 3 and 4, pupils study how we suffer the effects of water evaporation and condensation in daily life. It is unclear what these effects are from the curriculum notes. Water condensing into clouds and dew is not covered until Grades 5 and 6. Furthermore, in Chinese Taipei pupils at the higher grades learn that evaporation is endothermic which is not taught in England at this stage.

Separating mixtures of materials is covered in both curricula and taught in years 4 and 6 in England. Deciding how to separate mixtures using knowledge of solids, liquids and gases is taught in year 4 as well as simple sieving. In year 6, dissolving is studied as well as how to recover solids by evaporation. Filtering is also not covered until year 6. In Chinese Taipei not all these topics are covered although the solubility of different substances is covered in Grades 3 and 4 and how this is affected by temperature is not covered until Grades 5 and 6. Also at Grades 5 and 6 pupils learn that substances are composed of smaller particles by observing processes such as dissolution, diffusion, cutting substances and assembling building blocks.

The fourth and final overarching topic in the English curriculum is ‘Physical processes’. Electrical circuits are studied in spiral fashion in the English curriculum, every two years in years 2, 4 and 6. In Chinese Taipei the construction of simple circuits is covered in Grades 3 and 4. Other aspects such as changing the number or type of components in a circuit and the effect this has, as well as representing circuits with drawings and conventional symbols, are not covered in the Chinese Taipei curriculum.

A range of forces is studied in both curricula. Attraction and repulsion in magnets is studied in year 3 in England. In Chinese Taipei in Grades 1 and 2 pupils observe that magnets can attract objects at a distance and through paper. Subsequently in the higher grades, 5 and 6, polarity is studied, as well as the deflection of a compass caused by the interaction of a magnetic needle and magnetic field.

Gravity is taught in year 6 in England and in Grades 5 and 6 in Chinese Taipei. Friction (including air resistance) is taught in year 4 in England according to the schemes of work yet not until Grades 5 and 6 in Chinese Taipei. Opposing forces are not taught until year 6 in England. This is not so explicit in Chinese Taipei, however, perceiving simple forces and how they can be used simply (pushing a ball) is studied in Grades 1-4.

Measuring forces and identifying the direction in which they act is taught in years 4 and 6 in England. This is covered in a broader fashion in Chinese Taipei and integrated with knowing the location of objects with co-ordinates (including distance and direction) and being able to use regular movement to measure time and direction (for example changes of shade). Pupils are also taught to know the size of a force as a result of the degree of deformation. These topics are taught in Grades 3 and 4 and expanded upon in Grades 5 and 6 with the knowledge of the relationships between force, speed, time and length. Furthermore, at this level, Chinese Taipei students also learn about how objects can maintain balance despite being affected by force, and look at the see-saw principle.

Light as a topic is covered in years 1, 3 and 6 in England. In Chinese Taipei shadows as well as describing light with ‘light’, ‘shade’ and ‘colour’ are covered in Grades 1 and 2 and that the reflection of light has a certain direction is also covered in these grades. The topics covered in Chinese Taipei but not in England are studied in Grades 3 and 4 and include that light is refracted when passed through different media and that a rainbow can be seen after refraction in a certain angle. In grades 5 and 6, pupils in Chinese Taipei observe irradiated light and imaging and explore the regulation of instruments and their pronunciation.

Sound is predominantly studied in year 5 in England according to the English Schemes of work. In Chinese Taipei this appears to be studied earlier, in Grades 1 and 2 although they do not study how to change the pitch and loudness of sounds.

The Earth, sun and moon and periodic changes are predominantly studied in year 5 in England. In Chinese Taipei pupils in Grades 1 and 2 study day and night and that shadows will follow these changes and that this can be used to measure time. A whole range of aspects within this topic are studied in Grades 5 and 6 in Chinese Taipei. These are aspects not covered in England and include the fact that the sun rises in the East and sets in the West (and that this direction is different in different seasons), that the moon waxes and wanes, and to know that the sun is a fixed star. Stars and constellations are also studied in these Grades.

In Chinese Taipei pupils study a further range of umbrella topics which are not covered in the English Key Stage 2 science curriculum. These topics are discussed below, starting with weather which is covered in Grades 1-4 predominantly. In Grades 5 and 6 the topic is also included and pupils are taught to describe changes of weather by quantifiable methods of temperature, wind direction, wind speed, rainfall and so on. Furthermore, pupils are taught to recognise symbols of high and low pressure lines, frontal surface and typhoons on weather maps.

The form and conversion of energy is studied in Grades 1 and 2 at a basic level, knowing the sun can provide thermal energy for example, and at a more advanced level in Grades 5 and 6. Water is also studied at a basic level in Grades 1 and 2 and with regard to surface tension in Grades 5 and 6.

Oxidation and reduction is predominantly studied in the higher grades as well as acid, alkali and salt with the only Grade 3 and 4 study point for the latter topic being the ability to distinguish the acidity and alkalinity of common foods by using smell, touch and taste.

Machinery is a topic covered across all the grades, which complements the Chinese Taipei science curriculum’s integration with technology. At the younger grades, 1 and 2, pupils use the flow of water or air to make water guns and blow pipes. At Grades 3 and 4, pupils look at how water can help to transport things, how to use the siphon phenomenon to pump water and to use connecting pipes to measure water levels.

It is not until Grades 5 and 6 that pupils study levers, pulleys, chains, belts, gears and axles and how these as well as fluid can transmit power.

Information and information transmission is also studied across the grades in Chinese Taipei with the concept of simple messages and how these can be communicated being covered in the younger years, with an increase in difficulty in Grades 3 and 4 with, for example, semaphore being introduced. In Grades 5 and 6 this is built upon with pupils studying how different animals can transmit various messages by voice.

National disasters and prevention such as recognising typhoons and earthquakes and how to prevent these are studied by the older pupils in Grades 5 and 6.

The development and usage of energy is staggered across the grades with the importance of energy conservation in daily life being covered in Grades 1 and 2. Knowing what energy is, and perceiving the common fuels as well as cultivating an attitude of conservation is studied in Grades 3 and 4. At Grades 5 and 6 the specific energy forms such as coal, natural gas, petroleum, nuclear energy, hydropower and solar energy are studied. Also at these grades pupils study the importance of imports into the country for the effectiveness of different methods of generating energy. Pupils also learn the sun is the largest source of energy and look at solar energy and put forward creative ideas for resolving the problem of reducing energy sources and understanding the importance of fuels in daily life in the process.

The beauty of science as well as the ethics of science are two final topics studied in Chinese Taipei. The former is studied in Grades 3-6, looking at the beauty in the sequences of life such as the periodic changes of the planets and the changes in animals and plants as well as the beauty of minerals in rocks. The ethics of science is studied in the higher grades, 5 and 6, and encourages pupils to make research honest and to ensure scientific work should respect life and the environment.

13.6 Integration of Subjects

As outlined in the aims and rationale of the curriculum section, the aim of the Chinese Taipei curriculum has been to move towards integrating elements of biology, chemistry, earth science, physics and life technology. This has been done alongside the interactions between the individual and himself/herself, the individual and society, as well as the individual and nature. The overarching aim from this integrated approach is that pupils will learn to understand the connection between science and their everyday lives.

Pertinent points that stand out about the integrated approach to the science curriculum include much reference to topics more commonly studied in geography in England, for example, weather. The Chinese Taipei curriculum then also makes this relevant to the pupils in their country, i.e. by studying natural disaster prevention.

The whole Chinese Taipei curriculum and how it is titled highlights the marked integration of science with technology. This makes many of the topics studied in the core teaching points very relevant and practical. For example, Chinese Taipei pupils study electricity and explicitly link this to toys, using electricity to make toys work. Another example is the

study of force, in particular pressure. Pupils study this and subsequently in relation to understanding how water guns work. This link of science to machinery within the curriculum is clear also with a look at, for example, the workings of chains, levers, pulleys, gears and axles and how devices can transmit power.

The focus on communication is interesting with a look at information and information transmission, for example, and how science and technology work within this.

Two other interesting integrated topics are 'the beauty of science' and 'ethics of scientific activities'. Looking at the beauty of nature and fostering pupils to integrate their emotion with science is very explicit in the Chinese Taipei curriculum. Similarly, a consideration for ethics in relation to science aims to encourage respect for nature and objects in science.

13.7 Differentiation

The local expert reports that just over 2.5% of primary pupils are in special education and that a range of provision exists.

13.8 Mandatory or recommended time for Subjects and Content Areas

The local expert reports that:

Generally, the allocations of the major learning areas and alternative courses of the Taiwan curriculum are 80% and 20%, respectively. Learning period of Language Arts account about 20%-30% of the Area Learning Periods. The Mathematics and Science and Technology learning areas each account for 10%-30% of the Area Learning Periods. The time for each period is approximately 40 minutes for elementary schools. Schools may adjust the time for each period and the weeks of each semester according to the school environment and the needs of students.

For the elementary schools, the Total Learning Periods consist of Area Learning periods and Alternative Learning Periods. The numbers of these three periods are listed as follows:

Table 13.3: Numbers of the Total Learning Periods, Area Learning Periods, Alternative Learning Periods per week

Length of learning periods	***Total learning periods***	***Area learning periods***	***Alternative learning periods***
Grade 1	*22-24*	*20*	*2-4*
Grade 2	*22-24*	*20*	*2-4*
Grade 3	*28-31*	*25*	*3-6*
Grade 4	*28-31*	*25*	*3-6*
Grade 5	*30-33*	*27*	*3-6*
Grade 6	*30-33*	*27*	*3-6*

13.9 Guidance or Compulsion of Teaching Methods

The local expert reports that:

One of the characteristics of the Grade 1-9 Curriculum Guidelines is that the guidelines encourage teachers to develop school-based curriculum. The instructional methods included are only suggested as guidance for teaching practice rather than compulsory. For example, according to the Science and Technology learning area curriculum guidelines, the themes and sub-themes do not represent corresponding chapter titles in the teaching materials. Teachers can re-arrange the learning contents to compile their teaching materials. In addition, for the themes related to the attitude or belief dimensions (such as the concept of humanity in the learning of sustainable development of Science and Technology), it is suggested to employ integrated methods to bring the issues into the learning process with other related themes rather than the doctrinal instruction of teaching by telling.

References

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English translation of *'The Study Fields of Science and Life Technology'* used as the Chinese Taipei curriculum.

14 Science comparison: Hong Kong

This comparison was completed in Hong Kong with summary sections added by NFER staff.

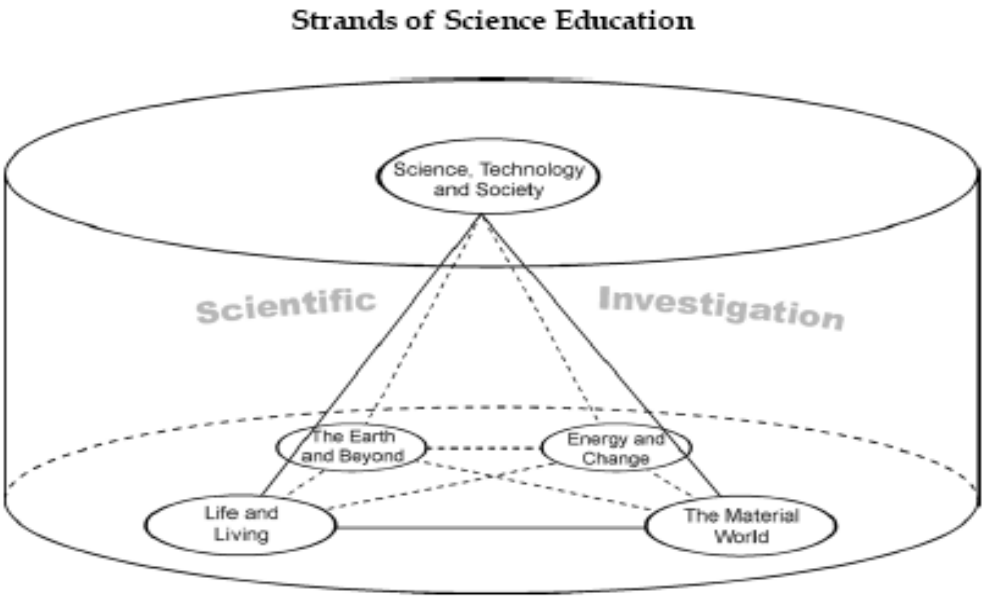
The English national science curriculum for ages 7 to 11, which is Key Stage 2 and covers years 3, 4, 5 and 6, is compared with that of Hong Kong for the same age group, which is year 3 covered by Key Stage 1 and years 4, 5 and 6 covered by Key Stage 2.

In Hong Kong, Science Education (SE) is taught in conjunction with the other two Key Learning Areas (KLAs), Personal, Social & Humanities Education (PSHE) and Technology Education (TE), as a single subject, General Studies (GS), to students of the age group concerned.

Therefore, the following comparison is mainly based on content of both the General Studies for Primary Schools Curriculum Guide (Primary 1 - Primary 6) (CDC, 2002) and the Science Education Key Learning Area Curriculum Guide (Primary 1 - Secondary 3) (CDC, 2002).

14.1 Structure

According to the SE KLA Curriculum Guide, the major learning elements in science are arranged into six strands in the curriculum for the purpose of curriculum planning and organization. The six strands are Scientific Investigation, Life and Living, The Material World, Energy and Change, The Earth and Beyond, and Science, Technology and Society (STS). The six inter-related strands can be represented diagramatically as follows:



The six strands of SE KLA curriculum are embedded in the six strands of the GS curriculum including a) Health and Living, b) People and Environment, c) Science and Technology in Everyday Life, d) Community and Citizenship, e) National Identity and Chinese Culture, and f) Global Understanding and the Information Era. And there are science elements in a), b) and c).

For the science curriculum of England, the knowledge, skills and understanding in each programme of study identify the four areas of science that pupils study which include a) Scientific inquiry, b) Life processes and living things, c) Materials and their properties, and d) Physical processes.

Both the SE KLA and GS curriculum guides of Hong Kong provide the following information: curriculum framework specifying aims, learning targets, learning objectives, thematic approach, as well as strands, generic skills, values and attitudes as the components of the curriculum; suggestions regarding curriculum planning on central curriculum and school-based curriculum, collaborative lesson planning and modes of curriculum planning; guide to learning and teaching on the inquiry approach, information technology for interactive learning, homework, life-wide learning and catering for student diversity; guide to assessment on formative and summative assessment; suggestions to learning and teaching resources and resources management; and exemplars of effective learning.

Similar information is also provided by the science curriculum of England as follows: programmes of study including the knowledge, skills and understanding, and the breadth of study; attainment targets and level descriptors; key information that should be taken into account when teaching the subject; definitions of words and phrases in the programmes of study; suggested opportunities for pupils to use information and communication technology as they learn the subject; some key links with other subjects; information on inclusion; information on the use of language and ICT across the curriculum; and health and safety statement.

Science Education (SE) in Hong Kong is one of the Key Learning Areas (KLAs) of the school curriculum. At the age group concerned, it is an integral part of the General Studies (GS) curriculum, which also embraces the other two KLAs, Personal, Social & Humanities Education (PSHE) and Technology Education (TE). Teachers should help students connect their learning experiences in science and with those in other KLAs as this will facilitate effective learning with limited lesson time.

Teachers should seek to establish links with other KLAs (e.g. Chinese & English, Language, Mathematics, Personal, Social & Humanities, Technology Education, Arts, Physical Education) where appropriate to provide students with a coherent and holistic outlook to the learning of certain themes or issues.

Both SE KLA and GS curricula in Hong Kong are structured by Key Stage. Primary 1 to Primary 3 belong to Key Stage 1 while Primary 4 to Primary 6 to Key Stage 2. The science curriculum in England is also structure by Key Stage; however, Key Stage 1 includes year groups 1 to 2 while Key Stage 2 includes year groups 3 to 6.

	Hong Kong	England
Key Stage 1	Primary 1 to Primary 3	year groups 1 to 2
Key Stage 2	Primary 4 to Primary 6	year groups 3 to 6

The structure and terminology used in the two curricula can be compared as below:

Hong Kong	England
• **Students**	• **Pupils**
• **Curriculum** Set out the general directions for curriculum development of school science education in Hong Kong to fulfil the vision of enabling students to attain life-wide and life-long learning.	• **Curriculum** Determine the content of what will be taught and sets attainment targets for learning, and how performance will be assessed and reported.
• **Strands** Major learning elements in science are arranged into six inter-related strands for the purpose of curriculum planning and organization.	• **Areas** Knowledge, skills and understanding in each programme of study that pupils study.
• **Framework** Comprises a set of interlocking components including: subject knowledge and skills expressed in the form of learning targets and learning objects; generic skills; and values and attitudes. It sets out what students should know, value and be able to do at Key Stages 1 and 2, and defines the aims, learning targets, learning objectives, and core and extension.	• **Programmes of study** Sets out what pupils should be taught in science at Key Stages 1, 2, 3 and 4 and provide the basis for planning schemes of work.
• **Learning objectives** Define more specifically what students are expected to learn in accordance with the broad learning targets for Key Stages 1 and 2. They are to be used by teachers in the planning of the curriculum, units, lessons and activities.	• **Attainment targets** Set out the 'knowledge, skills and understanding that pupils of different abilities and maturities are expected to have by the end of each Key Stage'.
• **Thematic Approach** School can develop different themes to integrate the proposed core elements of the curriculum. Exemplars have been given to show how a school designed its own themes according to the needs, interests and abilities of its students.	• **Breadth of study** Identifies contexts in which science should be taught, make clear that technological applications should be studied, and identifies what should be taught about communication and health and safety in science.

14.2 Aims and rationale for the curriculum

The SE KLA and GS curricula have been developed by the Curriculum Development Council (CDC) to support the Basic Education Curriculum Guide - Building on Strengths (Primary 1 - Secondary 3) (CDC, 2002) and to help realise the recommendations made in the CDC Report on Learning to Learn - The Way Forward in Curriculum Development (CDC, 2001) and in the Education Commission's (EC's) education reform final report, Learning for Life, Learning through Life (EC, 2000). Developing of the curriculum guides have taken the concerns, needs and interests of schools, teachers and students as well as societal expectations expressed during the Learning to Learn consultation period into consideration.

The Basic Education Curriculum Guide - Building on Strengths (Primary 1 - Secondary 3) (CDC, 2002) has suggested four key tasks to help students to develop independent learning capabilities within and across Key Learning Areas. These tasks including Moral and Civic Education, Reading to Learn, Project Learning, and Information Technology for Interactive Learning can be adopted and adapted in the SE KLA and GS to enliven learning and teaching, and to help learners progress towards the vision of whole-person development and learning to learn.

The SE KLA Curriculum Guide is developed according to the broad aims of education in Hong Kong. It will serve as a reference for developing a school-based curriculum. Schools are expected to develop a school-based curriculum to meet the needs of their students with reference to the learning targets and objectives set out in the curriculum guide.

The GS curriculum, on the other hand, is designed in the belief that students' learning experiences should be connected and not compartmentalised, so that students can develop a holistic view of themselves as individuals in the community, their place in the natural world, and the interaction of human beings with the environment. The curriculum has been developed with the emphases on: creating more learning space by removing obsolete content; strengthening the interface with kindergarten; integrating students' learning experiences, promoting life-wide learning; developing students' independent learning ability; enhancing interest and curiosity in science and technology; and putting emphasis on students' affective development.

In Hong Kong, school science education will provide learning experiences through which students acquire scientific literacy. Students will develop the necessary scientific knowledge and understanding, process skills, values and attitudes, which are the three inter-locking components that the curriculum framework comprises, for their personal development, for participating actively in a dynamically changing society, and for contributing towards a scientific and technological world. Science education therefore aims for students to: a) develop curiosity and interest in science; b) develop the ability to inquire and solve problems; c) acquire basic scientific knowledge and concepts for living in and contributing to a scientific and technological world; d) recognise the usefulness and limitations of science and the interconnections between science, technology and society and to develop an attitude of responsible citizenship, including respect for the

environment and commitment to the wise use of resources; e) become familiar with the language of science and be equipped with the skills to communicate ideas in science-related contexts; f) appreciate and understand the evolutionary nature of scientific knowledge; g) attain personal growth through studying science; and h) be prepared for further studies or enter careers in scientific and technological fields.

As one of the key learning areas in the school curriculum, science education also aims to develop students' capability for lifelong learning while maintaining their sense of wonder about the world around them. Good science education for students is vital for Hong Kong to keep pace with technological advancement and for enhancing Hong Kong's economic growth and sustainability.

The GS curriculum related to SE aims to enable students to: a) maintain a healthy personal development and become confident, rational and responsible citizens; b) develop curiosity and interest in the natural and technological world as well as understand the impact of science and technology on society; c) develop a care and concern for the environment.

The GS curriculum was first introduced in response to the recommendations of Education Commission Report No. 4 (EC, 1990). The Syllabus for General Studies: Primary 1-6 (CDC, 1997) implemented in 1996 integrated the subjects of Social Studies, Primary Science and Health Education, which were taught as separate subjects, and aimed at preparing children for a comprehensive education in the course of primary education. The GS subject encompassed and reinforced the intellectual, communicative, social, moral, physical and aesthetic areas of development which children acquired in kindergartens. It also prepared children for their secondary education at a later stage.

The present GS curriculum is developed on the basis of the previous one and revised in accordance with the curriculum reform in 2000. It aims at guiding children to have a better understanding of themselves and the world around them, and of the inter-dependence between people, things and their environment. The curriculum proposes a range of contexts for developing students' knowledge and abilities to achieve the aims of education. As Hong Kong is experiencing rapid social, scientific and technological development, it is necessary to introduce an open and flexible curriculum framework that enables teachers to enhance their students' capabilities of learning how to learn so that they can meet and overcome the challenges of the new century.

14.3 Content

The programmes of study of the England curriculum set out in detail what students should be taught whereas the learning objectives of the SE KLA and core elements of GS in Hong Kong set out what students should know in more general terms so as to give schools and teachers the flexibility and ownership to plan and develop alternative curriculum modes to meet varied needs. This difference in approach makes detailed comparisons of difficulty and breadth more difficult.

Using topics in the England curriculum as a starting point, most of the topics covered in the England curriculum are covered in SE KLA and GS curriculum of Hong Kong. Topics concerning "Weather", "Energy and Change" and "Science, Technology and Society", "Environment and Resources" are covered in the Hong Kong curriculum only:

Topics	**Learning objectives of SE KLA[3] & core elements of GS[4] of Hong Kong**
Weather	KS1 · to identify simple features of weather change · weather changes and how they affect our daily life KS2 · to identify and describe weather and seasonal changes and their effects on living things · adverse weather conditions and related safety measures
Energy and Changes	KS1 · to describe ways energy is used in daily life · to identify sources of energy in daily life · to be aware of safety issues in the use of energy in daily life · sources of energy and ways in which energy is used in daily life KS2 · to report on patterns of energy use in the home, school and other workplaces · to identify safety measures associated with the use of different forms of energy · to be committed to the wise use and conservation of energy in daily life · to design and make models enabling the efficient transfer of energy · simple solutions in solving energy problems

[3] Items in blue colour
[4] Items in red colour

Science, Technology and Society	KS1 · to appreciate some of the ways scientific and technological advancements have influenced our life · to recognise some of the ways modernization and the information era have influenced us · how technology contributes to daily life · using science and technology to solve problems at home · safety issues in relation to science and technology · famous scientists and inventors and their contributions KS2 · to appreciate some of the ways scientific and technological advancements have influenced our life · to appreciate that the study of science is partly for creating meaning in our world and partly to improve our quality of life · to discuss and recognize some of the ways modernization and the information era have influenced us · technological advances leading to the detailed observation of distant big objects and very small objects · the trends in scientific and technological advances · safety and personal responsibility in using science and technology
Environment and Resources	KS2 · to be committed to the wise use of natural resources and the conservation of the environment · to recognise the Earth as a wealth of resources · to show concern for the environment and make wise use of natural resources · to show concern for the environment and make wise use of natural resources · the Earth as a source of resources · renewable and non-renewable resources available on Earth

Since the GS curriculum in Hong Kong integrates the learning of Personal, Social and Humanities Education (PSHE), Science Education (SE) and Technology Education (TE), the development of personal and social values and attitudes is intrinsic within the GS curriculum. Schools are encouraged to strengthen the coherence and connection between different areas of learning in the curriculum through the adoption of thematic approach and a life event approach. Learning objectives for values and attitudes which is one of the three interlocking components comprising the curriculum framework are also listed out. Therefore, all science topics will be introduced in conjunction with aspects relating to personal, social and emotional development whenever possible. For instance, when discussing the life processes of animals and plants, the values and attitudes that

students have to develop will be to appreciate the existence of living things and show concern for endangered species

14.4 Difficulty and coverage

In Sc1 Scientific Enquiry

It seems that the England's curriculum covers more in the Sc1 Scientific Enquiry which emphasizes ideas and evidence in science and investigative skills with planning, obtaining and presenting evidence, as well as considering evidence and evaluating. In the HK curriculum, there is introduction of Investigation with steps of investigation - identifying the problem, predicting results, designing an investigation, measuring and recording, and interpretation of data. It is speculated that more hands-on investigation will be arranged in England classrooms.

In Sc2 Life processes and living things

The learning elements of the two curricula are quite similar, with an exception on the "Living things in their environment". There is more emphasis of the HK curriculum on the interdependence, relationships, influences, and impact of living things and the environment. How the activities of human affect other living things and their living environments, the concern for endangered species, and environmental protection issues are also covered in the HK curriculum.

- The HK curriculum covers more on major organs and systems of the body while that of England covers mainly only circulation.
- Although both curricula talks about the interdependence of living things, the HK curriculum also mentions how the activities of human affect other living things and their living environments.
- The HK curriculum places much emphasis on environmental protection issues.
- The England curriculum seems to cover more on micro-organisms because the harms as well as the benefits of micro-organisms are mentioned but the HK curriculum seems to focus mainly on the harms.

In Sc3 Materials and their properties

- Rocks and soils are not mentioned in the HK curriculum but in England's. This may be due to the fact that HK is a small crowded city full of high-rise buildings and resources found in the natural environment are seldom mentioned.
- There are more topics covered in the "Sc3 materials and their properties" in the England curriculum with changing materials and separating mixtures of materials. "Materials" is a new topic to the HK curriculum and the coverage seems limited.

In Sc4 Physical Processes

- Forces of attraction and repulsion between magnets are covered in the curriculum of England but not in that of HK.
- The HK curriculum recommends the recognition and investigation of some simple patterns and phenomena related to light, sound, electricity and movement, while the UK curriculum spells out the specific science concepts (e.g. how sound is made - vibration, how sound travels, series and parallel circuits, different types of force, etc).

- More specific learning elements are described in the UK curriculum (e.g. changing the number or type of components of a circuit, drawings symbols to represent circuits, how to measure forces and identify the direction in which they act, etc.)
- The HK curriculum seems to be covering more when the Sun, Earth, Moon and Universe is concerned. In the HK curriculum, other objects in the sky apart from the Sun, Earth and Moon, people's effort in space exploration and how our everyday lives are affected, patterns and changes observable on Earth caused by the movement of the Sun, Earth and Moon are included.

Generally speaking, there are more scientific elements in the England curriculum, while the HK curriculum advocates development of themes which connect learning experiences in three key learning areas to meet the needs and interests of students. Besides, it seems that the curriculum of England is a bit more difficult than the curriculum of HK in a sense that it gives teachers less flexibility to decide what needs to be included under the programmes of study.

In summary the comparison of the two curricula in breadth and difficulty can be summarized as:

Scientific enquiry, difficulty		The Hong Kong curriculum is regarded as:
more demanding in	0	curriculum area
of similar demand in	12	curriculum areas
less demanding in	1	curriculum area

Scientific enquiry, breadth		The Hong Kong curriculum is regarded as:
broader in	2	curriculum areas
similar in breadth in	9	curriculum areas
narrower in	5	curriculum areas

Scientific enquiry: The Hong Kong curriculum is therefore viewed as similar in difficulty and narrower.

Life processes and living things, difficulty The Hong Kong curriculum is regarded as:

more demanding in	5	curriculum areas
of similar demand in	12	curriculum areas
less demanding in	9	curriculum areas

Life processes and living things, breadth The Hong Kong curriculum is regarded as:

broader in	8	curriculum areas
similar in breadth in	10	curriculum areas
narrower in	12	curriculum areas

Life processes and living things: The Hong Kong curriculum is seen less demanding and narrower.

Materials and their properties, difficulty The Hong Kong curriculum is regarded as:

more demanding in	1	curriculum area
of similar demand in	4	curriculum areas
less demanding in	4	curriculum areas

Materials and their properties, breadth The Hong Kong curriculum is regarded as:

broader in	1	curriculum area
similar in breadth in	4	curriculum areas
narrower in	13	curriculum areas

Materials and their properties: The Hong Kong curriculum is again regarded as less demanding and narrower.

Physical processes, difficulty The Hong Kong curriculum is regarded as:

more demanding in	4	curriculum areas
of similar demand in	0	curriculum areas
less demanding in	15	curriculum areas

Physical processes, breadth The Hong Kong curriculum is regarded as:

broader in	4	curriculum areas
similar in breadth in	0	curriculum areas
narrower in	15	curriculum areas

Physical processes: The Hong Kong the curriculum is again regarded as less demanding and narrower.

The average rating for confidence in the judgment of difficulty was 1.7, below *quite confident* (2.0) while that for breadth was 1.8, again below *quite confident* (2.0). The lower values for this comparison compared with the other science comparisons reflect the generality of most of the statements in the Hong Kong science curriculum.

14.5 Order of Teaching and when Taught

In Hong Kong, neither the SE KLA nor the GS curriculum is structured by year. They are structured by Key Stage as the Science Curriculum in England but examples of how schools can develop different themes to integrate the proposed core elements of the curriculum are provided.

With reference to the exemplar that shows how a school designed its own themes according to the needs, interests and abilities of its students, the following table lists the science-related content of the examples of themes of the GS curriculum for year 3 to 6 to show topics which are visited once and those which are revisited and the extent to which they are revisited. For example, the concept “Reduce, reuse, replace and recycle” is introduced in year 3 and will later be revisited in year 6 by putting the concept into action. However, topics like “Bacteria and viruses” will only be visited once in year 4.

Year 3	Year 4	Year 5	Year 6
• Wide variety of living things in Hong Kong • Basic needs of living things • Living things and their living environment • Living things and my living environment	• The natural environment • How human beings are affected by the environment • How human beings are affected by the environment • People’s response to natural hazards	• Inter-relationship between green plants and the atmosphere • The impact of physical environment on people’s life	• Adaptation of living things to the environment • Balance of Nature affected by human activities
• Reduce, reuse, replace and recycle • Energy conservation	• Protecting the environment	• Conservation of resources by using less electricity • Air pollution and health	• Energy and the environment • Different types of pollution in our community: causes and effects • Ways to protect our environment from pollution • Problems caused by exploitation of resources and its possible solutions • Conservation of our environment • Reduce, reuse, replace and recycle in action

Year 3	Year 4	Year 5	Year 6
• Daily changes of the Sun and the Moon: relative positions	• Surface of the Earth (continent and ocean) and changes in it	• Rotation of the Earth and its revolution around the Sun • Planet of our Solar System • Phenomena of our Solar System • Phenomena that we can observe when the Moon and the Earth move around the Sun	• Aims of exploration of space • Changes to our daily life brought about by space exploration • Contribution and success of China and other countries in the exploration of space
• Food hygiene and preservation • Over-eating and under-eating • Exercise and rest	• Body parts/ systems and their functions • Ways of keeping my body healthy • Oral health	• Food and nutrition • Smoking and health • Alcohol and health • Causes and effects of substance abuse	
• Simple features of a day's weather • Weather forecasts and keeping weather records • Relationship between cloud and rain	• Seasons in Hong Kong • Pattern of climate in Hong Kong		
	• Uses of water • Purification of water • Investigating water	• Change of state using water as an example	
	• Bacteria and viruses • Causes and prevention of diseases		• Killer disease in Hong Kong
		• Cycles in the living world • Need for continuation of life • Changes experienced at puberty • Healthy habits at puberty	• Inheritance of characteristics

14.6 Integration of Subjects

As mentioned in 1.1, Science Education (SE) at the primary level in Hong Kong integrates with the other two KLAs, Personal, Social and Humanities Education (PSHE) and Technology Education (TE), to form a single subject, General Studies (GS). The nature and content of the subject provide ample opportunities for collaboration with other KLAs. Different approaches may be adopted for organising the learning elements of the six strands in the GS curriculum as well as integrating with other KLAs. The three suggestions below are listed for consideration:

A balanced coverage of PSHE, SE and TE elements throughout Primary 1-6
This approach helps to ensure that the essential contents are included in the schools' curriculum plan, but is less able to meet the range of different students needs and interests.

Different emphases among the three KLAs at different levels
For the age group (7-11) concerned, alternative modes of curriculum planning focusing on either PSHE or SE and TE may be considered to cater for different needs and interests of students.

An integrated mode extending beyond the KLAs of PSHE, Se and TE to other KLAs
This helps to provide a holistic learning environment for students through appropriate themes.

Below are some examples of how other KLAs contribute to SE KLA suggested by the curriculum:

KLA	Examples
Chinese and English Language	• Read science fiction, stories of scientific discovery and scientists for fostering interest in science
Mathematics	• Manipulate data for the investigation and interpret quantitative information
Personal, Social & Humanities	• Engage in cross-curricular studies such as health education, sex education and environmental education
Technology Education	• Apply scientific principles in design and problem-solving process (it is widely accepted that learning experiences in science and technology are intertwined.)
Arts	• Appreciate the beauty of natural phenomena
Physical Education	• Engage in cross-curricular studies, such as sports science

14.7 Differentiation

On the principle of "one curriculum framework for all"[5], one curriculum is used by all students. As stated in the SE KLA and GS curriculum guides, teachers should take learner diversity into consideration and take appropriate action to enhance the effectiveness of teaching and learning and to help different learners learn better.

The curriculum can be flexibly and appropriately adapted to suit the needs, interests, abilities, experiences and learning styles of different students, for instance, extension themes and activities can be provided to students of high ability while themes to cover the core elements can be developed for those of average abilities. Teachers can select more challenging content and activities for students with a strong interest or high ability in science. Not everything in the textbook has to be covered.

Since students are all different in cognitive and affective development, teacher are encouraged to adopt specific strategies by making use of a spectrum of intelligences and multi-sensory experiences to tap the different potential of students. Teachers may employ appropriate learning and teaching strategies to help students develop their multiple intelligences and generic skills; demand a higher level of performance from more capable students or assign more challenging tasks to them; employ different ways to enhance interactive learning; make use of flexible grouping according to the nature and purpose of the activity; provide students with the same tasks and exercises but with varied amount and style of support from the teachers; and adjust the pace of learning and teaching in accordance with the speed of learning and ability of the students.

There is no need for a school to have standardised assessment if the students' abilities are wide-ranging. School can devise effective assessment policy and practices that allow for some differences in content reflecting the notion of core and extension, a range of modes of assessment, and different levels of performance among students. Both formal and informal formative assessment should be used frequently and self-assessment and peer assessment should are also encouraged.

In order to address the diverse learning needs of students, an Integrated Education Programme, the Whole-school Approach, was first promoted to schools in 1999. From 2003/04 onwards the EDB has implemented a pilot scheme of a New Funding Mode (NFM) for some schools. In the 2004-05 school year, 117 schools adopted a whole-school approach to inclusion with an enrolment of about 800 students with SEN such as hearing impairment, visual impairment, physical disability, autistic disorders or mild grade intellectual disability[6]. In the 2006-07 school year, 373 ordinary schools adopted a whole-school approach and supported about 11000 students with SEN or disability[7]. In the 2007-08, there are 282 schools (primary and secondary) participating in the NFM pilot scheme[8].

[5] EDB - Special Educational Needs http://www.edb.gov.hk/index.aspx?langno=1&nodeID=2378
[6] Disabled students enjoy studying in mainstream schools http://www.info.gov.hk/gia/general/200502/11/02090093.htm
[7] Hong Kong 2006 - Education - Overall Education Landscape http://www.yearbook.gov.hk/2006/en/07_04.htm
[8] EDB - Whole School Approach to Cater for Students' Diverse Learning Needs http://www.edb.gov.hk/index.aspx?nodeID=181&langno=1

The education policy of Hong Kong aims at providing opportunities for students with diverse learning needs to receive appropriate education alongside their peers so as to help them develop their potentials. The Government addresses students' special educational needs (SEN) by implementing the Integrated Education Programme in schools adopting a Whole-school Approach. The purpose of the whole school approach is to make full use of all available resources in the school, to adopt diversified teaching strategies and effective assessment methodology as well as to make curriculum adaptation to meet students' diverse learning needs. In Hong Kong, one curriculum is used by all students. Therefore, students with SEN, either in inclusive schools or special schools, will have full access to the mainstream curriculum.

In order to suit the needs of students with SEN, the Committee on Special Educational Needs (CSEN)[9] have also developed Programme of study; learning objectives; learning and assessment exemplars for students with SEN so that they are offered essential life-long learning experience. Materials and teaching packages on curriculum for students with SEN have also been uploaded[10] for teachers' reference.

14.8 Pedagogy and Time Allocations

As recommended in CDC report Learning to Learn - the Way Forward in Curriculum Development (2001) and the Basic Education Curriculum Guide - Building on Strengths (2002), 12-15% of students learning time in school **should** be allocated to the learning of GS, and the suggested learning time is 285-356 hours for each Key Stages 1 and 2. Students are therefore entitled to about 100 hours of learning time in GS per year. That is, on the assumption that there are 32 teaching weeks in a school year, school **should** allocate about a minimum of 5 periods per week to GS per school year for each level. However, schools are allowed to exercise flexibility to vary the total time allocated per year according to the mode of curriculum integration adopted. In addition, the curriculum states that students should be involved in scientific investigations in order to help them master basic understanding of scientific concepts and cultivate the habit of exploring science with an open mind. It is **recommended** that students should engage in not less than 15 hours at Key Stage 1 and 20 hours at Key Stage 2 of hands-on and minds-on learning activities in science and technology and not less than 15 hours at Key Stage 1 and 20 hours at Key Stage 2 on project learning. Schools can create curriculum space by spending about 80% of the total learning time on core elements and flexibly arrange learning activities for the remaining 20%.

[9] EDB - Special Educational Needs http://www.edb.gov.hk/index.aspx?langno=1&nodeID=2378
[10] EDB - Special Education Resource Centre - Introduction http://www.edb.gov.hk/index.aspx?nodeid=2524

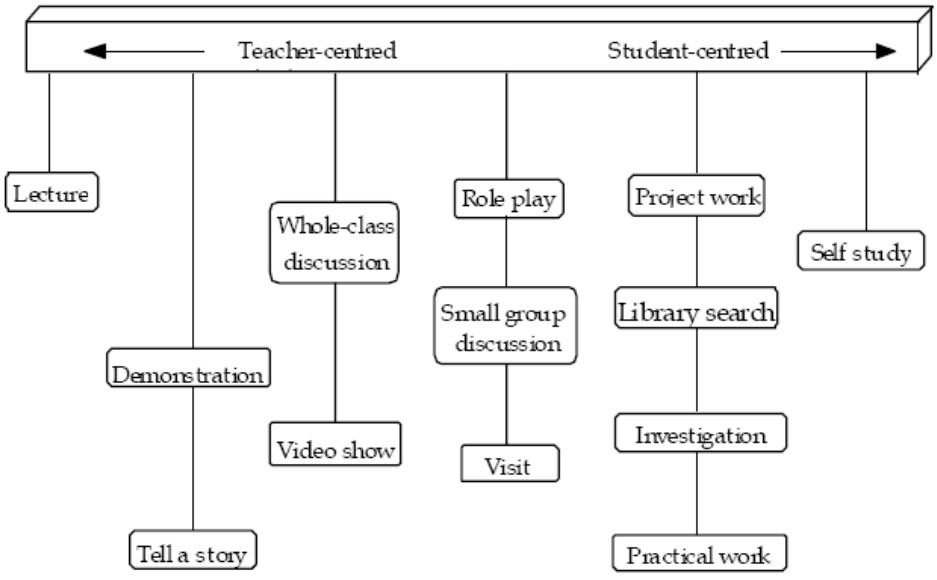
The table below summarises the time allocation for GS learning:

Learning time of student for GS in school	12-15%
Learning time for each KS	285-356 hours
Learning time for GS per student per year	About 100 hours
Learning time for GS per week per school	A minimum of 5 periods on the assumption that there are 32 teaching weeks in a school year
Engagement in hands-on and minds-on learning activities	Not less than 15 hours (KS1) Not less than 20 hours (KS2)
Engagement in project learning	Not less than 15 hours (KS1) Not less than 20 hours (KS2)

14.9 Guidance or Compulsion of Teaching Methods

There is guidance of teaching methods used by teachers, yet those methods are not compulsory. Each school, with its unique characteristics of teachers and students, should attempt to adapt the central curriculum to different degrees by varying the organization of contents (including the choice of extensions), contexts, criteria and modes of assessment as well as the learning and teaching strategies to be used in order to help their students achieve the learning targets. Teachers should also use different learning and teaching strategies to achieve different purposes and to suit the learning styles, abilities, interests and needs of students. The following spectrum shows a variety of strategies suggested by the SE KLA curriculum, ranging from very teacher-centred methods to very student-centred methods.

Spectrum of Teaching Methods



Teachers are encouraged to decide on appropriate teaching strategies in accordance with the topics / skills to be taught as well as the interests and abilities of their students. Factors that can be considered by teachers when deciding on the teaching strategies for a particular topic include learning objectives to be achieved, abilities and learning styles of students, interests of students, prior knowledge of students, availability of resources, and amount of time available.

Guiding principles are also provided by the GS curriculum guide for teachers to decide what learning and teaching strategies can be adopted for GS in a) optimising learning opportunities, b) arousing students' interest in learning, c) developing students' learning to learn capabilities, d) developing students' generic skills and nurturing students' positive values and attitudes, e) enriching students' learning experiences.

Taking the guiding principles into consideration, schools are encouraged to use the inquiry approach in the learning and teaching of GS, to enable students to: a) develop generic skills and nurture inquiring attitudes or habits of mind that will enable students to continue the quest for knowledge throughout life, b) take a proactive role in the learning process to construct knowledge about the natural and man-made world, c) become self-directed independent learners, d) develop a holistic view of themselves as individuals in the community, their place in the natural world, and the interaction of human beings with the environment, e) develop an interest in exploring, investigating and generating solutions for problems emerging from the study of social and science-related content.

Major strategies and activities such as interviews, surveys, fieldworks, case studies, role-play, games, data collection and analysis are introduced so as to help teachers to implement inquiry-based learning. More hands-on activities are encouraged to nurture students' curiosity in science. Project Learning which is one of the four key tasks recommended by the CDC document, investigation and service learning are introduced as strategies to implement inquiry-based learning. The other key tasks, Moral and Civic Education, Reading to Learn and Information Technology (IT) for Interactive Learning, can also be adopted in GS to enliven learning and teaching.

Quality and meaningful homework should also be given to students to construct knowledge, develop deeper understanding of and connections among the concepts learned, and provide an opportunity for them to apply the skills acquired. Purposes of homework and guidelines for homework setting are also provided. Some examples of meaningful science homework include: library search, writing a learning journal, designing a new device, building a model, writing an experimental report and collecting newspaper cutting.

Related documents

Curriculum Development Council (1997). Syllabus for General Studies: Primary 1 -6. Hong Kong: Curriculum Development Council.

Curriculum Development Council (2001). Learning to Learn - The Way Forward in Curriculum Development. Hong Kong: Curriculum Development Council.

Curriculum Development Council (2002). Basic Education Curriculum Guide - Building on Strengths (Primary 1 - Secondary 3). Hong Kong: Government Printer.

Curriculum Development Council (2002). General Studies for Primary Schools Curriculum Guide (Primary 1 - Primary 6). Curriculum Development Council.

Curriculum Development Council (2002). Science Education Key Learning Area Curriculum Guide (Primary 1 - Secondary 3). Hong Kong: Curriculum Development Council.

Education Commission (1990). Education Commission Report No. 4. Hong Kong: Government Printer.

Education Commission (2000). Learning for Life, Learning through Life: Reform Proposals for the

15 Science Comparison: Latvia

15.1 Structure

In Latvia, the school years are organised into Grades, with Grade 1 being the first year of compulsory primary education. Pupils in Latvia start compulsory primary school in the calendar year in which they turn seven years old. The academic school year however, runs from 1 September to 31 May. As school starting age is linked to the calendar year, not the academic year, it means that in the Grade 1 academic year pupils may be six years old when they start and turn seven or they may already be seven years old when they start and turn eight. Table 15.1 shows the age and English year group equivalents to the Latvian Grades 1-6.

Table 15.1: Age and English year group equivalents to the Latvian Grades 1-6

Latvia Grade	Age (years)	English year group equivalent
Grade 1	6/7 → 7/8	Year 2/3
Grade 2	7/8 → 8/9	Year 3/4
Grade 3	8/9 → 9/10	Year 4/5
Grade 4	9/10 → 10/11	Year 5/6
Grade 5	10/11 → 11/12	Year 6/7
Grade 6	11/12 → 12/13	Year 7/8

The Latvian curriculum for Grades 1-6 is structured in two blocks:

What pupils are expected to know by the end of Grade 3

What pupils are expected to know by the end of Grade 6

What pupils are expected to know by the end of Grade 3 can be compared with the Key Stage 2 Science curriculum, however, what is expected to be known by the end of Grade 6 includes pupils, whom in England might be in years 7 or 8. From the Latvian curriculum it is not possible to tell when specific aspects are taught. It is possible that some things are not taught until year 7 or year 8 age equivalents. Therefore when topics are labelled broader because of elements taught in Grades 4-6, it is not possible to say confidently this is broader than what is taught in English primary schools at Key Stage 2.

The Latvian curriculum prescribes what pupils must know at the end of Grade 3 and the end of Grade 6. These learning points are given under three broad headings at the end of both Grade 3 and Grade 6: 1. Basics of research work, 2. Nature's systems and processes and 3. Interaction between the human and environment. Each of these three headings is further sub-divided as can be seen in Table 1.2.

The curriculum document has a list of points pupils are expected to know or ways in which pupils are expected to behave by the end of Grade 3 and a similar list of expectations for pupils by the end of Grade 6. These form part of what the Latvian curriculum terms the 'Academic Discipline Standard' for Science at these grades.

The Latvian 'Basics of Research Work' strand is similar to the English 'Scientific Enquiry' strand. The Latvian 'Nature's systems and processes' strand is loosely an amalgamation of the other three English strands; 'Life processes and living things', 'Materials and their properties' and 'Physical processes'. It includes however, a range of points which in England are more likely to be studied in humanities or geography, i.e. weather and terrain (e.g. mountain formations and volcanic activity).

In the Latvian curriculum there is a clear emphasis on pupils' interaction with the environment in terms of safety and health etc. Several points on the Latvian curriculum document are attitudinal, expecting pupils to behave in certain ways in certain situations, particularly in terms of health and safety and the environment. Although present in the English curriculum in the 'Breath of Study', this appears more explicit in Latvian with exact guidance for pupil expectations in different situations.

Table 15.2: Division of Latvian curriculum at end of Grade 3 and Grade 6

Basics of research work	**Nature's systems and processes**	**Interaction between the human and environment**
Obtainment of information	Organisms and living processes	Safety
Research planning	Features of life	Environment
Experimental activity for obtainment of data	Plants Fungi (mushrooms)	Health
Processing and analysis of data obtained from information sources and in experiments	Human	Importance of natural sciences and technologies.
Introduction with the obtained results and discussing the results.	Micro-world	
	Ecosystems	
	Earth and its place in the Universe	

Basics of research work	Nature’s systems and processes	Interaction between the human and environment
	Planet Earth within the Solar system	
	Lithosphere of Earth	
	Hydrosphere of Earth	
	Atmosphere of Earth	
	Earth nature’s sceneries	
	Substances and materials	
	Substances and materials in nature	
	Characteristics of substances and materials	
	Transformations of substances and materials	
	Use of substances and materials	
	Composition of substances solutions	
	Physical processes	
	Light	
	Sound	
	Heat	
	Kinetics	
	Electrics and magnetism	

15.2 Aims and rationale for the curriculum

The Latvian science curriculum objectives for Grades 1-6 are described below, taken directly from the curriculum.

Objective and tasks of the subject

The objective of the subject "Science" is to create and improve the interest of the student about study of natural systems and processes, by creating understanding of nature's diversity and unity, in order to promote favourable attitude towards environmental and health preservation and improvement.

The task of the subject "Science" is to create an option for the student to:

- *Learn the basics of research work in science*
- *Study the nature's systems and processes, by learning to understand the diversity and unity of the nature*
- *Understand importance of achievements in natural sciences in the daily life of humans and to understand the necessity of preserving environment and health, by obtaining practical experience in preserving and improving the quality of the environment.*

15.3 Content

Broadly speaking, much of what is in the English curriculum is also covered in the Latvian curriculum. As outlined in section 1.1 on Structure, the Latvian 'Basics of Research Work' strand is similar to the English 'Scientific Enquiry' strand. The Latvian 'Nature's systems and processes' strand is loosely an amalgamation of the other three English strands; 'Life processes and living things', 'Materials and their properties' and 'Physical processes'.

In both curricula therefore, the science of planning and carrying out investigations is explicit. Both curricula cover aspects such as using resources, thinking about what might happen, taking measurements (using equipment correctly and taking measurements in appropriate units), observing safety regulations, repeating measurements, presenting results, identifying patterns in results, writing conclusions and reviewing their work. Both curricula also emphasise the importance of pupils learning about how science has played a part in the development of many useful things.

Pupils in both countries learn about life processes in plants and humans and look at how these differ in different environments. Both curricula cover plant parts and conditions for growth as well as keys and grouping. They also look at different plants and animals in different habitats. Both curricula look at ecosystems as well as micro-organisms. Protection of the environment is also a theme in both countries.

An understanding for the need to have a healthy life style is apparent in both curricula, with the human body studied by pupils in both countries. In Latvia, animal bodies are also studied.

Both countries look at materials and their properties. The concepts of rocks, solids, liquids, gases, mixing and separating materials as well as physical transformations such as freezing, burning and boiling are all included across the two curricula. Both curricula look at parts of the water cycle.

The topics of electricity, the Earth and beyond, magnets, forces, light and sound are all covered in each country.

In Latvia many of the aspects outlined above are covered in greater depth and difficulty than they are in England as will be outlined in Section 1.4.

There are only a few points which are explicitly taught to English pupils which are not specified directly in the Latvian curriculum. These include:

- a need for contexts used for teaching in England to be of interest to pupils (although the study of local animals and mushrooms in Latvia may contribute towards this in Latvia)
- the importance of grouping plants and animals as a result of many varieties
- how to recover dissolved solids by evaporating the liquid from the solution
- the relationship between exercise and pulse rate.

The Latvian curriculum also includes a range of teaching points which in England are more likely to be studied in humanities or geography. On the Latvian science curriculum there is an emphasis on the globe and terrain with pupils for example needing to know about the terrain of Latvia, the globe structure, the division of the Earth's surfaces, local lakes and rivers, volcanic and earthquake ranges and the scenery of the surrounding area amongst other things.

Weather also features as a key topic in Latvian science requirements with pupils needing to know about climate zones and climate formation in Latvia, how to establish wind direction and about atmospheric pressure. Energy resources also feature with an emphasis on the difference between renewable and non-renewable energy sources and comparing fuels (especially those in Latvia).

Many aspects of the Latvian curriculum are linked in to Latvia specifically and areas local to the pupils studying the curriculum. This is evident not only in those subjects not covered in the English PoS but also other common areas. For example, Latvian pupils are expected to know and study *Latvian* plants, mushrooms, animals and mineral deposits specifically.

As outlined in section 1.1 on Structure, in the Latvian curriculum there is a clear emphasis on pupils' interaction with scientific contexts terms of safety. The contexts and knowledge expected from pupils are very clearly outlined in the Latvian curriculum document, e.g. *knows about the hazards of high temperature liquids,* and *knows the causes for possible traumas or poisoning (poisonous substances, caustic substances, asphyxiates, poisonous plants, poisonous mushrooms, animals, electricity, noise, radiation) and can avoid risk situations.*

Furthermore, several points in the Latvian curriculum document are attitudinal, expecting pupils to behave in certain ways in certain situations, particularly in terms of health and safety and attitude towards the environment. Examples include, *observes safety instructions when in nature (for instance on water, on ice, in a forest, swamp, sun)* and *has a favourable attitude towards the surrounding environment and natural beauty.*

Although present in the English curriculum in the 'Breath of Study', safety and attitudinal expectations are far more explicit in Latvia with more exact guidance.

15.4 Difficulty and coverage

On the curriculum comparison document, rankings about ease and breadth are made, comparing each strand of the matched curricula. As the Latvian curriculum is divided up into what pupils need to know by the end of Grade 3 and what they need to know by the end of Grade 6, rankings have been made comparing the Grade 1-3 curriculum to the English curriculum and a separate ranking has been made comparing the G4-6 curriculum to the English curriculum. This is also a useful distinction as pupils at the end of Grade 6 in Latvia, could be in years 7 or 8 in England (i.e. not at Key Stage 2). Instead of saying therefore that every judgement about ease and breadth of the Latvian end of Grade 6 curriculum compared with the English curriculum is 'not confident' as a result of it potentially equating to year 7 or 8 in England, the judgements are a straight comparison of the content rather than when it is taught. The order of teaching and when topics are taught is the focus of Section 1.5 below.

In terms of investigative work and skills, the Latvian curriculum is more detailed and specific about which pieces of equipment pupils need to be familiar with using and which exact risks they need to be aware of. Pupils in Latvia also appear to be judged on their general attitudes and safety procedures. Some equipment which is used in Latvia in Grades 1-3 is equipment not covered explicitly in Key Stage 2 science, i.e. sundials and compasses as well as materials like fusion metals. Also by the end of Grade 6 Latvian pupils are expected to know concepts such as 'density' and 'physical and chemical transformations'. This vocabulary is definitely harder, more diverse and more exact in Latvia's curriculum than England's curriculum. By the end of Grade 6 there is also an evaluative component that comes through in the Latvian curriculum with pupils expecting to be able to evaluate the credibility of sources being used for example. Self and peer evaluation is evident in both countries' curricula.

The required observational and experimental skills seem to be broadly similar, however, in the Latvian curriculum a wider range of contexts where these should be applied are described. Sometimes these contexts, especially by the end of Grade 6 in Latvia, are beyond what is the in the programme of study for Key Stage 2 science, i.e. proving exhaled carbon dioxide and oxygen in air. It is not clear in which grades these contexts are introduced in Latvia so it may be that these are not covered until England's equivalent Y7 or Y8. Contexts appear broadly similar for requirements at the end of Grade 3 in Latvia as compared to the science programme of study at Key Stage 2.

In Latvia pupils are required to have a more thorough knowledge of important discoveries in science, even by the end of Grade 3. This extends to being able to evaluate these to the importance of modern day life and understanding the effects of improper use thereof on human health and surrounding environment by the end of Grade 6. In England pupils are expected to look at the part science has played in the development of useful things, however, recalling these and evaluating them explicitly, without further information, is not a requirement.

With regard to life processes and living things, in Latvia pupils do not need to link the *life processes* of animals and plants to the environments in which they are found (not by the end Grade 3 or Grade 6). Although in Latvia pupils do need to know *all* the life processes already by the end of Grade 3, whereas English pupils do not need to know respiration and sensitivity at Key Stage 2. In Latvia, as in England, pupils need to link *characteristics* of animals and plants to their environment.

In Latvia pupils study the parts of the human body. This study point is very generic in their curriculum so it is hard to know exactly how deeply the human body parts are studied. However, by the end of Grade 6 in Latvia pupils need to know a range of organ systems which they do in England. The English curriculum is more explicit with a focus on the heart, muscles and bones. What is more profound in the Latvian curriculum is a requirement for pupils to know about the senses and their role in understanding the world. This is covered in England at a very basic level in Key Stage 1 science although not followed through into Key Stage 2 explicitly. The negative impact of drugs on the body as well as the positive impact of exercise and how exercise affects pulse rate is explicitly covered in England but not so in Latvia. The function and care of teeth, the need for a balanced diet and the requirement for food for activity and growth are specific learning points in England but not in Latvia. The approach to a healthy life style in Latvia is included in their curriculum in a more active way, i.e. pupils must actively engage in being healthy as part of their curriculum, i.e. *has nurturing attitude towards the health of self and the others* and *understands the importance of a healthy life style and tries to observe it*. Such behavioural components do not form part of the English curriculum.

Similar aspects about the making and use of keys are taught in both countries. In England pupils are expected to know the importance of sorting animals and plants into groups because there is such a large variety of each. This is not covered in the Latvian curriculum. In terms of grouping animals, in Latvia, one particular grouping is made explicit - which are similarities and differences in animal behaviour (i.e. wild v domestic) which pupils need to know by the end of Grade 6. The Latvian curriculum is broader and

more difficult than the English curriculum in this area as by the end of Grade 3 in Latvia, pupils need to know the names of common plants and mushroom in Latvia and be able to recognise which are edible. Also by this stage Latvian pupils must know common animals and animal body parts. This is built on further such that by the end of Grade 6 Latvian pupils need to know all animal organ systems and development stages. None of these aspects are covered in the English Key Stage 2 science curriculum.

The topic of micro-organisms is covered in broader detail in Latvia with pupils for example comparing the transformations of various substances under the influence of water and air (rotting, decomposing etc) with an encouragement to observe the surrounding environment. These are loosely covered in England but not in this detail.

In England the statement about protecting living things and the environment is very generic and does not specify any particular things pupils need to know in this area. The Latvian curriculum is specific in this area and includes topics that are unlikely to be covered in English. This is particularly the case for Latvian pupils by the end of Grade 6 with curriculum points such as *participation in events related to environmental issues* and *having a favourable attitude towards the environment and natural beauty*. Also Latvian pupils must know how to experimentally evaluate air quality and methods for properly picking mushrooms.

In terms of the study of materials and properties, Latvia and England learn similar things. From study of the Latvian curriculum it is unclear if pupils should be able to group materials from knowledge into the natural/industrial manufactured groups or only from given information. In England pupils should be able to evaluate use of different materials for different purposes but only with use of data or otherwise for very general properties of materials. Latvian pupils do not need to sort materials on the basis of their magnetic properties but this is explicit in the English curriculum. Electrical conductivity of materials is in the Latvian and English curricula.

In terms of describing rocks and grouping them by comparing characteristics, the two curricula appear similar. It is unclear however, if Latvian pupils must have knowledge of specific rocks and their characteristics that would allow them to group them without access to information and data about the rocks. In England rocks are certainly investigated in this way but memory of specific characteristics of specific rocks would not be necessary.

That temperature is a measure of how hot or cold something is is not explicit as a learning point in Latvia, however, heat as a concept should be known. Knowledge of reversible and non-reversible changes is not explicitly mentioned in the Latvian curriculum but is in England. In Latvia pupils study physical and chemical changes and also, concepts about burning, a non-reversible process, are expected to be learnt in Latvia. These include knowing by the end of Grade 3 how to stop the burning process for various materials and having an understanding of the necessity for burning and dangers of wrong use thereof. The topic of burning is therefore far broader and more difficult in Latvia than England.

Basics about solutions are similar in both curricula although more explicit in Latvia with one point for example stating that pupils should be able to find out how much soluble material is in a solution. The Latvian curriculum is also broader, expecting knowledge of solutions used in daily life in by the end of Grade 3 and expecting pupils to compare the deliquescence of substances in water using solution curves by the end of Grade 6. Despite evaporation as a method for separating liquid from the solution being explicit only in England, not Latvia, the Latvian curriculum is broader and more difficult in this area.

Also in this subject area there are a range of Latvian curriculum points which are untouched in England including knowledge about the importance air and water in daily life, that air is a mixture of oxygen, nitrogen and carbon dioxide and properties of air. Also pupils need to describe the use of Latvian natural resources.

Most of the elements of electricity studied are similar across the two curricula. This is especially so in terms of constructing circuits (although in Latvia pupils need to know fuel as an energy source explicitly), changing components and the effect on brightness of bulb and making a switch. In addition, in Latvia there is a behavioural component to the study of electricity where by the end Grade 6 pupils must know how to act if an electrical unit is broken and also must know about the influence of radiation.

Coverage of forces as a topic is broadly similar in the two countries, i.e. gravity, friction, air resistance and magnets. In the Latvian curriculum there is a mention of energy alongside these other forces but it is unclear what needs to be known about energy as a concept. In Latvia the curriculum is broader and extends with pupils studying acceleration and deceleration in Grades 1-3 and they must be able to explain changes in movement speed and direction. By the end of Grade 6 they must be able to calculate and experimentally establishing speed if path and time is known. Pupils also study compass directions and must be able to establish directions with use of a compass.

The topic of light is similar in both countries in terms of breadth and difficulty aside from the additional complex point in Latvia that pupils need to know how an image is formed in a mirror. This is broader and more difficult than what is studied in England.

What is studied in terms of sound is mixed in the two countries. By the end of Grade 3 in Latvia what pupils learn seems to be narrower than in England, yet one point of the Latvian curriculum states they have to know about propagation and reflection of sound, and echoes which is not covered in England. Aspects of sound that match those in England are taught in Grades 4-6 in Latvia.

There are differences in England and Latvia between expectations on the topic of the Earth and beyond. In England pupils need to know the Sun, Earth and Moon are roughly spherical. This is not explicit in the Latvian curriculum but pupils must be aware of the concepts of these planets and also the stars. The latter they do not need to know in England. In Latvia pupils need to observe the elevation of the Sun above the horizon during the day or different seasons which is not the case in England. However, in England the Moon's orbit is explicit but this is not so in Latvia, where instead pupils need

to know about the formation of the moon phases. In Latvia the theme is broader and more difficult, covering also concepts such as long and short years, changing of seasons, equinox, time zones and weather features such as clouds, climate, atmosphere as well as continental elements like parts of the world, islands, peninsulas, mountains, rocks and soils.

The Latvian curriculum coverage is different from that in England largely due to very explicit contexts in Latvia. An example to highlight this is learning about the concept of burning. In England, pupils are expected to know that burning is a non-reversible change and results in the formation of new materials. This is very abstract and out of context when you consider that in Latvia the necessity of burning must be known by pupils (as well as how to stop something burning). This places burning with a reference point and not just an abstract idea. Coupled with this contextual approach is the very active and practical side to the Latvian curriculum, not only in the experimental areas of science. For example, pupils must know how to ring for help, treat burns and adhere to safety codes.

In summary the comparison of the two curricula in breadth and difficulty can be summarized as:

Scientific Enquiry, difficulty	The Latvia curriculum is regarded as:	
more demanding in	12	curriculum areas
of similar demand in	23	curriculum areas
less demanding in	3	curriculum areas

Scientific Enquiry, breadth	The Latvia curriculum is regarded as:	
broader in	19	curriculum areas
similar in breadth in	18	curriculum areas
narrower in	5	curriculum areas

Scientific Enquiry: The Latvia curriculum is therefore viewed as more demanding and broader.

Life Processes and Living Things, difficulty	The Latvia curriculum is regarded as:	
more demanding in	16	curriculum areas
of similar demand in	15	curriculum areas
less demanding in	8	curriculum areas

Life Processes and Living Things, breadth	The Latvia curriculum is regarded as:	
broader in	36	curriculum areas
similar in breadth in	15	curriculum areas
narrower in	9	curriculum areas

Life Processes and Living Things: The Latvia curriculum is seen as more demanding and broader.

Materials and Their Properties, difficulty The Latvia curriculum is regarded as:

more demanding in	6	curriculum area
of similar demand in	11	curriculum areas
less demanding in	4	curriculum areas

Materials and Their Properties, breadth The Latvia curriculum is regarded as:

broader in	17	curriculum areas
similar in breadth in	9	curriculum areas
narrower in	5	curriculum areas

Materials and Their Properties: The Latvia the curriculum is regarded as similar in difficulty but broader.

Physical Processes, difficulty The Latvia curriculum is regarded as:

more demanding in	10	curriculum area
of similar demand in	18	curriculum areas
less demanding in	2	curriculum areas

Physical Processes, breadth The Latvia curriculum is regarded as:

broader in	23	curriculum areas
similar in breadth in	18	curriculum areas
narrower in	2	curriculum areas

Physical Processes: The Latvia the curriculum is regarded as more demanding and broader.

The average rating for confidence in the judgment of difficulty was 2.3, above *quite confident* (2.0) while that for breadth was 2.5, midway between *quite confident* (2.0) and *very confident* (3.0)

15.5 Order of Teaching and when Taught

As outlined in Section 1.1, the Latvian curriculum for Grades 1-6 is structured in two blocks:

- What pupils are expected to know by the end of Grade 3
- What pupils are expected to know by the end of Grade 6.

What is taught year on year is therefore not explicit, only what pupils are expected to know at the end of blocks of three years. By looking at the blocks it is possible to gain a sense of the order of teaching, although not year by year.

In terms of the science of planning and carrying out investigations, the structure of teaching appears broadly similar across the two countries. From the evidence available it is possible to see that in Latvia the higher order skills involved in investigative science are taught in Grades 4-6, e.g. describing results, understanding when measurements may need to be repeated, writing more advanced conclusions as well as evaluating and

applying information and findings to the relevance of these in the real world. In the English curriculum it is not explicit when investigative skills are taught as it is relevant to all different contexts across the year groups. It is likely though, given the structure of the rest of the curriculum that the approach to investigative science is similarly taught in a spiral fashion. The higher order skills are taught to older pupils while younger ones are first introduced to the procedures and protocols for planning and conducting investigations.

Learning about healthy living is a topic scattered across the age ranges in both countries. In England, the heart is covered in year 5 according to the schemes of work and muscles and bones in year 4. In Latvia the parts of the body are covered at a younger age in Grades 1-3.

In Latvia, the stages of the human life cycle are not covered until Grades 4-6. In England these are introduced in year 2 (the end of Key Stage 1) and then looked at again in year 5 if done in accordance with the schemes of work. Similarly, keys are not taught in Latvia until Grades 4-6, when in England these are introduced in year 3 and taught also in years 4 and 6. However, in Latvia, it seems the younger grades are taught about all the different common plants and mushrooms in Latvia and about animal body parts. This is the grounding used to then teach about keys in the older grades. In England pupils are not expected to know the common plants in England or animal body parts at Key Stage 2 however, do learn about the structure of plants in year 3 and build on this in year 6.

Simple ecosystems are taught in Grades 1-3 in Latvia and this knowledge is built on in Grades 1-4 in terms of needing to understand the place of different animals within it. This is similar to the English curriculum which teaches food chains in year 4 and built on in year 6. However, in Latvia, pupils must observe seasonal changes in ecosystems and by the end of Grade 6 changes in ecosystems have to be evaluated. Animals and plants in different habitats is not a teaching point in Latvia until Grades 4-6 whereas it is already introduced to pupils in year 4 in England.

The topic of micro-organisms not taught until Grades 4-6 in Latvia which is similar to England where it is not addressed until year 6 according to the schemes of work.

In both countries the younger pupils are expected to be able to compare every day materials on simple properties such a state, colour, flexibility, hardness, strength and thermal conductivity. Electrical conductivity and magnetic properties are included in this in the English curriculum but using these to compare materials is not explicit in the Latvian curriculum.

An interesting difference between the two countries is that changes such as evaporation, boiling, freezing, condensation, melting, burning and dissolving are not taught in England until year 6 and in relation to whether these are reversible or not. In Latvia these are taught to the younger grades 1-3 although not with reference to reversibility.

The separation of materials by a range of means is not covered in Latvia until grades 4-6, whereas in England this is introduced in year 4 and then built on in year 6 according to the schemes of work. Looking at solutions and how to get dissolved materials back is not covered until year 6 in England but sieving is something that is likely to be studied in year 4.

With regards to electricity, in Latvia pupils are not taught about how altering the number and type of components in a circuit affects the brightness of a bulb until Grades 4-6. Nor do they need to know the symbols to drawn an electric circuit until that time. Connecting simple circuits and using simple components, such as switches, are taught in Grades 1-3. This is similar to the English curriculum where elements of electricity are taught in years 2, 4 and 6.

The English curriculum introduces forces earlier than the Latvian curriculum. In Latvia, only magnetic forces are studied in Grades 1-3. Other forces such as friction, air resistance and gravity are not taught until Grades 4-6. In England, these forces, with the exception of gravity which is taught in year 6, are taught in years 3 and 4. Measuring forces and establishing the direction they act in is studied in year 4 in England and built on in year 6. In Latvia however, this is not covered until Grades 4-6. Opposing pushes/pulls are studied by the higher age groups in both countries.

In Latvia only the very basics are taught about light in Grades 1-3, i.e. the origination of light and the ability to recognise a range of light sources. In England this is taught across years 1, 3 and 6. Shadows are taught in year 3 in England but are not covered until Grades 4-6 in Latvia. In both countries, light reflected from surfaces as well as seeing being as a result of light entering our eyes are not until the older age range.

More aspects of sound are taught in the younger years in Latvia than in England, for example, about the reflection of sound and the detection of sound with the ear. These latter examples are not in the English curriculum at Key Stage 2 at all. Some of what is taught in Grades 4-6 in Latvia is covered in year 5 in England, for example that sound is as a result of vibrations and changes of pitch and volume.

The topic of the Earth and beyond is studied in year 5 in England according to the schemes of work. In Latvia the topic is studied in both grade blocks 1-3 and 4-6. Much of what is broader in Latvia in terms of this topic is what is taught in grades 4-6, for example, observing the elevation of the Sun above the horizon and using terms such as long/short years and equinox. Understanding the change of seasons in Latvia, a topic not covered in England is actually taught to the younger years as is explaining the changes in nature in various seasons, based on own observations.

The Latvian curriculum also covers a range of points not covered in the English Key Stage 2 curriculum. These topics are taught across Grades 3-6 so it is not the case that all broader aspects of the Latvian curriculum, as compared to the English curriculum, are taught only to the older pupils. For example, pupils, by the end of Grade 3 in Latvia, need to name the common mushrooms in Latvia and know which are edible, observe seasonal changes in eco-systems, understand the peculiarities in soil formation and know how to

act if, for instance, an electrical unit is broken, wire insulation is damaged or wires are torn.

As there is no English comparative for these broader Latvian topics it is not possible to say categorically whether these are harder or easier than in England. However, what appear to be more difficult broader curriculum points, compared with an overall sense of ease/difficulty in the English curriculum at Key Stage 2, are expectations for pupils by the end of Grade 6 in Latvia, rather than Grade 3. For example, compares the types of fuel according to the aggregate state and influence of burning products on environment, and according to the warning signs, can group poisonous substances, caustic substances, asphyxiates, burning substances. In this way, the Latvian curriculum works like the English curriculum, as a spiral, with topics revisited and the introduction of more difficult points at the higher grades.

15.6 Integration of Subjects

In the Latvian curriculum there is a clear emphasis on pupils' interaction with and behaviour towards the environment in terms of safety and protection. The Latvian science curriculum also includes a range of teaching points which in England are more likely to be studied in humanities or geography. As outlined in Section 1.3, in the Latvian science curriculum there is an emphasis on the globe and terrain as well as weather with pupils for example needing to know about the terrain of Latvia, the globe structure, the division of the Earth's surfaces, local lakes and rivers, climate zones and climate formation in Latvia, how to establish wind direction and about atmospheric pressure. Energy resources also feature with an emphasis on the difference between renewable and non-renewable energy sources and comparing fuels (especially those in Latvia).

15.7 Differentiation

The local expert indicates that:

There is one curriculum for all students in Latvia. Mentally handicapped students do not have to meet all the requirements of the curriculum and the learning content depends on the special education program they acquire, which might be very flexible……

If there are ordinary students with very different abilities in one class this is first of all the teacher's problem. In some cases the school might form some special correction classes for some low ability students.

15.8 Pedagogy and Time Allocations

The local expert reports:

The regulations of Cabinet of Ministers of Latvia "About state standard of primary education and subject standards of primary education" Nr.1027 defines the following time schedule for different subjects (the excerpt of subjects is presented in table).

Content areas and subjects (excerpt)	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
Science	2	2	2	2	2	2			
Workload of pupils (total number of lessons per week for all subjects)	21	21	24	25	27	30	31	33	33

The number of lessons per subject per week is mandatory.

16 Science Comparison: Ontario

16.1 Structure

The primary science curriculum for Ontario is called 'The Ontario Curriculum, Grades 1-8: Science and Technology' and it is published by the Ministry of Education and Training. The curriculum for primary science starts in Grade 1 (Year 2 equivalent: age range 6 to 7) and ends in Grade 8 (Year 9 equivalent: age range 13 to 14). This study mainly draws on material from Grades 2-5 as these correspond to the Key Stage 2 Years 3-6. Where necessary, however, other Grades have been consulted if they contain material normally taught in Key Stage 2. The Ontario science curriculum analysed in this discussion was in use between 1998 and 2007, and was therefore the curriculum in operation prior to the collection of the TIMMS data for 2003. A new curriculum was produced in Ontario in 2007 for implementation in September 2008 and comparisons will also be made between the 1998 version and the new 2007 Ontario curriculum to identify key similarities and changes.

The curriculum is organised in strands, which run across all of the year groups and within each strand there are topics:

Table 16.1 Topics in the Ontario science curriculum

	Topics			
Strand	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
Life Systems	Growth and changes in animals	Growth and changes in plants	Habitats and communities	Human organ systems
Matter and Materials	Properties of liquids and solids	Magnetic and charged materials	Materials that transmit, reflect or absorb light or sound	Properties of and changes in matter
Energy and Control	Energy from wind and moving water	Forces and movement	Light and sound energy	Conservation of energy
Structures and Mechanisms	Movement	Stability	Pulleys and gears	Forces and acting on structures and mechanisms
Earth and Space Systems	Air and water in the environment	Soils in the environment	Rocks, minerals and erosion	Weather

The organisation of the 1998 curriculum within each topic for each year group takes the following form:

- Overview: this provides a brief summary of the key areas of knowledge and understanding to be developed within that topic, together with an outline of key learning experiences such as using models and simulations; exploration; investigation; observation; classification; and designing and making.

- Overall expectations: these are the key areas of knowledge, understanding or skill that students will be expected to have attained in that topic by the end of that particular grade.

- Specific expectations: this section provides the detailed outcomes for that particular topic within a particular year group and the section is subdivided into three parts:

    - Understanding basic concepts: these outcomes relate to the subject-specific knowledge, understanding and skills within that topic

    - Developing skills of inquiry, design and communication: these outcomes are more general and run through all of the topics within each strand, with some slight variation depending on the topic (these are summarised below)

    - Relate science and technology to the world outside the school: these outcomes focus on the applications of science and technology from 'Understanding basic concepts', making explicit the links to the uses of science and technology in everyday life and their impact on communities and the environment.

16.2 Aims and rationale for the curriculum

The introduction to the 1998 Ontario science curriculum contains an overview of the nature of both science and technology. Science is viewed as 'a form of knowledge that seeks to describe and explain the natural and physical world.' Technology is viewed as 'both a form of knowledge that uses concepts and skills from disciplines (including science) and the application of this knowledge to meet an identified need or solve a specific problem using materials, energy and tools (including computers). The method of technology consists of inventing or modifying devices, structures, systems or processes.'

Like the science curriculum for England, that for Ontario is based on a constructivist framework where pupils are expected to build up their knowledge and understanding through first hand experience including investigation. The rationale for the approaches within the curriculum to science and technology education emphasises this constructivist view of learning in science:

Science is not only a body of knowledge but a 'way of knowing'. Scientific investigation involves exploration, experimentation, observation and measurement, and analysis and dissemination of data. These activities require specific skills and habits of mind….The science and technology curriculum is designed to develop these skills and habits of mind. (The Ontario Curriculum, (1998) P4).

The aims of the Ontario curriculum for science and technology are:

- *to understand the basic concepts of science and technology;*
- *to develop the skills, strategies, and habits of mind required for scientific inquiry and technological design; and*
- *to relate scientific and technological knowledge to each other and to the world outside the school* (The Ontario Curriculum, (1998) P.4).

Close links between the subject areas of science and technology were established with the introduction of the 1998 revised Ontario curriculum and the above aims demonstrate the significance of these links. Also a large emphasis is placed on relating science and technology to the outside world and recognising the need for sustainable development. Another element that is given prominence is the significance of communication in science and technology: '*Communication is an essential component of the science and technology curriculum since many of the activities and tasks that students undertake involve the use of communication skills, both written and oral. …Students therefore need to be able to communicate effectively'* (The Ontario Curriculum, (1998) P.9). The third of the above aims emphasises the significance of positive attitudes or 'habits of mind' for science learning. There is also a section in the introduction to the 1998 Ontario curriculum document focusing on the importance of attitudes. These attitudes and values are described as '*commitment to accuracy, precision and integrity in observation, experimentation, and reporting; respect for evidence, concern for the observance of safety procedures; and respect for living things and the environment*' (The Ontario Curriculum, (1998) P.9). Students' attitudes to science, technology and education are considered to have a significant effect on their achievement.

The emphasis placed on attitudes and communication parallel the spiritual, moral, social and cultural development and the development of key skills aspects in the section 'Learning across the National Curriculum' in the introduction to the National Curriculum document for England (P.8). In addition, a section on 'The Role of Parents' in the introduction to the Ontario curriculum (P.5) puts strong emphasis on the importance of parental involvement in supporting their child's learning. It seeks to outline approaches for increasing parental involvement in children's education at a variety of levels. For discussion regarding the roles of teachers and pupils, please see section 3.2.

16.3 Content

Because of the complexity of the Ontario Curriculum for Science and Technology, the following approach was adopted in structuring the spreadsheet analysis in which the Ontario curriculum was compared to the English National Curriculum for Science. Throughout, the 'Specific Expectations' were used for comparison with the National Curriculum, rather than the 'Overall Expectations' because of the more general nature of the latter (being in the form of a summary or overview of the 'Specific Expectations'). The 'Specific Expectations' are subdivided into three separate parts and each of these was used differently in structuring a comparison with the National Curriculum:

Understanding basic concepts: All of the outcomes from each of the topics for the year groups Grade 2 (equivalent to Year 3) through to Grade 5 (equivalent to Year 6) were compared with the elements of the National Curriculum Programme of Study for Science in the spreadsheet comparison.

Developing skills of inquiry, design and communication: The format of these skill-based outcomes relating predominantly to the Sc1 (Scientific Enquiry) section of the English National Curriculum, is founded on a series of repeating themes which appear in the form of statements across all of the strands and topics, demonstrating progression across year groups, with some specific exceptions (see below). The basic structure of these outcomes remains the same within each topic, but having a different focus, depending on the context. Therefore to facilitate comparison with the relevant Sc1 National Curriculum Programme of Study elements, the basic common stem of each of these skill-based outcomes was used in the spreadsheet comparison.

Relating science and technology to the world outside the school: These outcomes make links between the 'basic concepts' of the topic and the application of these concepts to everyday life. As each outcome requires the learning of factual information or a skill, they have been matched (where possible) to the relevant elements of the National Curriculum Programme of Study for Science. Many of the outcomes however do not have an equivalent learning point in the English National Curriculum.

Key elements of the section 'Developing skills of inquiry, design and communication' running through all topics within each strand have the following common elements, which are grouped by theme where appropriate:

Present in the theme Life Systems:

- Ask (G2,3)/formulate (G4,5) questions about and identify some needs of …, and explore possible answers to these questions and ways of meeting these needs;

- Plan investigations to answer some of these questions or find ways of meeting these needs, and describe (G2)/explain (G3) the steps involved OR plan investigations for some of these answers and solutions identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions (G4,5).

Present in all themes (other than Life Systems):

- Ask (G2,3) / formulate (G4,5) questions about and identify (needs and) problems related to… (a context of the topic);

- Plan investigations to answer some of these questions or solve some of these problems, (and describe the steps involved (G2)/explain the steps involved (G3) OR plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions (G4,5).

Present in the themes Matter and Materials, Energy and Control, and Structures and Mechanisms:

- Design and assemble/construct/make, (using given materials), an object/system/device/structure that… (relates to the context of the topic).

Present in all themes:

- Use appropriate vocabulary in describing their investigations, explorations, and observations (G2,3)/including correct science and technology terminology in describing their investigations, explorations and observations (G4,5);

- Record relevant observations, findings, and measurements, using written language, drawings, and concrete materials (G2), charts and graphs (G3) OR compile data gathered through investigation in order to record and present results using tally charts, tables, and labelled graphs produced by hand or with a computer (G4,5);

- Communicate the procedures and results of investigations for specific purposes (G2) and to specific audiences (G3-5), using drawings, demonstrations, and oral and written descriptions (G2), and simple media works (G3-5).

16.3.1 Comparison of curriculum elements corresponding to Sc1: Scientific Enquiry

Programme of Study (PoS) elements of the National Curriculum for England that are not covered by the Ontario curriculum are:

- 1/1a - that science is about thinking creatively to try to explain how living and non-living things work, and to establish links between causes and effects;

- 1/1b - that it is important to test ideas using evidence from observation and measurement;

- 1/2g - check observations and measurements by repeating them where appropriate;

- 1/2i - make comparisons and identify simple patterns or associations in their own observations and measurements or other data;
- 1/2j - use observations, measurements or other data to draw conclusions;
- 1/2k - decide whether these conclusions agree with any prediction made and/or whether they enable further predictions to be made;
- 1/2l - use their scientific knowledge and understanding to explain observations, measurements or other data or conclusions;
- BoS 1c - using a range of sources of information and data, including ICT-based sources.

There are no elements of the Ontario curriculum that are not represented within the Sc1 section of the National Curriculum for England.

16.3.2 Comparison of curriculum elements corresponding to Sc2: Life processes and living things

PoS elements of the National Curriculum for England that are not covered by the Ontario curriculum are:

- 2/2d - about the effect of exercise and rest on pulse rate (there is no reference in the Ontario curriculum to the effects of exercise and rest on pulse rate, although an understanding that exercise contributes to good health is required);
- 2/4a - to make and use keys (there is no direct reference to making and using keys, although students are required to be able to classify animals and plants using observable characteristics);
- 2/4c - that the variety of plants and animals makes it important to identify them and assign them to groups.

There are many elements of the Ontario curriculum that are not represented within the PoS of the English National Curriculum. These include learning about the life cycles of animals other than humans, the uses humans make of plants and food production, including farming.

16.3.3 Comparison of curriculum elements corresponding to Sc3: Materials and their properties

PoS elements of the National Curriculum for England that are not covered by the Ontario curriculum are:

- 3/1c - that some materials are better electrical insulators than others;
- 3/3c - how to separate insoluble solids from liquids by filtering;
- 3/3d - how to recover dissolved solids by evaporating the liquid from the solution;

- 3/3e - to use knowledge of solids, liquids and gases to decide how mixtures might be separated.

There are many elements of the Ontario curriculum that are not represented within the PoS of the English National Curriculum. These include learning to a greater depth about soils (e.g. how they are formed from rocks and can be used in manufacturing), rocks (e.g. how they are formed and classified) and states of matter (e.g. comparison of mass of a substance in different states), and learning about the processes and natural materials used in manufacture.

16.3.4 Comparison of curriculum elements corresponding to Sc4: Physical processes

PoS elements of the National Curriculum for England that are not covered by the Ontario curriculum are:

- 4/1a - to construct circuits, incorporating a battery or power supply and a range of switches, to make electrical devices work;
- 4/1b - how changing the number or type of components in a series circuit can make bulbs brighter or dimmer;
- 4/1c - how to represent series circuits by drawings and conventional symbols, and how to construct series circuits on the basis of drawings and diagrams using conventional symbols;
- 4/3d - that we see things only when light from them enters our eyes;
- 4/4b - how the position of the Sun appears to change during the day, and how shadows change as this happens.

There are many elements of the Ontario curriculum that are not represented within the PoS of the English National Curriculum. These include learning to a greater depth about sound (e.g. how the human ear works) and light (e.g. coloured light and refraction) and learning about energy (e.g. sources of energy and how it is used) geography topics (e.g. weather), and design and technology topics (e.g. structures and their design). It must be noted that as there are separate geography and design and technology curriculums in England, geography and design and technology elements are not included in the English Key Stage 2 programme of study for science.

16.4 Breadth and Difficulty

An overview of the comparative breadth and difficulty of the Ontario curriculum will be presented for each of the four areas of the National Curriculum. A significant number of areas of the Ontario curriculum corresponded more closely to outcomes for geography (26 in total) and design and technology (66 in total). These will not be included in the following comparison with the English National Curriculum for science.

Scientific enquiry, difficulty The Ontario curriculum is regarded as:

more demanding in	3	curriculum area
of similar demand in	8	curriculum areas
less demanding in	2	curriculum areas

Scientific enquiry, breadth The Ontario curriculum is regarded as:

broader in	3	curriculum areas
similar in breadth in	8	curriculum areas
narrower in	10	curriculum areas

Scientific enquiry: The Ontario curriculum is therefore viewed as similar in difficulty and narrower.

Life processes and living things, difficulty The Ontario curriculum is regarded as:

more demanding in	7	curriculum areas
of similar demand in	9	curriculum areas
less demanding in	5	curriculum areas

Life processes and living things, breadth The Ontario curriculum is regarded as:

broader in	30	curriculum areas
similar in breadth in	10	curriculum areas
narrower in	6	curriculum areas

Life processes and living things: The Ontario curriculum is seen as similar in difficulty but broader.

Materials and their properties, difficulty The Ontario curriculum is regarded as:

more demanding in	3	curriculum areas
of similar demand in	10	curriculum areas
less demanding in	0	curriculum areas

Materials and their properties, breadth The Ontario curriculum is regarded as:

broader in	20	curriculum area
similar in breadth in	10	curriculum areas
narrower in	4	curriculum areas

Materials and their properties: The Ontario the curriculum is regarded as slightly more demanding and broader.

Physical processes, difficulty The Ontario curriculum is regarded as:

more demanding in	5	curriculum areas
of similar demand in	6	curriculum areas
less demanding in	0	curriculum areas

Physical processes, breadth The Ontario curriculum is regarded as:

broader in	54	curriculum areas
similar in breadth in	6	curriculum areas
narrower in	5	curriculum areas

Physical processes: The Ontario the curriculum is regarded as more demanding and broader.

The average rating for confidence in the judgment of difficulty was 2.6, between 2.0, *quite confident*, and 3.0, very confident while that for breadth was 3.0, just below *very confident*.

16.5 Order of Teaching and when Taught

The curriculum is organised around year groups (Grades). In relation to the themes within the Ontario curriculum (corresponding to the Science 2, 3 and 4 content of the English National Curriculum), detailed learning outcomes are listed for each of the year groups.

In the rationale for the structure of the curriculum, no reference is made to a spiral approach. Analysis of the curriculum reveals that although the themes are repeated in subsequent years, the actual content of the topics within the themes is rarely closely related in different years. This reflects the requirement to teach different topics within each theme for different year groups. In contrast the science process skills are revisited within subsequent years and there is a progression in the curriculum requirements for the outcomes relating to 'Developing Skills of Inquiry, Design and Communication' (see section 1.3).

16.6 Integration of Subjects

Significant rearrangement took place with regard to integration of science and technology with the introduction of the 1998 curriculum. Prior to this, science and technology had been more distinct. The rationale for the 1998 curriculum provides insight into the reasons behind this close integration of science and technology, since science knowledge, understanding and skills are applied within the technology curriculum, and technology provides application for scientific learning within society.

In the introduction to the Ontario curriculum, significant emphasis is also placed on both verbal and written communication and aspects of mathematics in the learning of science and technology. In addition links to language and literacy in the form of explicit communication outcomes appear in each topic for all grades under 'Developing Skills of Inquiry, Design and Communication', together with links to elements of mathematics. See the discussion in section 1.3 for further details.

In the introduction to the 2007 curriculum, there is a section on 'Cross-curricular and integrated learning' which is defined as providing 'opportunities to learn and use related content and/or skills in two or more subjects' ((The Ontario Curriculum, (2007) P.30).

Although emphasis is still placed on linking science and technology with language and literacy and mathematics, mention is also made of other subjects such as social studies.

16.7 Comparison of the aims, rationale, structure and content of the 1998 version of the Ontario science curriculum with the 2007 version

The rationale for the 2007 curriculum is based on the same theoretical constructivist framework as the 1998 curriculum. A new addition is the introduction of six fundamental concepts that underpin the curriculum:

- Matter
- Energy
- Systems and interactions
- Structure and function
- Sustainability and stewardship
- Change and continuity

These are developed through the three goals (aims) of the curriculum. The goals for the 2007 curriculum remain virtually unchanged in comparison with the 1998 curriculum, except for the order (the position of the first and third aims have been changed so that the first aim now focuses on relating science and technology to society and the environment (previously the world outside school). This reflects a change in the priority attached to this aim. Throughout there is increased focus on technological problem solving.

A continuum showing the progression from ‘beginning’ to ‘proficient’ has been included for three types of scientific and technological skills:

- Scientific investigation: inquiry / experimentation skills (e.g. safety, predictions, presenting results and drawing conclusions);
- Scientific investigation: inquiry/research skills (e.g. selecting and considering the value of different sources of information;
- Technological problem-solving skills (e.g. designing, building and evaluating models).

All three of the above categories are subdivided into the four following processes:

- Initiating and planning
- Performing and recording
- Analysing and interpreting
- Communicating

Large changes have been made to the structure of the 2007 curriculum, although the detail of the outcomes is very similar. Throughout there is increased emphasis on technological problem-solving. Topics are now arranged in year groups rather than within themes. A more detailed overview of each topic has been included at the start of each topic, followed by a new table containing the fundamental concepts within the topic, which are linked to the relevant 'Overall expectations'. The 'Specific expectations' section has been rearranged with expectations for 'Relating science and technology to society and the environment' (previously '….to the world outside the school') being positioned first. Within each topic, this has undergone the most significant changes in content, being reduced in number and more focussed on how to manage and control the impact of aspects of the physical world on people and on ways to impact positively on the physical world. It is followed by 'Developing skills of scientific investigation and technological problem solving' (previously 'Developing skills of inquiry, design and communication'). The changed emphasis in this skills section to focus more on problem solving is reflected in the new title. The final section 'Understanding basic concepts' has retained its title, but has a reduced number of outcomes. Although the outcomes are very similar in the 2007 curriculum compared with the 1998 curriculum, they have been moved between sections. For example many of the outcomes from the section 'Understanding basic concepts' have been moved into the 'Developing skills of scientific investigation and technological problem solving' section, with the addition of skill-based terms at the start of the outcomes such as: observe; investigate; use scientific inquiry/research skills; use appropriate science and technology vocabulary; use a variety of forms to communicate; use technological problem-solving skills. Reference to following appropriate safety procedures has also been included in this section.

The themes and topics in the 2007 Ontario curriculum are shown in the table below:

Table 16.2 Topics in the 2007 Ontario science curriculum

Strand	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
Understanding Life Systems	Growth and changes in animals	Growth and changes in plants	Habitats and communities	Human organ systems
Understanding Structures and Mechanisms	Movement	Strong and stable structures	Pulleys and gears	Forces and acting on structures and mechanisms
Understanding Matter and Energy	Properties of liquids and solids	Forces causing movements	Light and sound	Properties of and changes in matter
Understanding Earth and Space Systems	Air and water in the environment	Soils in the environment	Rocks and minerals	Conservation of energy and resources

In the 1998 curriculum, the strand 'Understanding life systems' was named 'Life systems'. No changes have been made to the topics within this strand in Grades 2 to 5. 'Understanding structures and mechanisms' (previously 'Structures and mechanisms') has basically the same topics, except for the topic 'Strong and stable structures' which was previously named 'Stability'. The outcomes of this topic have been modified to include a focus on factors influencing the strength of structures in addition to their stability. The strand 'Understanding matter and energy' has been developed through amalgamation of two strands from the 1998 curriculum, namely 'Energy and control' and 'Matter and materials'. Five of the original topics from these two strands have essentially been retained, although the topic 'Conservation of energy and resources' (previously 'Conservation of energy') has been moved into the strand 'Understanding Earth and Space Systems' and the following topics have been removed:

- Magnetic and charged materials
- Materials that transmit, reflect, or absorb light or sound
- Energy from wind and moving water

The topics that remain are:

- Properties of liquids and solids
- Forces causing movement (previously 'Forces and movement')
- Light and sound (previously 'Light and sound energy)
- Properties of and changes in matter

Finally, in the strand 'Understanding Earth and space systems' (previously 'Earth and space systems') the topic 'Conservation of energy and resources' replaces 'Weather' and also now has a resources focus incorporated within it studying issues surrounding conservation of resources such as recycling.

16.8 Differentiation and Tailoring Content to Ability

The introduction to the 1998 Ontario curriculum for science and technology has a section dedicated to 'exceptional students'. This section emphasises that '*recognising the needs of exceptional students and providing appropriate programs for them are important aspects of implementing the curriculum*' (The Ontario Curriculum, (1998) P.11). Two distinct approaches exist:

- for students whose needs can be met within the existing framework, modifying the 'choice of instructional methods' is considered sufficient for them to attain to their potential
- legislation exists (Regulation 305) which ensures that for students whose needs cannot be met through this approach, an Identification Placement, and Review Committee should work in conjunction with parents and practitioners to identify

the specific needs of the student, which should be met through the creation of an Individual Education Plan (IEP).

The potential for creating an IEP for students who have special 'short-term learning needs because of medical or other reasons' is also mentioned. However there is no other reference to provision that exists for students who are performing below the expected standards.

In the 2007 curriculum there is an additional focus on supporting students with special educational needs who are attaining below the expected level for their grade, with emphasis on the need for 'differentiated instruction'.

16.9 Mandatory or Recommended Time for Subjects and Content Areas

There is no indication in the Ontario curriculum document of the amount of time that should be spent on science teaching and learning. Also the Ministry of Education and Training website did not contain any reference to time allocations for subject teaching.

16.10 Guidance or Compulsion of Teaching Methods

In the 1998 Ontario science curriculum, learning is viewed as a partnership between teachers and students in which they have 'complementary responsibilities'. Emphasis is placed on the role of students taking responsibility for their own learning, with explicit links being made between achievement and 'hard work'. Also the significance of collaborative learning is highlighted.

The focus of the role of the teacher is outlined in the introduction in the section 'The Role of the Teacher'. The main teaching role is summarised as 'developing appropriate instructional strategies' to address a range of learning needs through a 'variety of teaching approaches' and by bringing 'enthusiasm' into learning. Emphasis is placed on 'hands-on-activities' based on the theoretical perspective that:

'…the inquiry and design skills emphasized in this curriculum must be taught and learned through experiences with concrete materials. The activities provided should allow students to discover and learn fundamental concepts through investigation, exploration, and experimentation, and to place these concepts in the social, environmental, and economic contexts in which their relevance and application will be most evident.' (The Ontario Curriculum, (1998) P.6).

This further reinforces the commitment to a constructivist approach to teaching and learning outlined in the rationale for the curriculum. Also the importance placed on application of scientific and technological expertise is again seen in this section.

In the introduction to the curriculum, the section on 'Attitudes in Science and Technology' identifies a link between teaching and student attitudes. Here it is emphasised that teaching methods and learning activities should 'encourage students to recognize the value and relevance of what they are learning and will go a long way towards motivating students to work and to learn effectively.' (The Ontario Curriculum, (1998) P. 9).

Views on the role of the teacher are very similar in the 2007 curriculum to the 1998 version. An additional section on the role of the Principal in the teaching and learning process has been added. This role is seen as a facilitator to support student learning in partnership with teachers and parents. Another additional section refers to the role of ‘community partners’ in providing support and acting as models for students.

References

Ministry of Education and Training (1998) The Ontario Curriculum, Grades 1-8: Science and Technology;

Ministry of Education and Training (2007) The Ontario Curriculum, Grades 1-8: Science and Technology.

17 Science Comparison: Singapore

17.1 Structure

The primary science curriculum for Singapore is called the Primary Science Syllabus and it is published by the Curriculum Planning and Development Division of the Singapore Ministry of Education. The curriculum for primary science starts in Primary 3 (Year 4 equivalent: age range 8 to 9) and ends in Primary 6 (Year 7 equivalent: age range 11 to 12). Two versions of the Singapore science curriculum exist and the one that is being analysed in depth was implemented between 2001 and 2007, as this was the curriculum in operation prior to collection of the TIMSS data for 2003. Comparison will also be made between the 2001 version and the new 2008 curriculum to identify key similarities and changes. An important change in terminology in 2008 is that learners are now referred to as students rather than pupils.

In the 2001 Singapore curriculum, the science process skills are separated out from the other aspects of the curriculum, and this section corresponds to the section in the National Curriculum for Science Sc1: Scientific Enquiry.

The science process skills in the 2001 Singapore curriculum are grouped as follows:

Basic process skills:

- Observing
- Comparing
- Classifying
- Measuring and using apparatus
- Communicating
- Analysing
- Generating
- Evaluating

Integrated processes:

- Creative problem solving
- Decision-making
- Investigation

The basic and integrated process skills are listed in two separate tables, and the years (P3, 4, 5 or 6) when these process skills should be taught are indicated. Integrated process skills (creative problem solving, decision-making and investigation) are defined

as ‘complex operations which call upon the use of several basic process skills’ (p8). The basic process skills are therefore viewed as components on which the integrated process skills are built. In the National Curriculum document, it is specified that the Sc1 Scientific enquiry component should be taught within the context of the Sc2, 3 and 4 areas of the programme of study. Similarly in the 2001 Singapore curriculum, it is indicated that the science process skills should be developed within the context of other areas of science: ‘In science process teaching and learning, teachers should teach each of the basic process skills explicitly through the use of appropriate activities and then meaningfully infuse the teaching of these skills in their lessons’ [p8].

The part of the Singapore curriculum, relating to the National Curriculum areas of the programme of study: Sc2, 3 and 4, is also organised in tabular form. Unlike the National Curriculum, each year group (P3 to P6) has its own specific curriculum organised in the form of learning outcomes, together with an additional column headed ‘Remarks’ (which gives more detail on what should be taught for each learning outcome, indicating the breadth and depth of the planned learning). This corresponds loosely with the ‘Breadth of study’ section of the National Curriculum, which suggests ‘contexts, activities, areas of study and range of experiences’ (p.12#) within which the knowledge, understanding and skills component of the curriculum can be taught, although in the Singapore curriculum this is in far more detail and related specifically to each area of the curriculum.

The part of the Singapore science curriculum corresponding to coverage of Sc 2, 3 and 4 in the National Curriculum for England is arranged into five themes: diversity, cycles, systems, interactions and energy. This differs from the way in which the National Curriculum for science in England is structured: Scientific Enquiry (Sc1), Life processes and living things (Sc2), Materials and their properties (Sc3), Physical processes (Sc4), which is based on the different areas of science: biology, chemistry and physics. The structuring of the Singapore curriculum within these five themes results in the grouping of content areas that are not usually associated when structure is based on the traditional areas of science. In the Singapore curriculum, different combinations of themes are covered in each year group. The five themes contain the following areas of science, and for each, the year group in which it is taught is indicated (P3: Primary 3 - equivalent to Year 4; to P6: Primary 6 - equivalent to Year 7):

Diversity:

- Variety and characteristics of living things (P3)
- Materials (P3)
- Classification of organisms and materials (P6)

Cycles

- Life cycles of plants and animals (P3)
- Matter (P4)
- Water (P4)
- Day and night cycles (P5)

- Unit of life (P5)
- Reproduction in plants and animals (P5)

Systems

- Plant parts and functions (P3)
- Digestive and skeletal / muscular systems (P3)
- Respiratory and circulatory systems (P4)
- Electrical systems (P5)

Interactions

- Magnets (P3)
- Simple machines (P5)
- Forces (P6)
- Environmental impact (P6)
- Ecology (P6)

Energy

- Light (P4)
- Heat (P4)
- Photosynthesis and respiration (P5)
- Forms of energy and conversions (P6)

17.2 Aims and rationale for the curriculum

The introduction to the 2001 Singapore science curriculum contains a brief overview of the nature of science, as ‘a body of knowledge about the natural world and a set of skills and processes by which this knowledge is acquired, synthesised, evaluated and applied’ (p3). Science education is viewed as the training that enables learners to ‘acquire this body of knowledge and the set of skills’. A discussion of the importance of science education refers to the need to prepare a scientifically literate workforce, and also to produce ‘competent professionals in the various scientific disciplines.’ It also comments on the value of science as a vehicle for developing positive attitudes including: curiosity, keenness, creativity, open-mindedness, perseverance and concern. This focus on spiritual, moral, social and cultural development and the development of key skills parallels the section ‘Learning across the National Curriculum’ in the introduction to the National Curriculum document for England.

Like the science curriculum for England, the curriculum for Singapore is based on a constructivist framework where pupils are expected to build up their knowledge and understanding through first hand experience including investigation:

For pupils to have meaningful learning it is important that they be allowed to experience first hand the process of seeking answers to problems. This requires that pupils physically explore and discover knowledge…. They must be able to effectively integrate and link new concepts to the existing body of knowledge. (p3-4#)

The selection of the concept areas to be taught in the Singapore curriculum aims to give a 'broad based understanding of the environment, and…..help build a foundation upon which pupils can rely for further study.' (p4#)

The aims of the Singapore curriculum for science are (p4):

- *Provide primary pupils with experiences which build on their interest in and stimulate their curiosity about their environment*
- *Provide pupils with scientific concepts to help them understand themselves and the world around them*
- *Provide pupils with opportunities to develop skills, habits of mind and attitudes necessary for scientific inquiry*
- *Prepare pupils towards using scientific knowledge and methods in making personal decisions*
- *Help pupils appreciate how Science and Technology influence people and the environment.*

These aims further reinforce the constructivist basis of the curriculum, seeking to encourage practitioners to build on pupils' interests and to engage them in the learning process. They also emphasise the importance of positive attitudes and curiosity for successful learning in science. The necessity for scientific knowledge and understanding is recognised (second bullet), although the emphasis on the need to develop 'skills, habits of mind and attitudes necessary for scientific inquiry' (third bullet) reinforces an enquiry-based approach to developing this knowledge and understanding. In addition a principle that underpins the aims of the curriculum is apparent in the fourth bullet: the significance of the ability to apply scientific knowledge and methods in everyday life to inform personal decision-making. The final bullet makes clear links between Science and Technology, emphasising their influence on daily life and the interactions of people with the environment.

17.3 Content

17.3.1 Comparison of curriculum elements corresponding to Sc1: Scientific Enquiry

All aspects of the NC PoS within Sc1: Scientific Enquiry has equivalent elements within the Singapore curriculum. An element within the Singapore curriculum that does not have a direct correspondence with the NC is: *construct a hypothesis* [Basic Process Skill/Generating/3a]. The element of the NC PoS which links most closely to this is: *ask questions that can be investigated scientifically and decide how to find answers* [1/2a]. Hypothesising requires application of scientific knowledge and understanding to develop a theoretical construct or question which may subsequently be tested through scientific enquiry. The requirement of the NC is less advanced than this as it only requires pupils to think of questions which could be investigated, but do not necessarily need to have been developed through a process of scientific reasoning.

A significant difference between the Singapore curriculum and the NC for England is the age at which science process skills are introduced. The first consideration is that the formal curriculum for science in Singapore does not begin until Primary 3, which is the equivalent of Year 4 in the English system. This does not mean that no science is carried out in schools and settings prior to this, only that there is no formal curriculum prescribing the learning. The Basic Process Skills of observing, comparing, classifying, measuring and using apparatus and communicating verbally and pictorially are introduced in Primary 3, together with elements of analysing and generating. Further elements of analysing and generating are introduced in Primary 4, 5 and 6, together with aspects of evaluating, tabular communication (Primary 4) and graphical communication (Primary 5). The integrated process skills of creative problem solving and decision-making are introduced in Primary 4 (Year 5) and investigation is not introduced until Primary 5 (Year 6). Elements required for investigation, for example: the ability *to identify variables that will affect the investigation* (Basic Process Skills/Analysing/2b) are introduced earlier (in this case Primary 4). The Integrated Process Skill of 'Investigation' therefore denotes the combination of the relevant Basic Process Skills necessary to plan and implement complete investigations (possibly unsupported). Aspects of the Singapore curriculum relating to the Breadth of Study section in the National Curriculum can be identified as implicit elements within the aims and rationale (see spreadsheet for details).

17.3.2 Comparison of curriculum elements corresponding to Sc2: Life processes and living things

Elements of the PoS of the NC for England that are not covered by the Singapore curriculum are:

- 2/1c - there is reference in the Singapore curriculum to 'characteristics (NC life processes) of all living things' (equivalent to 2/1a), but there is no requirement to compare these in plants and animals
- 2/2b - understanding of the role of food for growth is specified, but pupils are not required to know about the importance of an adequate and varied diet

- 2/2d and 2/2h - understanding of the effect of exercise and rest on pulse rate and the importance of exercise for good health are not required, although pupils do learn about skeletal and muscular systems

- 2/2g - aspects relating to the effects of substances such as alcohol on the body and their effects on personal health are not included

- 2/4c - there is no reference to the reasons why plants and animals need to be assigned to groups, although pupils are required to carry out classification

- 2/5c - understanding of how plants and animals are adapted to live in particular habitats is not required

- 2/5f - pupils are not required to learn about micro-organisms (not mentioned in Primary 6 either)

Elements of the Singapore Curriculum that are not represented within the PoS of the NC for England are:

- Understanding of the concept of systems within organisms

- Understanding of cells as the basic unit of life; how cells divide to facilitate growth; identification of different parts of plant and animal cells

- Recognition of the integration of the different systems involved in carrying out life processes; understanding of the importance of water to the life processes

- Understanding of the process of respiration in releasing energy for life processes; recognition that energy is required to make things move and for life processes

- Understanding of the basic mechanism of reproduction in humans and that many characteristics are passed on from parents to offspring.

- Comparison of the ways in which nutrients, water and oxygen are transported in plants and animals

- Comparison of the way in which plants and different animals take in oxygen and give out carbon dioxide; recognition that air is a mixture of gases (context of respiration)

- Specific requirement to compare life cycles in different animals (although this is not stated as a requirement in the NC it is carried out in many schools and often in Key Stage 1)

- Comparison of different forms of reproduction in plants (including various forms of asexual reproduction); comparison of sexual reproduction in plants and animals

17.3.3 Comparison of curriculum elements corresponding to Sc3: Materials and their properties

Elements of the PoS of the NC for England that are not covered by the Singapore curriculum are:

- 3/1d - there is no reference either to describing or grouping rocks in the Singapore curriculum
- 3/2a, 3/2f, 3/2g, 3/3a, 3/3b, 3/3c, 3/3d, 3/3e - there is no reference to describing changes that occur when materials are mixed or non-reversible changes. There is also nothing in the Singapore curriculum relating to ways of separating mixtures of materials (covered by five separate areas of the PoS for England)

Elements of the Singapore Curriculum that are not represented within the PoS of the NC for England are:

- making the connection between understanding that good conductors of electricity are usually good conductors of heat
- knowing that matter is anything that has mass and occupies space
- knowing common sources of heat; differentiating between heat and temperature; knowing the effects of heat gain/loss in contexts of daily life; understanding that heat flows from a hotter to a colder object and relating this to temperature changes
- understanding the importance of the water cycle
- knowing some uses of water

17.3.4 Comparison of curriculum elements corresponding to Sc4: Physical processes

Elements of the PoS of the NC for England that are not covered by the Singapore curriculum are:

- 4/2e - how to measure forces and identify direction of action
- 4/3e, 4/3f, 4/3g - there is no reference to sound in the Singapore curriculum or to ways of changing sounds
- 4/4a, 4/4b - there is no reference to requiring pupils to learn the spherical shape of the Earth, Sun and Moon or how the position of the Sun appears to change in the sky during the day and the effect of this on shadows.

Elements of the Singapore Curriculum that are not represented within the PoS of the NC for England are:

- the Singapore curriculum requires pupils to be able to list simple machines and to manipulate them to determine their characteristics and uses
- a broader understanding of magnets is required in the Singapore curriculum relating to ways of making magnets and knowledge of their uses
- the requirement for knowledge of the composition of the solar system is specified in the Singapore curriculum, together with the fact that the Sun is a star that gives out light, whereas the Moon and planets do not (this knowledge is often taught at Key Stage 2 but is not a requirement of the curriculum)
- knowledge of some uses of man-made satellites is required
- understanding of the link between the Earth's position relative to the Sun as a contributing factor to Earth's ability to support life

17.4 Breadth and Difficulty

An overview of the comparative breadth and difficulty of the Singapore curriculum will be presented for each of the four areas of the National Curriculum.

Sc1: Scientific Enquiry

In a comparison of the areas of the curriculum relating to Scientific Enquiry, the Singapore curriculum is similar in difficulty to the National Curriculum in 12 curricular areas, and easier in one area.

There is 1 area in which the Singapore curriculum is broader (which corresponds to the area of the Singapore curriculum that is not represented in National Curriculum), 10 areas in which it is narrower than the NC and 11 areas where the two curricula are similar. The Breadth of Study section of Sc1 accounts for over half of the areas in which the Singapore curriculum is narrower. The Breadth of Study section, however, has close parallels with the Singapore curriculum; but these are mainly implicit in the aims and rationale of the Singapore curriculum rather than explicit in the curricular outcomes.

In the majority of cases these judgements are either 'quite confident' or 'very confident'. The Singapore curriculum is narrower than the National Curriculum for England, but there is a very close match between the two curricula with regard to difficulty.

Sc 2: Life processes and living things

In a comparison of the areas of the curriculum relating to the Sc2 strand of the National Curriculum, the Singapore curriculum is similar in difficulty to the National Curriculum in 7 curricular areas, harder in 6 areas and easier in 2 areas. There are 25 areas in which the Singapore curriculum is broader (including the areas of the Singapore curriculum that are not represented in National Curriculum), 12 areas in which it is narrower than the NC

and 5 areas where the two curricula are similar. In the majority of cases these judgements are ‘very confident’. Overall within the Sc2 strand of the National Curriculum, the Singapore curriculum is therefore broader and more demanding than the National Curriculum for England.

Sc 3: Materials and their properties

In a comparison of the areas of the curriculum relating to the Sc3 strand of the National Curriculum, the Singapore curriculum is similar in difficulty to the National Curriculum in 7 out of 8 curricular areas, and easier in 1 area. With regard to breadth, there are 9 areas in which the Singapore curriculum is broader (including the areas of the Singapore curriculum that are not represented in National Curriculum), 10 areas in which it is narrower than the NC and 6 areas where the two curricula are similar. In the majority of cases these judgements are ‘very confident’. Overall within the Sc3 strand of the National Curriculum, the Singapore curriculum is therefore very different in content to the National Curriculum, although overall the breadth and difficulty are similar.

Sc 4: Physical processes

In a comparison of the areas of the curriculum relating to the Sc4 strand of the National Curriculum, the Singapore curriculum is similar in difficulty to the National Curriculum in 6 curricular areas, harder in 3 areas and easier in 2 areas. There are 12 areas in which the Singapore curriculum is broader (including the areas of the Singapore curriculum that are not represented in National Curriculum), 8 areas in which it is narrower than the NC and 6 areas where the two curricula are similar. In the majority of cases these judgements are ‘quite confident’ or ‘very confident’. Overall within the Sc4 strand of the National Curriculum, the Singapore curriculum is therefore very different in content to the National Curriculum, broader and slightly harder.

17.5 Order of Teaching and when Taught

The Singapore curriculum is organised around year groups. In relation to the themes within the Singapore curriculum (corresponding to the Science 2, 3 and 4 content of the National Curriculum), detailed learning outcomes are listed for each of the year groups. The process skills within the Singapore curriculum are presented in tabular form, with statements detailing aspects of each of the process skills, together with an indication of the year groups in which these skills should be developed.

In the rationale for the structure of the curriculum, a spiral approach was advocated: ‘*characterised by the revisiting of concepts and skills at different levels and with increasing degrees of depth. The spiral approach allows the learning of scientific concepts and skills to match pupils’ cognitive development. It therefore helps pupils build upon their existing understanding of concepts and facilitates the gradual mastery of skills.’*(p4#)

Analysis of the curriculum reveals that although the themes are repeated in different years, the actual content within the themes is rarely closely related in different years. This reflects the requirement to teach different topics within each theme for different year

groups. For example, the theme ‘Systems’ appears in Primary 3, 4 and 5, but the topics within each of these year groups are different:

Primary 3: plant parts and functions; digestive and skeletal/muscular systems

Primary 4: respiratory and circulatory systems

Primary 5: electrical systems

Similarly ‘Interactions’ is taught in Primary 3, 5 and 6, with again a completely different focus for each of the topics:

Primary 3: magnets

Primary 5: simple machines

Primary 6: forces; environmental impact and ecology.

Also ‘Energy’ is a theme for Primary 4, 5 and 6, but there is no overlap in the topics:

Primary 4: light; heat

Primary 5: photosynthesis and respiration

Primary 6: forms of energy and conversions

The other two themes: ‘Diversity’ and ‘Cycles’ do show some overlap in the topics and therefore the capacity for building on previous knowledge and understanding. ‘Diversity appears in Primary 3 and 6:

Primary 3: variety and characteristics of living things; materials

Primary 6: classification of organisms and materials

The theme of ‘Cycles’ is found in Primary 3, 4 and 5

Primary 3: life cycles of plants and animals

Primary 4: matter; water

Primary 5: day and night cycles; unit of life; reproduction in plants and animals

In contrast the science process skills are revisited within subsequent years and there is a progression in the curriculum requirements for ‘Analysing’, ‘Generating’ and ‘Evaluating’. Apart from ‘Evaluating’ (which is not introduced until Primary 4) all of the Basic Process Skills are introduced in Primary 3. The Integrated Process Skills are also present in the curriculum for subsequent years. ‘Creative Problem Solving’ and ‘Decision-Making’ are introduced in Primary 4, with ‘Investigation’ being introduced in ‘Primary 5’. From this analysis it appears that the rationale emphasising a spiral curriculum has its focus more

within the science process skills than within the curriculum content aspects of the curricular themes.

17.6 Integration of Subjects

Planned integration of science and technology takes place within the theme of Interactions in Primary 5, where pupils are required to learn about the characteristics of machines and their uses. Other than this there are no guidelines for the planned integration of science within other subject areas.

17.7 Comparison of the aims, rationale, structure and content of the 2001 version of the Singapore science curriculum with the 2008 version

The local expert reports that the Singapore curricula are revised on a six year cycle and that in this revision content has been removed to make time for inquiry- based instruction. The rationale given in the 2008 curriculum emphasises this: 'the teacher as the leader of inquiry in the science classroom.' A diagram has been inserted that emphasises learning in science through enquiry by the integration of 'skills and processes', 'ethics and attitudes' and 'knowledge, understanding and application'. Also links have been made to the role of science in daily life, within society and in the environment. The aims are very similar to those in the 2001 curriculum, except for the fifth aim 'help students appreciate how science influences people and the environment' has lost the science and technology focus.

The overall structure of the 2008 curriculum is significantly different from that of the 2001 version, although the basic elements have been conserved. The 2001 curriculum was organised around year groups with the teaching of specific aspects of themes being prescribed within particular year groups. This resulted in the teaching of related aspects of the science curriculum being separated by long periods of time, with little flexibility for practitioners to choose when to implement a particular aspect of the curriculum. In the 2008 version of the curriculum, learning is organised around the themes, with the content for each theme being grouped (a more similar arrangement to the National Curriculum for England). There is some prescription in the 2008 version with regard to when particular aspects of a theme are to be taught, but this is limited to whether a particular aspect should be taught in 'Lower Block' (P3/4) or 'Upper Block' (P5/6).

The format in which the outcomes are organised has changed considerably. In the 2001 version of the curriculum, the Learning Outcomes were arranged in tabular form with accompanying 'Remarks' giving more detail about the content of what should be taught and suggested contexts. In the 2008 version the outcomes are subdivided into three types which form three columns in the outcomes table:

- Knowledge, understanding and application
- Skills and processes
- Ethics and attitudes

The outcomes from 2001 have been reorganised within these three categories with slight changes to the wording. Also additions have been made to the wording of many of the outcomes in the 'Skills and processes' column to illustrate how the skills and processes of science can be developed within the particular context of the theme. Significant additions have been made to the curriculum in the 'Ethics and Attitudes' column with a focus on the following areas, again within the particular contexts of the themes:

- Showing curiosity
- Valuing individual effort and team work
- Showing objectivity
- Showing concern

An explanation of the key areas of knowledge and understanding has been added at the start of each theme in the 2008 curriculum. Another significant addition is the inclusion of key inquiry questions at the start of the section for every theme, consisting of a closed information question focussing on knowledge and an open question focussing attention on implications of the area of study or on encouraging the making of connections between different areas of knowledge or understanding.

The composition of the skills and processes are very similar in both curricula, although 'Generating' from the 2001 curriculum has been subdivided into its key components: 'Generating possibilities; Inferring; Predicting; and Formulating hypotheses.' The curricular themes 'Diversity; Cycles; Systems; Interactions; and Energy' have remained unchanged. However there has been a reduction in the content of the curriculum in the areas within these themes. The main changes are summarised below (highlighted areas in the 2001 curriculum indicate areas that have been removed or significantly reduced in the 2008 curriculum. Underlined areas in the 2008 curriculum indicate areas that have been reorganised):

Table 17.1 2001 and 2008 Singapore science curricula

Themes	2001 Curriculum	2008 Curriculum
Diversity	• Variety and characteristics of living things (P3) • Materials (P3) • Classification of organisms and materials (P6)	• Diversity of living and non-living things (general characteristics and classification) (P3 & 4) • Diversity of materials (P3 & 4)
Cycles	• Life cycles of plants and animals (P3) • Matter (P4) • Water (P4) • Day and night cycles (P5) • Unit of life (P5) • Reproduction in plants and animals (P5)	• Cycles in plants and animals - life cycles (P3 & 4) - reproduction (P5 & 6) • Cycles in matter and water - matter (P3 & 4) - water (P5 & 6)
Systems	• Plant parts and functions (P3) • Digestive and skeletal / muscular systems (P3) • Respiratory and circulatory systems (P4) • Electrical systems (P5)	• Plant system - plant parts and functions (P3 & 4) - respiratory and circulatory systems (P5 & 6) • Human system - digestive system (P3 & 4) - respiratory and circulatory systems (P5 & 6) • Cell system (P5 & 6) • Electrical system (P5 & 6)
Interactions	• Magnets (P3) • Simple machines (P5) • Forces (P6) • Environmental impact (P6) - significantly reduced • Ecology (P6)	• Interaction of forces - Magnets (P3 & 4) - Frictional force, gravitational force, forces in springs (P5 & 6) • Interaction within the environment (P5 & 6)
Energy	• Light (P4) • Heat (P4) • Photosynthesis and respiration (P5) • Forms of energy and conversions (P6)	• Energy forms and uses - Light and heat (P3 &4) - Photosynthesis (P5 & 6) • Energy conversion (P5 & 6)

Detailed analysis shows that the majority of the outcomes from 2001 have been transferred to 2008, with only slight changes to the wording of the outcomes. The following learning outcomes are either no longer present in the 2008 curriculum or have been reorganised:

Diversity

- 'show an awareness that materials as well as organisms can be grouped based on their properties or characteristics' (P6/D/a)
- 'classify some common materials' (P6/D/b)
- 'differentiate between plants, animals and fungi based on form, nutrition and movement' (P6/D/d)

Cycles

- all of the outcomes relating to the Solar System in P5 have been removed
- 'list some uses of water' (P4/C/k)
- 'show an awareness of the need to conserve water' (P4/C/m)
- three outcomes relating to the structure of plant and animal cells have been moved from 'Cycles' (P5/C/g,h,i) to 'Systems'
- 'show an understanding that a cell divides to produce new cells' (P5/C/j)

Systems

- 'show an understanding that an organism is a system which has different parts to carry out different functions' (P3/S/a)
- 'recognise the interaction between the human skeletal and muscular systems in enabling movement' (P3/S/e)
- 'recognise that

- dry cells / batteries provide energy in a closed circuit
- current transports energy from the dry cells / battery to the bulb
- a switch can be used to break or close a circuit' (P5/S/c)

Interactions

- 'list some simple machines' (P5/I/b)
- 'manipulate these simple machines to determine their characteristics and uses' (P5/I/c)

- three outcomes relating to: awareness of the use of materials to meet technological needs; how the development of science and technology affects the environment; and the influence of the environment of science and technology have been reduced and amalgamated (P6/I/p,q,r)

Energy

- 'recognise that respiration is a process in which energy is made available for life processes to occur' (P5/E/c)
- 'show an understanding that energy can be converted from one form to another' (P6/E/c)

The 'Basic Process Skills' have been renamed 'Skills' and changes are as follows:

Table 17.2 Skills in the 2001 and 2008 Singapore science curricula

Singapore Science Curriculum 2001 **Basic Process Skills**	**Grades**	Singapore Science Curriculum 2008 **Skills**	**Grades**
Observing	3,4,5,6	Observing	3,4,5,6
Comparing	3,4,5,6	Comparing	3,4,5,6
Classifying	3,4,5,6	Classifying	3,4,5,6
Measuring and using apparatus	3,4,5,6	Using apparatus and equipment *(measurement not stated)*	3,4,5,6
Communicating (verbal, pictorial)	3,4,5,6	Communicating (verbal, pictorial)	3,4,5,6
Communicating (tabular)	4,5,6	Communicating (tabular)	3,4,5,6
Communicating (graphical)	5,6	Communicating (graphical)	3,4,5,6
Analysing : Level 1 Level 2 Level 3	 3,4,5,6 4,5,6 5,6	Analysing	3,4,5,6
Generating Level 1 Level 2 Level 3	 3,4,5,6 4,5,6 5,6	Generating possibilities Inferring Predicting Formulating hypotheses	3,4,5,6
Evaluating Level 1 Level 2 Level 3	 4,5,6 5,6 6	Evaluating	3,4,5,6

The ‘Integrated Process Skills’ (2001) have been renamed ‘Processes’ (2008)

Table 17.3 Skills in the 2001 and 2008 Singapore science curricula

Singapore Science Curriculum 2001 **Integrated Process Skills**	**Grades**	Singapore Science Curriculum 2008 **Processes**	**Grades**
Creative Problem Solving	4,5,6	Creative Problem Solving	3,4,5,6
Decision-Making	4,5,6	Decision-Making	3,4,5,6
Investigation	5,6	Investigation	3,4,5,6

From the tabular comparison, the composition of the Skills and Processes in the two curricula can be seen to be very similar, but with a significant change in the level of prescription with regard to the year groups in which they should be introduced. In the 2008 curriculum there is a requirement to teach all of the skills and processes within each of the year groups, in contrast to the staggered approach for 2001. In the 2008 curriculum, in addition to the process skills being listed separately in the curriculum document they are also integrated within the themes. In the 2001 document, progression of skills was indicated in the table on page 9 of the curriculum document, whereas in the 2008 document progression is detailed as separate outcomes for Skills and Processes within the syllabus for each year group. This has advantages in that it provides practitioners with ideas of how to integrate the skills and processes within the other aspects of the curriculum, although it could also be limiting if the curriculum document was interpreted in a prescriptive manner.

Differences between the two curricula in relation to differentiation and guidance on teaching methods are explored in sections 1.8 and 2.0 respectively.

17.8 Differentiation and Tailoring Content to Ability

In the 2001 Singapore science curriculum at the end of Primary 4 pupils are formally streamed into three streams: EM1 and 2 are the streams for higher attaining pupils whilst EM 3 has the lower attaining pupils. In EM1 and 2 pupils follow an identical curriculum in science, whereas in EM 3 the curriculum has been reduced with some parts of the curriculum removed, however the remaining elements are identical to EM 1 and 2.

From 2008 the introduction of subject-based banding has replaced the EM3 stream. This means that students can study at different levels (Standard or Foundation) in different subjects.

17.9 Mandatory or recommended Time for Subjects and Content Areas

The local expert reports that science is a compulsory subject in the school curriculum from primary 3 to primary 6 but it is not taught formally as a subject in primary 1 and primary 2. The recommended times for science in the schools' weekly timetable from P3-6 are:

Level	Time (hours per week)	No. of periods
Primary 1	0	0
Primary 2	0	0
Primary 3	1.5	3
Primary 4	2.0	4
Primary 5	2.5	5
Primary 6	2.5	5

17.10 Guidance or Compulsion of Teaching Methods

In the 2001 Singapore science curriculum there is no guidance on the teaching methods that could be employed, although a section has been included in the introductory part of the new 2008 version of the curriculum. The section 'Teaching and learning through inquiry' in the new science curriculum for Singapore, focuses on approaches to teaching that are embedded in an inquiry-based model for teaching and learning science. The key areas of science as inquiry are identified as:

- Questioning: posing, selecting, clarifying questions to explore or investigate
- Collecting and evaluating evidence
- Constructing explanations
- Making connections
- Communicating ideas, explanations and reasoned arguments

Teachers are encouraged to support students in developing these skills through a variety of approaches:

- Approaches for exploring and visualising ideas (concept cartoons) and developing links between concepts (concept mapping)
- Facilitating cooperative learning
- Using a variety of teaching approaches e.g. demonstration, questioning

- Strategies for active and independent learning (SAIL) emphasising learning as a formative and developmental process in which learning expectations are made clear to students ‘so that they know where they are in the learning process and how they can improve’ (p14)

- Planning a range of activities for developing learning e.g. games, investigations, problem-solving contexts, projects, field trips, role play, drama, dance and movement.

18 Literacy Comparison: British Columbia

18.1 Structure

The 1996 curriculum for language in British Columbia is a very comprehensive document consisting of over 350 pages. It is entitled an Integrated Resource Package (IRP) rather than a curriculum or syllabus.

18.1.1 Structure of document

The Introduction, which sets out the rationale behind the language curriculum, is followed by a grade-by-grade break-down of what teachers are to teach. In terms of level of detail, this document falls between the English National Curriculum and the Primary Strategy. It indicates in which grade subject areas are to be delivered but not the precise term / semester. For each grade and for each language area, there is a list of *Prescribed Learning Outcomes*, which are phrased very much like the statements in the English National Curriculum Programmes of Study. To accompany each set of *Prescribed Learning Outcomes*, there are *Suggested Instructional Strategies, Suggested Assessment Strategies* and *Recommended Learning Resources.* The document covers Kindergarten up to and including Grade 7. There are several appendices following this. The largest of these is a detailed catalogue of the *Recommended Learning Resources*, ie the books, tapes, visual resources from which teachers have to choose their teaching materials. Two other appendices also provide guidance on cross-curricular teaching and assessment.

18.1.2 Structure of language

Rather than breaking language down into reading, writing, speaking and listening, in British Columbia language skills are grouped differently clustering related aspects of written, spoken and visual communication together. At each grade, the following framework is used to convey the language skills that are to be taught:

Comprehend and Respond:

- Strategies and Skills
- Comprehension
- Engagement and Personal Response
- Critical Analysis

Communicate Ideas and Information:

- Knowledge of Language
- Composing and Creating
- Improving Communications

- Presenting and Valuing

Self and Society:

- Personal Awareness
- Working Together
- Building Community

18.1.3 Structure of School system

Due to the structure of the British Columbian school system it has been impossible to find an exact match for the Key Stage 2 years. Children start their Kindergarten year at school in the calendar year in which they turn five. This means that during the course of an academic year there will be children in the class who have not yet had their fifth birthday, those who are already five and those, after the new year, who turn six years of age.

British Columbia school year	Ages of children	English equivalent Year groups
K	Ages 4 to 6	R and Y1
G1	Ages 5 to 7	Y1 and Y2
G2	Ages 6 to 8	Y2 and Y3
G3	Ages 7 to 9	Y3 and Y4
G4	Ages 8 to 10	Y4 and Y5
G5	Ages 9 to 11	Y5 and Y6
G6	Ages 10 to 12	Y6 and Y7

Source: http://www.bced.gov.bc.ca/primary_program/

For the purposes of this comparison, we have looked at Grades 4, 5 and 6.

18.2 Aims and rationale for the curriculum

The British Columbian document provides a long and fully discussed rationale for the view of language that underpins what teachers are expected to teach. There is a concise explanation of what language is, how it develops and why good language skills are important. This is followed by a detailed account of what the *English Language Arts Programme* is intended to achieve. The aims of the programme are stated as the following:

- communicate effectively in written, spoken and visual forms
- develop positive attitudes towards language learning
- make connections to other areas of study and to life outside the classroom
- think critically, creatively and reflectively
- appreciate their own culture and the culture of others
- use technology

Each of these areas is explored and through this the British Columbian view of communication is conveyed. Communication *refers to any written, spoken or visual representation involving language.* Language is not viewed as separate skills of reading, writing, speaking and listening, but as *connected; they are integrated, interdependent processes,* and, as will be seen in the discussion of the content of the *Integrated Resource Package,* none of the *Prescribed Learning Outcomes* targets these skills individually. All are worded in such a way as to refer to at least, but sometimes more than, two of the skills of reading / writing / listening / speaking / viewing. Three types of communications are discussed: *literary*, *informational* and *mass media*. There is a repeated emphasis on the need to expose children to language in the greatest range of contexts possible for the greatest range of purposes, some of which refer to personal enrichment and fulfilment, as well as the need to communicate effectively, e.g. *students need to be able to communicate with precision, clarity and artistry… Learning to interact successfully with others is essential for students' success in school, lifelong learning and productive, satisfying lives.*

The discussion touches lightly on Canadian heritage in that children are expected to …*learn about our country's cultural heritage as expressed in language*…; likewise, there is a single mention of citizenship: *develop the reading and writing skills required of informed citizens*. However, in a document of this length it would be surprising if these were omitted. There is equal, if not more, stress given to appreciation *of their own culture and the culture of others*…. *understand and respect cultural, racial and linguistic diversity*. More pervasive in the introduction is the message to teach children to be creative users of the language, e.g. *present and respond to ideas, feelings and knowledge sensitively and creatively; express themselves powerfully, convincingly and gracefully; realise their individual potential as communicators*.

18.3 Content

Inevitably, the extent of the Canadian document, which is so much longer than most other curricula considered in this exercise, will be to its advantage in any comparative exercise such as this. It would seem that everything, or almost, that is in the English National Curriculum, will be found somewhere in the British Columbian and that the coverage of the Canadian curriculum is more thorough, informative, broader and deeper, due to its sheer comprehensiveness. As a result, the comparison of the two curricula is not truly a comparison of 'like with like'.

The vastness of the Canadian document makes it all the more striking that there are some specific areas of language learning of which it gives no mention. The table below shows the extent of overlap with the English national curriculum, using the headings provided by the English document:

Table 18.1 Reading curricula compared

Reading: Knowledge, skills and understanding		**Reading: Breadth of study**	
En2 1: Reading strategies	good match	En2 8: Literature	partial match
En2 2: Understanding texts	good match	En2 9: Non-fiction and non-literary texts	partial match
En2 3: Reading for information	good match		
En2 4: Literature	good match		
En2 5: Non-fiction and non-literary texts	partial match		
En2 6: Language Structure and variation	no coverage		
Writing: Knowledge, skills and understanding		**Writing: Breadth of study**	
En3 1: Composition	good match	En3 9: Purposes	little match
En3 2: Planning and Drafting	good match	En3 10: Thinking, Investigating, Organising and Learning	good match
En3 3: Punctuation	good match	En3 11: Readers	no coverage
En3 4: Spelling	little match	En3 12: Forms of writing	good match
En3 5: Handwriting and Presentation	good match		
En3 6: Standard English	good match		
En3 7: Language Structure	partial match		

There are, therefore, two areas of the English curriculum which are not covered in British Columbia. The first of these is En2 6: Language Structure and variation: *to read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology [for example, how adjectives and adverbs contribute to overall effect, the use of varying sentence length and structure, connections between chapters or sections].* The first clause of this statement is self-evident and is clearly within the aims of all reading curricula. However, it is the association of this improvement in *accuracy and understanding* with technical knowledge and familiarity with grammatical terminology that is not common to the two curricula. It is interesting to note that the 350 pages of the British Columbian language document contain only two mentions of knowledge of terminology. One of these is part of the assessment guidance given to teachers in that they may observe the use of terminology when assessing the *Prescribed Learning Outcomes* for the Grade 5 module Communicate Ideas and Information *(Knowledge of Language),* although use of terminology is not posited as one of the learning outcomes, itself. The second occurrence of the use of terminology in the British Columbian curriculum appears in the *Recommended Learning Resources*. In this section, a book is recommended precisely because it does *not require mastery of grammatical terminology, to achieve success.*

The other area of the English curriculum which finds no equivalent in the British Columbian is En3 11: Readers. This refers to the range of audiences for whom children should be taught to write during Key Stage Two: *The range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers*. This apparent omission is interesting as there are countless references to audience in the *Prescribed Learning Outcomes* from Grade 1 onwards, including for example: *It is expected that students will demonstrate their understanding of and abilities to use a variety of forms and styles of communication that are relevant to specific purposes and audiences*. (Grade 4: Communicate Ideas and Information *(Presenting and Valuing)).* Despite the finding that focus on audience is manifest throughout the *Prescribed Learning Outcomes,* there is nowhere a list of recommended audiences for whom children should write.

There are two areas in the English National Curriculum, therefore, which have no parallel in British Columbia. The reverse situation - curriculum areas in British Columbia for which there are no match in England - is more extensive.

No counterpart has been found, for example, for the British Columbian statements in Grade 4, 5 and 6 referring to the skills that nurture comprehension monitoring. These are:

- developing questions, re-reading, reading further and reviewing to clarify meaning (Grade 4 & Grade 5)
- … and build understanding (Grade 5)

- formulate questions that are relevant to specific audiences and purposes (Grade 5)

- use questioning, predicting, summarising and graphic organisers to accomplish specific purposes (Grade 6)

An examination of the Primary Strategy confirms that much less attention is focused on these activities in England. Of the activities listed above, only summarising is explicitly mentioned and occasionally targeted according to the Primary Strategy.

There also appears to be no direct English National Curriculum equivalent to:

- use a variety of written and graphic forms, including charts, webs and maps to organise details and information (Grade 4 & Grade 5)

- organise details and information they have read, heard or viewed using a variety of written & graphic forms, including charts, webs and maps (Grade 6)

This difference may stem from the very integrated nature of the British Columbian approach to language teaching. According to the English National Curriculum, pupils are expected to handle a variety of different formats in their reading (in En2 5f: *evaluate different formats, layouts and presentational devices [for example, tables, bullet points, icons*]). At the same time, there is a statement in the writing Programmes of Study that suggests that these formats should be adopted and practised during Key Stage two (En3 1e: *use features of layout, presentation and organisation effectively).* The Canadian requirements differ from the English in that children are expected to recast the information they read into the different formats listed above, thereby using what they read to feed into what they are asked to produce. Due to the structure of the English National Curriculum which separates activities relating to the different core language skills, activities of this type are not featured. However, they are found in the Primary Strategy. Activities which specifically combine reading and writing, in a way not unlike the Canadian activities above, appear from Year 3 onwards. For example: Year 3, Term 1, Point 22: Writing Composition (*to make a simple record of information from texts read, e.g. by completing a chart of information discovered…)*; Year 4, Term 2, Point 23: Writing Composition (*to collect information from a variety of sources and present it in one simple format, e.g. wall chart, labelled diagram).* It is highly likely that integrated activities, such as this, are commonplace in primary classrooms in England.

Amongst the tasks that are specified in the British Columbian document, there is another for which no exact parallel has been found in England, even in the detail of the Primary Strategy. This concerns work conducted in Grades 5 and 6 on gender stereotyping: *categorise roles and describe stereotypes portrayed by characters in various print and non-print works* (Grade 5); *compare the portrayal of males and females in mass media with their own experiences* (Grade 6). According to the Primary Strategy, it is possible that this area is touched upon in Year 5 in England when carrying out activities stemming from: …*investigating treatment of different characters, e.g. minor characters, heroes, villains, and perspectives on the action from different characters; consider and evaluate*

these features in relation to their own experience. However, there is nothing in England that specifically targets male / female stereotyping.

There is an entire set of Canadian activities in the Self and Society domain of the British Columbian curriculum that has no parallel in the reading or writing Programmes of Study in England. They are the following:

- Demonstrate awareness of how to use language and communications technologies to maintain relationships with others (Grade 6); develop and monitor their communication goals and plans (Grades 4, 5 & 6); demonstrate confidence in their abilities to communicate effectively in a variety of classroom situations (Grades 5 & 6)

- Demonstrate a willingness to improve their understanding by seeking clarification from others (Grade 4); demonstrate respect for others by communicating their ideas and information in an orderly fashion (Grade 4)

- Demonstrate an awareness of the diverse languages, ideas, opinions, cultures and contributions of their peers (Grades 4 & 5); describe the diverse languages, ideas, opinions, cultures and contributions of their peers (Grade 6); use language to acknowledge special events and people and to honour accomplishments in and beyond the classroom (Grade 4)… within the community (Grades 5 & 6).

The greatest overlap with these activities is probably to be found in the Speaking and Listening Programmes of Study, which are not included in this study. However, the Canadian statements do not segregate the different skills and aspects of reading and writing are featured in every set of *Prescribed Learning Outcomes*, as indeed they are in the set above. As before, elements of activities such as these can be found in the Primary Strategy, but in England they seem somewhat more marginal than in British Columbia.

18.4 Difficulty and coverage

18.4.1 Reading

18.4.1a Range

Looking at the *Prescribed Learning Outcomes* alone, one might think that the range of reading required in British Columbia is much narrower than in England. Only stories and poetry are explicitly stipulated as literary genres to be read, while from non-narrative genres only works of reference are mentioned *using print or electronic dictionaries or thesauri.* However, the *Recommended Learning Resources*, which list titles and publication details of the books, tapes, audios, videos, and multi-media resources to be used, indicate that a wider range is intended. Overall, there is a heavier weighting given to narrative genres with many stories, novels, collections of poetry on the list. In British Columbia, there is a heavy emphasis on the sorts of texts that are listed under En2 8e & f (*texts drawn from a variety of cultures and traditions*, (8e) *myths, legends and traditional stories* (8f)) and many that raise contemporary issues and matters for discussion. There

are far fewer informational texts and no mention of the types of text found in En2 9c (*newspapers, magazines, articles, leaflets, brochures, advertisements*) and very little of the genres found in En2 9a (*diaries, autobiographies, biographies, letters*).

18.4.1b Understanding and interpretation

As the British Columbian curriculum document is so much more detailed than the English, it is surprising when areas included in the England curriculum are not found in British Columbia. With one exception, equivalents for every statement within En2 1, 2 and 3 were found. The exception is En 2 3d: *draw on different features of texts, including print, sound and image, to obtain meaning.* It is uncertain how much significance to attach to the fact that this appears to be missing from the Canadian outcomes. Learning to derive meaning by as many means as possible is present in the Canadian document appearing at the beginning of each grades' set of *Prescribed Leaning Outcomes* relating to the Comprehend and Respond *(Strategies and Skills)* strand of their curriculum. Although not explicitly stipulated, it is likely that print, sound and image are implied in the Canadian statement: *It is expected that students will develop repertoires of skills and strategies to use as they anticipate, predict, and confirm meaning while reading, viewing, and listening.* In fact, overall, there is much more information provided in the British Columbian curriculum about strategies to be adopted for deriving meaning. As seen above, the need to teach comprehension monitoring skills (*developing questions, re-reading, reading further and reviewing to clarify meaning*) is much more explicitly stated in British Columbia than it is in England.

With regard to the understanding and appreciation of literary works (En2 4), there appear to be two areas which do not attract as much coverage in British Columbia as in England. These are:

- *identify different ways of constructing sentences and their effects* (En2 4b)
- *recognise the differences between author, narrator and character* (En2 4d)

The first of these, while not covered in any explicit way in the *Prescribed Learning Outcomes*, is found in the *Suggested Instructional Strategies* for Grade 5 under the Communicate Ideas and Information *(Knowledge of Language)* strand:

Ask students to work in pairs and read through a variety of written material to find and list at least six different types of sentences. Have students share their lists and discuss with the class what they found as well as the impacts and purposes of certain kinds of sentences.

By contrast, there is nothing as subtle as the distinction required in En2 4d. In British Columbia, authorial purposes and techniques form an important part of the curriculum as they do in England, but no equivalent has been found to the requirement to be able to distinguish between the author, narrator and the characters in literature.

18.4.1c Reading aloud

Another interesting contrast in the two curricula is the differing status given to reading aloud. While in England there is some importance given to the 'performance' of literature in that it is a separate statement in the Programme of Study (En2 4i: *read stories, poems and plays aloud),* in British Columbia it has a much smaller profile, being mentioned tangentially as a means to the instruction or assessment of another, higher status, literacy skill. For example, it is mentioned as part of the miscue analysis procedure for the Grade 5 assessment of the Comprehend and Respond *(Comprehension)* strand.

Have students read a short passage aloud. Look for evidence in their expression that they understand what they are reading, and analyse any errors they make.

18.4.1d Thinking skills

In both curricula, there is an attempt to ensure that children are not only taught the rudiments of reading but that they are intellectually stretched and challenged in terms of subject matter. The English statements (En2 4e and 5g) *evaluate ideas and themes that broaden perspectives and extend thinking* and *demonstrate a willingness to choose challenging materials for reading…* find a parallel in Grades 5 and 6 in British Columbia in: *engage with challenging and demanding subject matter; use a broad range of challenging materials for recreational purposes and to obtain information* (Grade 6) and *extend their understanding of a given selection by developing related questions and activities* (Grades 5 and 6).

18.4.1e Vocabulary

Vocabulary development in relation to both reading and writing is seen as important in both countries. There is evidence that pupils are to be encouraged to use newly acquired vocabulary creatively. In England they are to use vocabulary *in inventive ways* (En3 1b), while in Grade 4 in British Columbia, they are to *demonstrate pride and satisfaction in using language.* Similarly pupils in both countries are taught to handle specialist vocabulary, as can be seen in these two very similar statements: *identify the use and effect of specialist vocabulary* (England En2 5a) and *make sense of unfamiliar and specialised vocabulary* (British Columbia Grade 6). This aspect of the curriculum appears to be introduced to pupils in British Columbia when they are somewhat older.

The major difference is in the treatment of vocabulary and use of language in the two curricula is in expectations with regard to the affective aspects of language choice and authorial intent. There are several statements related to this in the English reading curriculum that have no evident match in British Columbia:

- *Identify words associated with reason, persuasion, argument, explanation, instruction and description* (En2 5b)
- *Recognise phrases and sentences that convey a formal, impersonal tone* (En2 5c)

This does not mean to say that the matter is entirely omitted in British Columbia but it does not appear to receive coverage in the 'reading' aspects of the *Prescribed Leaning Outcomes*. In British Columbia, the issues of register, formality and effect of language choices are more likely to be found in skills associated with the oral and written production of language, i.e. in the Communicate Ideas and Information (*knowledge of language*) section than in those related to reading. This can be seen in the outcomes listed under Communicate Ideas and Information for pupils in grades 4 and 6: *respond formally and informally to the communications of their peers* (Grade 4); *demonstrate an awareness of how register and pacing should be adjusted according to content and audience* (Grade 4); *adjust their degree of language formality as required by the form and purpose of their presentations* (Grade 6).

18.4.2 Writing

Unavoidably, due to the way in which the British Columbian curriculum combines all aspects of reading, writing and oral skills, some areas of writing have already been touched upon in the section above.

18.4.2a Range of purposes

One of the greatest areas of mismatch is to be found in the domain of the range of purposes for which children are taught to write. Overlap appears in that children in both countries are explicitly taught creative writing, i.e: all that is covered in En3 9a (*to imagine and explore feelings and ideas, focusing on creative uses of language and how to interest the reader*). This has a direct parallel across all the grades in British Columbia in *create and express thoughts, ideas and feelings in a variety of oral, written and electronic forms; create a variety of communications to express personal feelings and thoughts* (Grade 4); …. *to create and express thoughts, ideas and feelings in a variety of oral, written and electronic forms* (Grades 5 and 6). Likewise, there is overlap in the purposes of writing to inform and explain (En3 9b), focusing on the subject matter and how to convey it in sufficient detail for the reader. Amongst the *Prescribed Learning Outcomes,* there are some that relate to similar areas, for example: *select and shape information appropriately for specific audiences and purposes* in Communicate Ideas and Information (*Composing and Creating*) Grade 5.

However, there is no counterpart in the *Prescribed Learning Outcomes* to En3, 9c-9d, which relate to writing for the purposes persuading and reviewing and commenting. Interestingly, aspects of these purposes sometimes appear under the *Suggested Instructional Strategies* and the *Suggested Assessment Strategies.* For example, in the Communicate Ideas and Information (*Composing and Creating*) strand for Grade 4, it is suggested that *students assume the role of advertiser and present their products to the class in a persuasive manner.* However, this does not have the status of a *Prescribed Learning Outcome.*

18.4.2b Text types

Interestingly, although there seems to be only partial overlap between the purposes for writing that children are taught in the two countries, there is much more unanimity over the text types that are prescribed. In fact with the exception that English children are required to write reviews and commentaries, it would appear that all other text types are common.

18.4.2c Spelling

The greatest area of mismatch between the two countries lies in the area of spelling. Given that English is the national language in both, this is perhaps a surprising finding. Of the ten statements that relate to spelling in the English National Curriculum (En3, 4a-j), only three found a comparable counterpart in the British Columbian *Prescribed Learning Outcomes*. The most startling difference was that there is no reference to any aspect of morphology, at all, until Grade 7. British Columbians are expected to be familiar with concepts which are commonplace in English classroom throughout Key Stage 2 when they are considerably older. Although not required by the *Prescribed Learning Outcomes* until Grade 7, *there* is evidence in the *Suggested Instructional Strategies* that one aspect of morphology, namely suffixes and prefixes, is taught slightly earlier in Grade 6. Nonetheless, this does not match the heavy emphasis given to morphology in the English curriculum.

Although no equivalents have been found to En3 4a, b or f in the *Prescribed Learning Outcomes (to sound out phonemes*; *to analyse words into syllables and other known words; to revise and build on their knowledge of words and spelling patterns)* in fact there is evidence from the *Recommended Learning Resources* that these aspects of spelling are covered in the corresponding age groups. The title *Learning Phonics and Spelling in a Whole Language Classroom* is a prescribed text from Kindergarten through to Grade 7.

18.4.2d Language Structure

Knowledge of Language is part of the Communicate Ideas and Information strand from Kindergarten onwards. The ability to communicate with grammatical accuracy is clearly important in British Columbia, as it is in England. As early as Grades 2 and 3, pupils are required by the *Prescribed Learning Outcomes* to *demonstrate abilities to use grammatically correct language when speaking and when writing simple sentences*. What differs, as has been noted above, is the stress put on knowledge of grammatical terminology, which has a statement devoted to it in the English curriculum, but is hardly mentioned in British Columbia. Most references to grammar in the British Columbian document refer to grammar in the context of editing and proofreading.

Another aspect of language structure is the ability to paragraph. This is seen as a core part of the upper Key Stage two writing curriculum in En3 7d which states that pupils must be introduced to *the purposes and organisational features of paragraphs, and how ideas can be linked.* In British Columbia, there is a close match with:

understanding of the purposes of the various parts. (e.g., The first paragraph is usually an introduction.) After they have read the first paragraph, ask questions such as: What is the purpose of this paragraph? Why do you think the author began this way? Can you guess the author's purpose? Proceed paragraph by paragraph, asking questions such as: What purpose does this paragraph serve? Could it be deleted? Etc. Two factors distinguish this from the requirements of the English national Curriculum. Firstly, this reference to paragraphs appears in the *Suggested Instructional Strategies* for the strand relating to Comprehend and Respond *(Comprehension),* not in the *Prescribed Learning Outcomes.* Secondly, the first mention of the function of paragraphing appears in Grade 7, which is beyond the years covered by Key Stage two.

Table 18.2 Writing curricula compared

Writing: Knowledge, skills and understanding		**Writing: Breadth of study**	
En3 1: Composition	good match	En3 9: Purposes	little match
En3 2: Planning and Drafting	good match	En3 10: Thinking, Investigating, Organising and Learning	good match
En3 3: Punctuation	good match	En3 11: Readers	no coverage
En3 4: Spelling	little match	En3 12: Forms of writing	good match
En3 5: Handwriting and Presentation	good match		
En3 6: Standard English	good match		
En3 7: Language Structure	partial match		

There are, therefore, two areas of the English curriculum which are not covered in British Columbia. The first of these is En2 6: Language Structure and variation: *to read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology [for example, how adjectives and adverbs contribute to overall effect, the use of varying sentence length and structure, connections between chapters or sections].* The first clause of this statement is self-evident, needs no further explanation, and is clearly within the aims of all reading curricula. However, it is the association of this improvement in *accuracy and understanding* with technical knowledge and familiarity with grammatical terminology that is not common to the two curricula. It is interesting to note that the 350 pages of the British Columbian language document contain only two mentions of knowledge of terminology. One of these is part of the assessment guidance given to teachers in that they may observe the use of terminology when assessing the *Prescribed Learning Outcomes* for the Grade 5 module *Communicate Ideas and Information (Knowledge of Language),* although use of terminology is not posited as one

of the learning outcomes, itself. The second occurrence of the use of terminology in the British Columbian curriculum appears in the *Recommended Learning Resources*. In this section, a book is recommended precisely because it does *not require mastery of grammatical terminology, to achieve success.*

The other area of the English curriculum which finds no equivalent in the British Columbian is En3 11: Readers. This refers to the range of audiences for whom children should be taught to write during Key Stage Two: *The range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers*. This apparent omission is interesting as there are countless references to audience in the *Prescribed Learning Outcomes* from Grade 1 onwards, including for example: *It is expected that students will demonstrate their understanding of and abilities to use a variety of forms and styles of communication that are relevant to specific purposes and audiences*. (Grade 4: *Communicate Ideas and Information (Presenting and Valuing)).* Despite the finding that focus on audience that is manifest throughout the *Prescribed Learning Outcomes,* there is nowhere a list of recommended audiences for whom children should write.

There are therefore only two areas in the English National Curriculum which have no parallel in British Columbia. The reverse situation - curriculum areas in British Columbia for which there is no match in England - is more extensive.

No counterpart has been found, for example, for the British Columbian statements in Grade 4, 5 and 6 referring to the skills that nurture comprehension monitoring. These are:

- developing questions, re-reading, reading further and reviewing to clarify meaning (Grade 4 & Grade 5)
- … and build understanding (Grade 5)
- formulate questions that are relevant to specific audiences and purposes (Grade 5)
- use questioning, predicting, summarising and graphic organisers to accomplish specific purposes (Grade 6)

An examination of the Primary Strategy confirms that much less attention is focused on these activities in England. Of the activities listed above, only summarising is explicitly mentioned and occasionally targeted according to the Primary Strategy.

There also appears to be no direct English National Curriculum equivalent to:

- use a variety of written and graphic forms, including charts, webs and maps to organise details and information (Grade 4 & Grade 5)
- organise details and information they have read, heard or viewed using a variety of written & graphic forms, including charts, webs and maps (Grade 6)

This difference may stem from the very integrated nature of the British Columbian approach to language teaching. According to the English National Curriculum, pupils are expected to handle a variety of different formats in their reading (in En2 5f: *evaluate different formats, layouts and presentational devices [for example, tables, bullet points, icons*]). At the same time, there is a statement in the writing Programmes of Study that suggests that these formats should be adopted and practised during Key Stage two (En3 1e: *use features of layout, presentation and organisation effectively).* The Canadian requirements differ from the English in that children are expected to recast the information they read into the different formats listed above, thereby using what they read to feed into what they are asked to produce. Due to the structure of the English National Curriculum which separates activities relating to the different core language skills, activities of this type are not featured. However, they are found in the Primary Strategy. Activities which specifically combine reading and writing, in a way not unlike the Canadian activities above, appear from Year 3 onwards. For example: Year 3, Term 1, Point 22: Writing Composition (*to make a simple record of information from texts read, eg by completing a chart of information discovered…)*; Year 4, Term 2, Point 23: Writing Composition (*to collect information from a variety of sources and present it in one simple format, eg wall chart, labelled diagram).* It is highly likely that integrated activities, such as this, are commonplace in primary classrooms in England.

Amongst the tasks that are specified in the British Columbian document, there is another for which no exact parallel has been found in England, even in the detail of the Primary Strategy. This concerns work conducted in Grades 5 and 6 on gender stereotyping: *categorise roles and describe stereotypes portrayed by characters in various print and non-print works* (Grade 5); *compare the portrayal of males and females in mass media with their own experiences* (Grade 6). According to the Primary Strategy, it is possible that this area is touched upon in Year 5 in England when carrying out activities stemming from: …*investigating treatment of different characters, eg minor characters, heroes, villains, and perspectives on the action from different characters; consider and evaluate these features in relation to their own experience.* However, there is nothing in England that specifically targets male / female stereotyping.

There is an entire set of Canadian activities in the *Self and Society* domain of the British Columbian curriculum that has no parallel in the reading or writing Programmes of Study in England. They are the following:

- demonstrate awareness of how to use language and communications technologies to maintain relationships with others (Grade 6); develop and monitor their communication goals and plans (Grades 4, 5 & 6); demonstrate confidence in their abilities to communicate effectively in a variety of classroom situations (Grades 5 & 6)

- demonstrate a willingness to improve their understanding by seeking clarification from others (Grade 4); demonstrate respect for others by communicating their ideas and information in an orderly fashion (Grade 4)

- demonstrate an awareness of the diverse languages, ideas, opinions, cultures and contributions of their peers (Grades 4 & 5); describe the diverse languages, ideas, opinions, cultures and contributions of their peers (Grade 6); use language to acknowledge special events and people and to honour accomplishments in and beyond the classroom (Grade 4)… within the community (Grades 5 & 6).

The greatest overlap with these activities are probably to be found in the Speaking and Listening Programmes of Study, which are not included in this study. However, the Canadian statements do not segregate the different skills and aspects of reading and writing are featured in every set of *Prescribed Learning Outcomes*, as indeed they are in the set above. As before, elements of activities such as these can be found in the Primary Strategy, but in England they seem somewhat more marginal than in British Columbia.

18.5 Order of Teaching and when Taught

As indicated elsewhere, the British Columbian model falls somewhere between the English National Curriculum and the Primary Strategy. It stipulates in which grades aspects of the language programmes are to be delivered but falls short of indicating in exactly which term /semester to teach each component. In the Introduction, it is clear that the order of teaching is left to the teacher: *nor is this organization intended to prescribe a linear means of course delivery; it is expected that teachers will adapt, modify, combine, and organize instructional strategies to meet the needs of students and respond to local requirements.* For those *Prescribed Learning Outcomes* where we needed to consult the Primary Strategy to assess the degree of correspondence between the curricula, we found that most areas are covered with similar age-groups. However, as has been pointed out before, this is not a infallible measure of equivalence, as this is heavily text-dependent.

18.6 Integration of Subjects

As indicated earlier in this report, the language curriculum of British Columbia regards the skills of reading, writing and oracy as highly integrated. This is manifest from the very title of the document: the *Integrated Resource Package* and its structure, which makes no attempt to separate the skills. The inter-connectedness of the skills is emphasised from the Introduction of the document onwards. In a section entitled *Making Connections*, the teacher is informed

Integration in the English language arts curriculum occurs on three main levels: among the curriculum strands, across the curriculum, and in life outside the school. The various uses of language - speaking and listening, writing and representing, reading, and viewing - are connected; they are integrated, interdependent processes. Skills in one mode are often correlated with skills in another. For example, good listeners and speakers usually become good readers. Students should therefore have the opportunity to build their skills in all language processes.

Furthermore, the *Prescribed Learning Outcomes* are phrased in such a way that they can usually be applied to more than one of the language processes, e.g.

use language to acknowledge people, commemorate special events, and honour accomplishments within the community

It is possible to envisage activities relating to reading, writing and oral work, stemming from outcomes such as this.

18.7 Differentiation

Appendix C: Cross-Curricular Interests contains guidance for teachers about adaptation of the curriculum to special needs. There is an initial emphasis on integration and inclusiveness in the classroom and there is only a single curriculum which applies to all children in the province. The following statement from Appendix C indicates the high priority given to inclusion:

All students can benefit from an inclusive learning environment that is enriched by the diversity of the people within it. Opportunities for success are enhanced when provincial learning outcomes and resources are developed with regard for a wide range of student needs, learning styles, and modes of expression.

Teachers are provided with a list of approaches that can make their classrooms more *inclusive learning environments* and the message stressed is that *all students can work toward achievement of the provincial learning outcomes.* Possible modifications and adaptations to the *Integrated Resource Package* that the teacher might employ to achieve this aim are briefly exemplified. In the Individual Education Plan (IEP) for each pupil with special needs, it is established whether that child will receive modified or adapted programmes or whether he / she is to follow regular instruction - or any combination of these programmes for different curricula areas.

Similarly in Appendix C, there is a section devoted to *Students in ESL.* It would appear that students who speak English as an additional language may spend some or all of their time in ESL services. However, as can be seen from the statement below, the ESL programme followed is still based on the *Integrated Resource Package* and the *Prescribed Learning Outcomes* that are applied to mainstream pupils. *ESL is a transitional service rather than a subject. …. Thus ESL does not have a specific curriculum. The provincial curriculum is the basis of much of the instruction and is used to teach English as well as individual subject areas.*

18.8 Mandatory or recommended time for Subjects and Content Areas

The local expert reports that there is no recommended or Mandatory time for literacy in British Columbia. .

18.9 Guidance or Compulsion of Teaching Methods

Every set of *Prescribed Learning Outcomes* is accompanied by a list of *Recommended Learning Resources.* This consists of print materials, video, multimedia and software. The *Recommended Learning Resources* are fully catalogued in an Appendix, where further details about each reference are provided, as well as indicating where the title can be obtained. It would seem, from the following statement, that there is considerable encouragement of teachers to select materials only from the recommended list

Resources that support provincial curricula are identified through an evaluation process that is carried out by practicing teachers. It is expected that classroom teachers will select resources from those that meet the provincial criteria and that suit their particular pedagogical needs and audiences. Teachers who wish to use non-provincially recommended resources to meet specific local needs must have these resources evaluated through a local district approval process.

It would appear that teachers can find their own materials but that these materials have to undergo a vetting process:

Teachers may choose to use provincially recommended resources to support provincial or locally developed curricula; choose resources that are not on the ministry's list; or choose to develop their own resources. Resources that are not on the provincially recommended list must be evaluated through a local, board-approved process.

This degree of compulsion relates only to the materials used in the classroom and does not pertain to teaching methods. As well as outlining the *Recommended Learning Resources*, which seem to be mandatory, the *Integrated Resource Package* also presents *Suggested Instructional Strategies,* which are not.

Teachers are free to adapt the suggested instructional strategies or substitute others that will enable their students to achieve the prescribed outcomes. These strategies have been developed by specialist and generalist teachers to assist their colleagues; they are suggestions only.

19 Literacy Comparison: Chinese Taipei

19.1 Introduction

This comparison considers those elements of the curriculum that relate to reading and writing, as laid out in National Curriculum Programmes of Study for English, and the Chinese Taipei curriculum for the National Language - Mandarin (Note: a translation of this Chinese Taipei curriculum material was used.)

Taiwan - school year	Ages of children	Learning stages	English equivalent Year groups
G1	Ages 5-6	Stage 1	Y1
G2	Ages 6-7	″	Y2
G3	Ages 7-8	″	Y3
G4	Ages 8-9	Stage 2	Y4
G5	Ages 9-10	″	Y5
G6	Ages 10-11	″	Y6

The Chinese Taipei education system is organised in a grade structure that replicates that of England, with the curriculum for Grades 1-9 being specified for elementary and junior high schools. This corresponds with the structure of the curriculum for Years 1-9 in England. More specifically, in the case of Mandarin, there are three 'learning stages' in the Chinese Taipei system, and these differ slightly in extent, with Stage 1 ending in G3/Y3 and Stage 2 spanning G4-6/Y4-6. This structure suggests, perhaps, that those learning approaches or curriculum features associated with the earlier stages of pupils' language learning in school are maintained until the end of Year 3. A focus on assessment of outcomes or on curriculum change at the end of Year 3 must play a part in determining the nature of pupils' performances. It is important to note that Stages differ between subjects, so that, for example, mathematics includes a stage incorporating G6-7/ Y6-7.

19.2 Structure

The curriculum for language in Chinese Taipei focuses on the 'national language' of Mandarin, covering Grades 1-9 (Y1-9). It incorporates learning in 6 strands or Ability indicators:

Abilities to use Mandarin phonetic symbols

Listening abilities

Speaking abilities

Literacy and handwriting abilities

Reading abilities

Writing abilities

Each of these strands is made up of specific statements relating to the content of learning, expressed as skills/competences, such as 'To read an article fluently and emotionally'.

For each Ability Indicator, different numbers of skills are specified, and there is no fixed number of skills per Stage. This is similar to the structuring of the National Curriculum (NC) Programmes of Study (PoS) for English, in which there are different numbers of references within the reading and writing strands. While both curricula use strands in this way - to suggest that the skills of reading, writing and speaking and listening are to be treated separately, at least for the purposes of planning and assessment, if not for practical teaching - the Chinese Taipei curriculum further separates speaking from listening, and includes other elements.

'Literacy and handwriting abilities' exist alongside 'writing abilities'. The latter strand comprises what might be thought of as text- and sentence-level skills for writing, incorporating composition, the writing process, style and punctuation. The literacy component of 'Literacy and handwriting abilities' appears to encapsulate spelling. The additional strand focusing on Mandarin phonetic symbols is particular to the linguistic situation in Chinese Taipei and to those countries where Mandarin is spoken / written. These symbols are an aid to pronunciation, and are added to Chinese characters (Mandarin words) to give guidance relating to sounds. The curriculum refers to the use of these symbols for Stages 1 and 2 (up to the end of G/Y6), to support pupils, and for them to be used to a lesser degree in Stage 3.

Along with this structuring of learning content, there are ten Curriculum objectives for Mandarin, arising from the ten Basic abilities or core competences for the Grades 1-9 curriculum as a whole. The table below gives an overview of this relationship.

Table 19.1 Basic abilities and Curriculum objectives for Mandarin

	Curriculum objectives for Mandarin
Basic abilities / core competences	
I. Self-understanding and developing potential abilities	Use the language to stimulate their potential abilities and develop learning space.
II. Appreciation, performance and innovation	Foster interest in composition and enhance the ability of appreciation and analysis of literature.
III. Career planning and lifelong learning	Have language self-learning ability and establish the foundation for lifelong learning.
IV. Expression, communication and sharing	Use the language to express feelings and ideas, share experiences and communicate opinions.
V. Respecting, caring and teamwork	Fit in surroundings and respond appropriately to advance and retreat through language interaction.
VI. Cultural learning and international understanding	Learn Chinese culture and recognize Taiwan's different ethnic cultures and foreign cultural customs through language learning.
VII. Planning, organizing and practice	Use the language to develop plans and implement effectively.
VIII. Use of technology and information	Combine the language and information technology to enhance learning effect and expand fields of study.
VIIII. Active exploration and research	Foster interest in exploring the language and promote the attitude of initiative learning.
X. Independent thinking and problem-solving	Use the language to think independently and solve problem.

NB: This table is taken from a translation of the curriculum document.

These elements in the curriculum in Chinese Taipei highlight a greater focus on pupils' attitudes and values than is the case for the English curriculum. The focus on national culture and cultures, and on those of other places and people is made explicit in: 'Learn Chinese culture and recognise Taiwan's different ethnic cultures and foreign cultural customs through language learning'. This aim is not replicated in the English NC directly, although knowledge about Standard and non-standard language and usage, including dialects, would incorporate a focus on different cultural groups. The pertinent feature here is the way in which these ten elements remain visible in the detail of the Chinese Taipei language curriculum. Pupils' attitudes toward learning and their appreciation of aspects of language/handwriting, for example, are embedded in the skills identified for reading and writing. While the National Curriculum incorporates overarching principles and strands, collectively labelled 'Learning across the curriculum', such as thinking skills, key skills, spiritual and moral development and education for sustainable development, there are no specific references to these skills within the English PoS, which must influence the degree to which such elements are planned for and taught.

19.2.1 Assessment

The curriculum for Mandarin includes information about assessment. The key features include:

- all six strands of the curriculum are assessed
- formative and summative assessments should be made
- the time and frequency of assessments are set by schools
- teachers can develop a range of assessments, alongside paper-based tests, including the use of profiles that collect together evidence of a pupil's performance over time
- the Ministry of Education and local Departments of Education are involved in co-ordinating assessment, through, it appears, the collation/development of tables of the Basic Learning Abilities (NB, this is not made clear in the translation used)
- Literacy and spelling are assessed through assessments of reading and writing.

In many respects, this situation resembles that in England, with a combination of formative and summative assessments used for language, and the use of assessment tasks that combine different skills in practical use (i.e., through writing assessments that focus on producing a piece of writing). The documentation seen does not make clear the nature and scale of end-of-Stage assessments.

19.2.2 Terminology

Discussion of terminology here is filtered through the uncertainties of translation. The curriculum for Mandarin is given as 'The national language - Mandarin', and while 'curriculum' or an alternative holistic term is not evident, other terms include:

- Basic abilities - the ten key competencies that overarch all subjects (these relate most closely to the key skills, thinking skills, spiritual and moral development etc strands in the NC)
- Curriculum objectives - the ten objectives for the Mandarin curriculum - closely aligned to the ten Basic abilities
- Ability indicators - the main skills references in the curriculum on which planning etc is based.

The materials refer to learners as 'students', and other notable differences from the terminology of the English NC are the use of 'literacy' for the spelling aspects of writing, in the 'Literacy and handwriting' strand. Specific terms such as 'article' (used for a non-fiction text that, it seems, may take different forms), occasionally highlight the difficulties of comparing different curricula.

19.3 Aims and rationale for the curriculum

As has been indicated above, the Chinese Taipei curriculum is informed by ten Basic abilities that span a range of areas. The Curriculum objectives for the subject comprise the following ten statements.

1. Use the language to stimulate their potential abilities and develop learning space.

This objective manifests itself in the different strands, for example, as 'To foster reading interest and good habits and attitudes'. There is some overlap between the first half of this reference and references in the reading NC to pupils reading enthusiastically and with appreciation. The NC for English does not focus however, on 'habits and attitudes' in this way.

2. Foster interest in composition and enhance the ability of appreciation and analysis of literature.

There is a fairly close correspondence between this objective and elements in the English NC, although the attitudinal aspect is again stronger in the Chinese Taipei curriculum.

3. Have language self-learning ability and establish the foundation for lifelong learning.

While this objective seems an important point of difference, with the NC PoS not featuring similar objectives, the Mandarin curriculum references relating to reading and writing do not differ noticeably from aspects of the English curriculum.

4. Use the language to express feelings and ideas, share experiences and communicate opinions.

This objective again corresponds to aspects of the English PoS, but there is some indication that the Chinese Taipei curriculum gives greater emphasis to sharing experiences. An example is the reference to pupils sharing ‘the fun of writing’.

5. Fit in surroundings and respond appropriately to advance and retreat through language interaction.

Similarly, this objective shows a greater focus on relationships with others than is evident in the NC for English; for example, a reading skill includes ‘to understand…respecting others in the process of reading’.

6. Learn Chinese culture and recognize Taiwan's different ethnic cultures and foreign cultural customs through language learning.

There is a noticeable focus on knowledge, of local and ‘foreign’ cultures and customs, which is not evident in the English PoS. Cultural knowledge matters far more in the Mandarin curriculum.

7. Use the language to develop plans and implement effectively.

8. Combine the language and information technology to enhance learning effect and expand fields of study.

9. Foster interest in exploring the language and promote the attitude of initiative learning.

10. Use the language to think independently and solve problems.

These objectives correspond to some aspects in the English curriculum, but demonstrate a particularly strong focus on self-direction and independent learning. This seems to be a key feature of the curriculum.

19.4 Reading curriculum: content

This section of the report uses the NC subsections for reading as the starting point for comparison.

What is covered in both curricula?

Most aspects of the English NC for reading are addressed in the Chinese Taipei curriculum for Mandarin, although there are differences in the ways that learning references are expressed or organised. Some key points are discussed below.

En2 1) Reading strategies

Phonemic awareness and phonic knowledge

Word recognition and graphic knowledge

The differences between English and Mandarin as languages, in terms of orthography, have an impact on the way in which reading skills are expressed. Thus, in the Chinese Taipei curriculum, phonemic awareness focuses on knowledge and use of the Mandarin phonetic symbols to support pronunciation and reading of the non-phonetic Chinese script. It is hard to compare these aspects of the two curricula; there is no clear suggestion, however, that one is more or less demanding than the other. In some cases, the Chinese Taipei curriculum combines reading and correct pronunciation in single references (for example: be familiar with the shape, pronunciation, meaning of new words), while the English curriculum separates phonemic awareness from graphic knowledge. This might suggest that there is a more holistic approach to these reading strategies in the Chinese Taipei curriculum. However, other references in the Literacy and handwriting strand of the curriculum focus more closely on graphic knowledge in isolation: To recognise 1000-1200 Chinese characters commonly used.

Knowledge of grammatical structures

Contextual understanding

Comment: Both of these aspects of the English NC are addressed in the curriculum for Mandarin, but there are differences of specificity. For example, the latter curriculum refers jointly to ‘grammar and rhetorical skills’, and also focuses on the understanding of sentences and words (separately) in different contexts. This again, makes it hard to be certain of how closely the skills references match, although there seem to be broad similarities in coverage.

En2) 3 Understanding texts

Make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing]

Use their knowledge of other texts they have read

En2 3) Reading for information

Scan texts to find information

Skim for gist and overall impression

Obtain specific information through detailed reading

Draw on different features of texts, including print, sound and image, to obtain meaning

Use organisational features and systems to find texts and information

En2 4) Literature

Recognise the choice, use and effect of figurative language, vocabulary and patterns of language

Identify how character and setting are created, and how plot, narrative structure and themes are developed

Evaluate ideas and themes that broaden perspectives and extend thinking

Express preferences and support their views by reference to texts

Read stories, poems and plays aloud.

Comment: It is worth noting that the matching of references relating to literary style particularly difficult, because of the global nature of many skills in the Chinese Taipei curriculum.

En2 8) Literature

Texts drawn from a variety of cultures and traditions

En2 9) Non-fiction and non-literary

Print and ICT based reference and information materials [for example, textbooks, reports, encyclopedias, handbooks, dictionaries, thesauruses, glossaries, CD-ROMs, internet]

Note to the reading curriculum

Reading: during Key Stage 2 pupils read enthusiastically a range of materials and use their knowledge of words, sentences and texts to understand and respond to the meaning. They increase their ability to read challenging and lengthy texts independently.

What is covered in the English curriculum for reading, but not in the Chinese Taipei curriculum?

The following aspects are addressed in the English NC, but not in the Chinese Taipei language curriculum.

En2 1) Reading strategies

Use inference and deduction

Look for meaning beyond the literal

Comment: These higher order reading skills are, presumably, taught within the Chinese Taipei curriculum, but there are no clear references that can be cited. The specification of these skills in the English NC stresses their importance.

En2 3) Reading for information

Scan texts to find information

Skim for gist and overall impression

Draw on different features of texts, including print, sound and image, to obtain meaning

Distinguish between fact and opinion [for example, by looking at the purpose of the text, the reliability of information]

Comment: Again, it is unlikely that scanning and skimming are entirely absent from the reading curriculum pupils in Chinese Taipei encounter, but references to these specific skills are not evident. The nearest equivalents focus on grasping the point of a text or summarising it; or on using an article to solve a problem/answer a question. Similarly, there is no specific focus on making meaning from the different aspects of a text. These differences might suggest that reading in the Chinese Taipei curriculum is less directed toward the teaching of specific information retrieval skills, but still incorporates more global references that require learners to employ those skills.

The English curriculum's emphasis on distinguishing fact and opinion is not present in the Chinese Taipei curriculum – which may again be a matter of specificity.

En2 4) Literature

Identify different ways of constructing sentences and their effects

Recognise the differences between author, narrator and character

Consider poetic forms and their effects

Comment: This set of skills focused on literary texts is not clearly addressed in the Chinese Taipei curriculum, although skills such as those relating to word and sentence type/usage appear in relation to non-fiction texts, there is not a clear set of references to the analysis of literature. The global nature of many references in the Chinese Taipei curriculum makes it very hard to isolate the relevant skills.

En2 5) Non-fiction and non-literary texts

Evaluate different formats, layouts and presentational devices [for example, tables, bullet points, icons]

Engage with challenging and demanding subject matter

Comment: The curriculum for Mandarin does not explicitly reference the presentational aspects of texts, although some of its more global references to understanding or extracting information from texts might well imply the use of such skills. There is also some attention given to discussing and understanding the ideas in texts, but engaging with challenging material is not specified as it is in the English curriculum.

En2 6) Language structure and variation

To read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology [for example, how adjectives and adverbs contribute to overall effect, the use of varying sentence length and structure, connections between chapters or sections].

Comment: While recognising techniques and effects is an element in the Chinese Taipei curriculum, there is no reference to using appropriate language to discuss these features. This knowledge may well be assumed rather than specified - in a sense, in order to discuss the features, pupils will inevitably need the appropriate linguistic tools. What is not clear is the degree to which such terminology is emphasised.

En2 8) Literature

A range of modern fiction by significant children's authors

Long-established children's fiction

Myths, legends and traditional stories

Playscripts

Comments: There is again, far less specificity in the Chinese Taipei curriculum about the range of text-types to be explored. Only texts from/ relating to other cultures are referenced. There is a reference, however, to enjoying children's poetry, within the Writing abilities section of the curriculum. 'Literature' is mentioned occasionally, but most references to texts tend to focus on non-fiction, and this again, does not tend to include specific named text types.

En2 9) Non-fiction and non-literary

Diaries, autobiographies, biographies, letters

Comment: As for literary texts, there are few references to the types of material to be included in the reading curriculum for Mandarin. While there are references to pupils writing cards, letters and posters within writing strand of the curriculum, only dictionaries, encyclopaedias, newspapers and magazines, and unspecified 'articles' are mentioned in reading.

What is covered in the Chinese Taipei curriculum for reading but not in the English curriculum?

1-2-6-4 To understand the characteristics of different cultures from reading

Comment: There is no material relating to the understanding of different cultures in the English NC, although exploring texts from other cultures is included. The Framework for literacy incorporates similar material in Year 4; although there are no specific learning

objectives that isolate learning about different cultures, this is covered in the planning guidance.

1-2-6-3 To understand the beauty of Chinese language from reading

Comment: This reference does not seem to have an equivalent in the English curriculum. Although there is a broad reference in the Programmes of Study to pupils being taught skills that will enable them to appreciate literary texts - the emphasis is placed on the list of skills that follows, rather than the act of appreciation.

1-7-9-4 To master the basic reading skills

Comment: This very broad skill is worth highlighting. While, like many others, it might be placed alongside a group of more specific skills in the English NC, the fact that it is expressed in this way suggests that understandings of what might constitute 'basic reading skills' must be either assumed/shared among those working in the Chinese Taipei system, or be based other materials and reference points.

1-2-9-5 To concentrate on the main points and understand the contents and general idea of a text

1-7-5-2 To understand the information observed in reading

1-7-7-3 To cultivate the abilities of analysis and summarisation in reading

2-6-3-3 To learn abilities of clipping, summarising and sorting out materials

1-7-10-5 To learn how to ask and answer question yourself to help understand the contents of an article

2-10-10-1 To think and understand the process of solving problems in articles.

2-10-10-2 To think and criticise an article

Comment: This cluster of references demonstrates the subtleties of expression and the way in which skills that seem likely to be addressed in the English curriculum may not necessarily be included in the relevant documents. For some of the skills relating to extracting information and summarising, the Framework for literacy includes similar objectives in Years 3 and 4.

2-4-7-4 To associate reading materials with real-life situations

2-8-5-2 To understand respecting and caring for surrounding people and things

2-8-5-3 To cultivate the spirit of participating in groups and enhance personal interaction from reading

2-8-5-4 To take the initiative to record personal feelings and experiences, and summarise article contents

2-9-8-1 To make use of computers and other technology products to enhance cognitive and language abilities

1-3-7-3 To arrange one's own learning plan

Comment: This cluster of references, while touching on different aspects of reading, tends to share a focus on personal qualities and attitudes, and on developing core learning skills that apply beyond the language curriculum. As highlighted in earlier discussions, the Chinese Taipei curriculum pays more explicit attention to such aspects of learning.

19.5 Reading curriculum: difficulty and coverage

A comparison of these two curricula is circumscribed to a degree by the uncertainties of translation, and by the difficulties of assessing challenge and breadth when comparing curriculum references that vary widely in specificity. In several cases, it has not been possible to give precise ratings for these features, but the discussion below highlights some key points.

En2 1) Reading strategies

Given the differences in reading/writing systems between the two curricula, it is perhaps not surprising that the curriculum references for reading differ widely in their scope and reference. Generally, there does not appear to be a noticeable difference in terms of challenge. While the English curriculum lists different strategies for reading, the Chinese Taipei curriculum incorporates some specific aims, such as the accurate reading of a particular number of Chinese characters.

En2 2) Understanding texts

The Chinese Taipei curriculum includes some rather broad references to children grasping the meaning of texts, while the English curriculum lists more specific skills. The skills of using inference and reading beyond the literal are not explicitly addressed in the Mandarin curriculum and this might suggest that it is less challenging in its demands upon pupils to interrogate meaning and engage in interpretation. However, other broader references do deal with this material, so it is hard to draw conclusions from this.

En2 3) Reading for information

There is broad comparability here in relation to the kinds of skills addressed, with the Chinese Taipei curriculum including references again, in broad terms. The specific information skills that the NC for English incorporates do not necessarily suggest higher demand, but there is clearly a more specific defining of what constitutes effective interaction with non-fiction materials. The Chinese Taipei curriculum, on the other hand, is broader in its focus on using these skills in the context of personal development - for example, in the use of library systems and information texts to increase interest and independence of learning.

En2 4) Literature

Again, this strand of reading features differences in the level of specificity, with the Chinese Taipei curriculum incorporating broad skill references that might be said to map against several different English NC references. There are clear emphases in the former to the sharing of reading experiences through discussion with others, and the expression of personal views emerging from reading. By contrast, the English curriculum refers to knowledge and understanding of named features such as plot, character and setting, which are not replicated in the Chinese Taipei document. In some respects, because of its tight focus on specific aspects of literary texts, the English curriculum could be seen as more demanding.

En2 5) Non-fiction and non-literary

Here, there is generally a closer match between the kinds of skills, and in some cases, the degree of detail, in each curriculum. Occasionally, the Chinese Taipei curriculum seems to be more demanding, for example, 'To understand the meaning of sentences in different language contexts, and select different words and sentences according to different language contexts' implies a more complete competence and knowledge than is evident in the English curriculum, which specifies features such as knowing the features of a formal/impersonal tone. Conversely, the NC seems to be more demanding at times when set against more general references; its requirement to 'identify words associated with reason, persuasion, argument, explanation, instruction and description' is only set against a very general Chinese Taipei reference to sentence types. The lack of focus on the layout and presentation of texts may also suggest that the Chinese Taipei curriculum is less demanding in this respect.

En2 8/9) Literature, Non-fiction and non-literary texts

In the closer specification of types of reading material, the English curriculum might be perceived as narrower and more demanding than the Chinese Taipei curriculum. The marked emphasis on listing text types is not replicated in the Chinese Taipei system, although it ought to be stressed that in the implementation of the curriculum through teaching guidance/materials, there may be a very clear focus on teaching through genre, etc. This is discussed later in the report.

19.6 Writing curriculum: content

This section of the report uses the NC subsections for writing as the starting point for comparison.

What is covered in both curricula?

En3 1) Composition

Choose form and content to suit a particular purpose [for example, notes to read or organise thinking, plans for action, poetry for pleasure]

Broaden their vocabulary and use it in inventive ways

Use language and style that are appropriate to the reader

Use and adapt the features of a form of writing, drawing on their reading

Use features of layout, presentation and organisation effectively

En3 2) Planning and drafting

Plan - note and develop initial ideas

Draft - develop ideas from the plan into structured written text

Revise - change and improve the draft

Proofread - check the draft for spelling and punctuation errors, omissions and repetition

Discuss and evaluate their own and others' writing.

En3 3) Punctuation

Pupils should be taught to use punctuation marks correctly in their writing, including full stops, question and exclamation marks, commas, inverted commas, and apostrophes to mark possession and omission.

En3 4) Spelling strategies

To sound out phonemes

To analyse words into syllables and other known words

To apply knowledge of spelling conventions

To use knowledge of common letter strings, visual patterns and analogies

To check their spelling using word banks, dictionaries and spellcheckers

To revise and build on their knowledge of words and spelling patterns

Morphology

The meaning, use and spelling of common prefixes and suffixes

The spelling of words with inflectional endings

The relevance of word families, roots and origins of words

En3 5) Handwriting and presentation

Write legibly in both joined and printed styles with increasing fluency and speed

Use different forms of handwriting for different purposes [for example, print for labelling maps or diagrams, a clear, neat hand for finished presented work, a faster script for notes].

En3 7) Language structure

Word classes and the grammatical functions of words, including nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, articles

The features of different types of sentence, including statements, questions and commands, and how to use them [for example, imperatives in commands]

The grammar of complex sentences, including clauses, phrases and connectives

The purposes and organisational features of paragraphs, and how ideas can be linked.

Breadth of study

En3 9) Range of purposes

To imagine and explore feelings and ideas, focusing on creative uses of language and how to interest the reader

To inform and explain, focusing on the subject matter and how to convey it in sufficient detail for the reader

To persuade, focusing on how arguments and evidence are built up and language used to convince the reader

To review and comment on what has been read, seen or heard, focusing on both the topic and the writer's view of it.

En3 10) Pupils should also be taught to use writing to help their thinking, investigating, organising and learning

En3 12) The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries.

What is covered in the English curriculum for writing, but not in the Chinese Taipei curriculum?

The following aspects are addressed in the English NC, but not in the Chinese Taipei curriculum for writing.

En3 2) Planning and drafting

Present - prepare a neat, correct and clear final copy

Comment: While the Chinese Taipei curriculum covers the process of composition quite clearly, through references to gathering materials and ideas, then producing a text, there is no clear focus on presentation skills. This may link in with the lack of emphasis given to writing for specific audiences (discussed below). In addition, while the process of composition implies planning, this skill is not very clearly defined in the Chinese Taipei curriculum, although amending and editing texts is addressed.

En3 4) Spelling strategies

The use of appropriate terminology, including vowel, consonant, homophone and syllable.

Comment: There is no indication in the curriculum for Mandarin that learners must know and use appropriate terminology for the analysis of linguistic features. It might be assumed, however, that pupils would be taught such terminology in order to discuss and review texts.

En3 6) Standard English

How written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display]

Some of the differences between standard and non-standard English usage, including subject-verb agreements and use of prepositions

Comment: The Chinese Taipei curriculum does not replicate the English focus on analysing standard and non-standard forms of language, or noting levels of formality. The emphasis appears to be upon correct usage, and as highlighted in the comments on reading, appreciating the ‘beauty’ of the language.

En3 9) Range of purposes

En3 12) Range of forms

Comment: While there is a fairly high degree of commonality in the kinds of purposes and text types mentioned in each curriculum, the Chinese Taipei curriculum does not specify persuasive writing or playscripts. It is worth noting too, that the Chinese Taipei curriculum tends here to focus on writing ‘simple’ or more complex texts, while the English curriculum links writing skills to achieving particular reader-focused ends: ‘how to interest the reader’, using ‘sufficient detail’ for the reader; how to ‘convince the reader’. These kinds of differences can complicate the attempt to make judgements about breadth and difficulty, but in some cases, the level of demand for aspects of writing seems lower in the Chinese Taipei curriculum when compared with the English curriculum.

En3 11) Range of audiences

The range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers

Comment: It is noticeable that the English curriculum focuses far more on writing for specific audiences, and on tailoring writing styles etc, accordingly. The Chinese Taipei curriculum refers quite narrowly to writing cards/notes to show concern for others, with the focus apparently on pupils' social development – there is no setting out, however, of the range of readers pupils should be writing for.

What is covered in the Chinese Taipei curriculum for writing but not in the English curriculum?

1-6-10-1 To stimulate interest in handwriting

1-6-10-2 To require oneself to write neat handwriting

1-3-2-1 To appreciate the characters written by teachers and students

1-3-2-2 To understand the relationship between font size, stroke thickness and calligraphy beauty generally

1-4-1-1 To maintain correct handwriting posture (upright sitting posture, correct pen holding and operating approaches), to foster orderly handwriting habits

1-4-2-2 To use and keep handwriting tools correctly

1-5-2-6 To co-ordinate with teaching of literacy, and do homework and write a letter with correct, neat pen calligraphy

Comment: Within the 'Literacy and handwriting abilities' strand of the curriculum, there are many additional, detailed handwriting references, reflecting the complex features of Chinese script when compared with roman script. The list above reflects some of the aspects of handwriting that are not covered in the English curriculum, which includes only two global references to handwriting skills. The inclusion of interest in, and appreciation of, writing seems significant, along with the focus on self-motivation: 'to require oneself to write neat handwriting'. The Framework for literacy includes some more specific references to handwriting skills than are evident in the English PoS, but there is no noticeable focus on pupils appreciating handwriting or imposing standards on themselves.

1-1-9-4 To foster the interest of writing by appreciation, oral reading, reading with beautiful tones etc

Comment: As was the case for reading, the Chinese Taipei curriculum gives more weight to pupils reading aloud and with attention to aesthetic effects. This is directed toward increasing their interest, and might be said to contrast with the greater focus in the English curriculum on effects targeted toward the reader/audience.

1-2-1-2 To imitate to write simple sentence patterns

Comment: This is a very basic skill in the Chinese Taipei curriculum it seems, while the English curriculum doesn't appear to focus on imitation/using models in this way. The Framework for literacy includes writing simple sentences at Y1 and Y2, which suggests that this skill might be either easier or similar in challenge, given that it is a reference for Grades 1-3 (Y1-3).

1-4-6-2 To write people and things around oneself or related to hometown

Comment: This reference implies that pupils should be writing about familiar people/places, which is not included in the purposes given in the NC. The planning guidance for the Framework for literacy includes reading/writing stories about familiar settings in Year 3. In this respect, the Chinese Taipei curriculum seems broadly similar in demand.

2-3-3-1 To collect favourite works and classify

Comment: This kind of focus seems more typical of reading curricula. Although classification of text types is an important part of reading/writing teaching, the English curriculum for writing does not incorporate collecting favourite works in this way.

19.7 Writing curriculum: difficulty and coverage

It is important to stress the difficulties of assessing the relative challenge and breadth of these curricula, particularly because of variation in the degree of generality and specificity.

En3 1) Composition

Generally, within this subset of skills, the Chinese Taipei curriculum seems to be slightly less challenging, particularly as the matching of purpose to form seems to appear from Grade 7 (Year 7) onward. Of course, in practice, it is difficult to be sure of the degree of competence implied in the Chinese Taipei reference, and whether it is more challenging than that expected at Key Stage 2 in the English system.

There is some indication that the Chinese Taipei curriculum references are more limited in scope, or tend to match with only part of the more expansive references in the English curriculum. For example, for the NC reference, ‘use and adapt the features of a form of writing, drawing on their reading’, the nearest corresponding reference is: ‘to write by using rewriting, adding, expanding, and abridging etc’. The latter does not mention reading material, and indeed, this Chinese Taipei reference also appears as a match with NC references for planning and drafting.

En3 2) Planning and drafting

Overall, there is a good degree of correspondence in relation to difficulty and breadth, although the Chinese Taipei curriculum does not make such a clear separation between composition and drafting as is used in the English curriculum.

En3 3) Punctuation

In relation to punctuation, there might be some scope for arguing that the Chinese Taipei curriculum is more demanding than the English curriculum, as it implies that pupils should know and use punctuation, without specifying the kinds of marks etc, they should use. Again, differing degrees of specificity in the curricula leave room for speculation.

En4 4) Spelling strategies

This aspect of the comparison is particularly difficult to establish because of the differences between the linguistic systems of each country. There are indications that the Chinese Taipei curriculum covers the same kinds of strategies as used in the English curriculum, but the level of challenge is very hard to assess.

En3 5) Handwriting and presentation

As discussed earlier in this analysis, handwriting is specified in far greater detail in Chinese Taipei than in England, and although comparisons of difficulty are not easy, there is some sense that demands for neat, controlled writing might be greater in Chinese Taipei.

En3 6) Standard English

This aspect of the English curriculum is not matched by the Chinese Taipei curriculum, suggesting that pupils' experience of linguistic analysis is broader in the English system.

En3 9) Range of purposes

While there is a good degree of match between the two curricula in this respect, there is some evidence that the Chinese Taipei curriculum is narrower, in that it doesn't explicitly mention persuasive writing, and focuses on one kind of commentary/review context.

En3 12) The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries

Of these text types, the clearest omission, so to speak, in the Chinese Taipei curriculum is playscripts. It is also notable that the Chinese Taipei references tend to be far more specific, linking the writing of these types with pupils understanding and executing them well.

19.8 Order of teaching and when taught

The structure of the Chinese Taipei curriculum for language incorporates three Stages, with learning objectives increasing through each Stage. For each strand (e.g. reading abilities), curriculum references are clustered under subsections, with specific skills appearing in Stage 1 (Grades 1-3), then being extended in Stage 2 (Grades 4-6) and Stage 3 (Grades 7-9). This suggests that there might be a repetition of teaching topics or focuses, with increasing degrees of challenge as pupils progress through the Grades. This is a similar principle to that governing the curriculum for Key Stages 1 and 2 in England. Also, as in the English curriculum, the numbers of references in each subsection, in each Stage, differs; many skills are revisited or extended in each Stage, but not all.

It is difficult to identify specific differences between the two curricula, in terms of the order in which learning objectives or skills appear. Overall, there seems to be a similar progression of key reading and writing skills, although there are points at which one curriculum is much more global, or much more specific in its references, than the other. One noteworthy element in the guidance on implementation given in the Chinese Taipei curriculum is the description of stages of learning: 'The first stage of development focuses on spoken expression, the second stage transits spoken expression to written expression, and the third stage will focus on both spoken and written expression.' It is not clear if this description is referring to the three Grade-related Stages, or to a more general principle about effective language teaching. There is no equivalent description in the English curriculum, although the processes of oral rehearsal, planning then writing, are part of general guidance in the Framework for literacy. There is also a reference in the Chinese Taipei document stating that reading should be the main focus of teaching in Grades 1-3 and 4-6, while 'In the third stage [Grades 7-9], it should be better to combine reading and writing, listening and speaking in double-sided development'. Again, there is no equivalent statement in the English curriculum.

Given the spread of Grades/Years in each system's Stages, it is not clear precisely when a skill may be taught (although the Framework for literacy provides indications of when topics are likely to be covered), and given the tendency for teaching to be differentiated according to pupils' needs, uniformity is also unlikely. This point is discussed further below.

19.9 Integration of subjects

The notes on implementation of the Chinese Taipei curriculum make clear that teachers' planning should, at certain points, combine speaking, listening, reading and writing, for effective language learning. There are also specific references in the curriculum to pupils writing for different practical purposes within the school context (such as notices and posters), and writing cards, notes or letters. One specific reference in the notes highlights work in other subjects: 'The teaching of handwriting in all grades should combine homework of all subjects'. However, there is no direct reference to different subject areas in the curriculum, or to more substantial cross-curricular working. This might mean that there is more of a separation between language teaching and other subject teaching in

Chinese Taipei, as compared with England, where the linking of literacy and other subjects has been promoted in recent years, but it is hard to be certain.

19.10 Differentiation

The implementation notes include minor references to teachers tailoring their planning to different needs, for example, they should plan to suit ‘individual differences’ and ‘teaching materials for writing should combine the needs of students’ with other elements. There is no detailed guidance evident in the document seen.

19.11 Pedagogy and time allocations

The local expert reports that there are recommended ranges for time spent on literacy:

Grade	G1	G2	G3	G4	G5	G6
Minimum (Hours)	2.7	2.7	3.3	3.3	3.6	3.6
Maximum (hours)	4.0	4.0	5.0	5.0	5.4	5.4

The ranges are quite wide and show an increase every two grades.

19.12 Guidance or compulsion of teaching methods

The local expert reports that:

“One of the characteristics of the Grade 1-9 Curriculum Guidelines is that the guidelines encourage teachers to develop a school-based curriculum. The instructional methods included are only suggested as guidance for teaching practice rather than compulsory”.

There are some detailed recommendations regarding planning and teaching of language in the Chinese Taipei curriculum.

Information about the compilation/writing of teaching materials stresses that materials should increase in difficulty, cover all relevant skills and for example, in the case of reading, that textbooks are appropriate in terms of their word counts and reading difficulty. A very specific note relates to the ratio of text to pictures being 50:50 in Grades 1-3 and that this ‘can be changed on the second and third stages as required.’ These points are similar to principles guiding planning in the English system, but seem to be more specific.

A point of interest is the emphasis upon providing materials for writing that 'focus on students' life experience and stimulate students' interest in learning writing'. The English curriculum and Framework for literacy also contain elements relating to motivation, but not with this degree of focus on life experience.

The attention given to the status of handwriting is worth noting: 'The relationship between literacy teaching and handwriting teaching should be valued'. In one sense this may mirror the English curriculum's emphasis on linking writing with phonic awareness, establishing the impact of kinaesthetic learning on literacy.

The process of teaching literacy skills through interactions at text, sentence and word level has been established firmly in the Framework for literacy, and this is matched in the notes relating to teaching reading in the Chinese Taipei curriculum. Teachers are recommended to move from an overview of a text, to section-by-section analysis and so on. It is also clear that the teaching of grammar is intended to occur with contextual framing ('provide relate language situation') rather than only through exercises.

As highlighted in earlier discussions of the two countries' writing curricula, there seems to be a clearer emphasis on encouraging pupils' interest in the Chinese Taipei curriculum: 'Attach importance to the students' experiences and feelings […] Focus on stimulating students' interest in writing, arouse internal emotional inherent experience'. There is also a statement encouraging the enjoyment of 'grammar and rhetoric', which seems again to go further than the English curriculum.

20 Literacy Comparison: Italy

20.1 Structure

The Italian Curriculum is highly integrated. This is evident not only from the fact that the reading, writing, speaking and listening requirements are not as rigidly separated as they are in the English curriculum documents, but also in that all the subjects are dealt with in the same document.

The document is highly theoretical and analytical. Root values are set out to explain the theory that gives rise to the concrete subject-specific matter that teachers have to deliver called '*specific learning objectives*'. The document is weighted in favour of rational and abstract theory rather than precise guidance. It describes in detail the relationship between the aims of Italian primary education and the role of the teacher in delivering the curriculum by devising the '*Learning Units*' and '*Personalised Study Plans*' and in putting together an '*Individual Skills Portfolio'* for each child. No practical guidance is given in the form of notes, plans of work or exemplification.

The Introduction gives much emphasis to the connectivity between subjects and everything the child experiences in school and outside, as can be seen from this quotation from page 5 of the Italian curriculum: "… *a specific learning objective in, for example, Mathematics is and must always be, at the same time, not only rich in resonances of a linguistic, historical, geographic, expressive, aesthetic, motor, social, moral religious nature, but it must also elicit adequate personal behaviour and this is true for every other specific learning objective.*" With regard to the language curriculum, the degree of differentiation between the different language skills increases with the age of the children. For the first three years of primary education, the whole of the Italian language and literature curriculum is presented as a single set of '*specific learning objectives*', under a single heading. For the last two years of primary schooling, the objectives are categorised under the following headings:

- Listening
- Speaking
- Reading
- Writing
- Morpho-syntactic
- Semantic
- Phonological
- Historical

Italian primary education falls into three stages: the first 'kindergarten' year, years 2 and 3, years 4 and 5. The curriculum document presents '*specific learning objectives*' for these three phases and for the purposes of this comparison we have looked at the objectives outlined for Italian years 2 to 5. Italian children start school one year later than

do England's children and so pupils in these years are aged seven years to eleven, thus representing an almost perfect match with English at Key Stage 2.

20.2 Aims and rationale for the curriculum

As indicated above, the Italian document focuses heavily on rationale. It specifies five broad root values underpinning the purpose of primary education: cultural, gnosiological and epistemological, social, ethical, psychological. The emphasis on the development of the whole child as a reflective, proactive person who achieves full potential, operating both inside and outside the school, pervades the entire document. At the same time, the document underlines the role of school in developing '*the value of corporeity*' and '*civil coexistence*' (being part of society), explaining how this benefits the individual (*strengthening all the other dimensions of the person: the rational, aesthetic, social, operative, emotional, moral and spiritual*) as well as benefiting society. Cultural heritage in terms of '*visions, theories and practices'* is also part of the curriculum. By comparison to all that is written about the role of school in developing the individual in the logical, moral, social, interpersonal and emotional domains, there is little said in the rationale about the pedagogy of the Italian language. It states only that the language is a tool '*fundamental for the children's ability to take advantage of all the educational opportunities on offer both inside and outside school*.' This is followed immediately by a statement underlining the importance of learning another European language as well as another means of expression in the artistic domain. In outlining the vision of the Italian curriculum, there is no reference in the entire document to the use of research.

Another apparent emphasis is on the responsibility of the school and teachers to deliver the curriculum, tailored to the needs of the individual. For each pupil a set of educational objectives is to be defined. These are determined by the starting point of each child, his/her *educational, cultural and professional* profile and consists of the greatest number of *specified learning objectives* that are within the reach of the abilities of that child. This takes the child's own pre-existent experience into account and aims to integrate all learning whether it be in the classroom, in the home or in the outside world.

20.3 Content

Unlike the England curriculum, the *specific learning objectives* in the Italian curriculum are not broken down into skill areas until the third phase of primary education. Then, like the English document, they are grouped into: listening, speaking, reading, writing, grammar. Grammar is further broken down into the following areas:

Morpho-syntactic

Semantic

Phonological

Historical

Despite the difference in the structure of presentation, it is clear that there is considerable overlap in what is covered within the skills of reading and writing in the two countries. There are Italian *specific learning objectives* that relate to all the main areas of the English reading curriculum, although, of course, there is more in common in some areas than in others. There appears, for example, to be considerable commonality in the strategies associated with phonemic awareness and phonic knowledge, word recognition and graphic knowledge, knowledge of grammatical structures and contextual understanding: that is, the work that is included under the heading of 'reading strategies' in the English curriculum. A detailed breakdown of reading skills, area by area, will be presented in the section below.

For writing, there are some stark differences in emphasis: namely, there are a few aspects that are taught in one country but apparently not in the other. One such area is handwriting and presentation, (En3 5a and b in the English curriculum). The Italian curriculum for language does not mention either of these aspects in the production of a piece of written work. It is possible, of course, that handwriting and presentation are to be found outside the language curriculum, but a cursory glance at other subject areas does not confirm this.

On a related topic, it is noteworthy that planning and drafting are covered in both countries. Although the Italian curriculum talks about self-correction, *taking stock of levels achieved* and improving production of work, it does not require the creation of a *neat, correct and clear final copy* (En3 2e), as the English statements do. These differences would imply that in Italy there is comparatively less focus on the presentation of a final and 'perfect' draft and more interest in the processes leading up to it. However, it should also be noted that 'planning' in the Italian curriculum is mentioned only in the context of *simple* texts and conducted to an *elementary* level. This is certainly not the impression conveyed in the English document, which suggests that mature planning skills be developed during Key Stage 2: *plan - note and develop initial ideas*; *draft - develop ideas from the plan into structured written text* (En3 2a & 2b).

Another national difference between the writing curricula lies in the range of audiences and readerships for whom children are taught to write. The English curriculum stipulates *the range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers* (En3 11). There is no reference to learning to write for a range of readers in the Italian curriculum, although it suggests that Italian children must bear their readership in mind when writing in two other objectives: *use language and style that are appropriate to the reader* and *choosing the ideas on the basis of the reader and purpose of the text*.

Similarly, there are some *specific learning objectives* posited in the Italian curriculum that appear to have no counterpart in the English curriculum document. These are the following:

- the basic difference between oral / written texts
- manipulating simple texts within a given limit

- pauses, intonation, gesture as a resource in spoken language
- the Italian language as a system in constant evolution over time
- analysing some of the evolutionary processes of the lexis in modern use
- translating discursive texts into graphics, tables and schematics and vice versa.

Although these cannot be matched up to any of the statements in the English curriculum, we know from the Primary Strategy that they are / were taught in England. This document provides evidence not only that equivalent areas of subject matter are covered in England but also indicates when teachers were required by the strategy to deliver them. The five areas listed above were all included in the Italian years 4 /5 curriculum (equivalent to English years 5 /6). The strategy stipulated that these areas be covered at different times between years 4 and 6, therefore suggesting a similar level of expectation between the two countries on these specific areas of language.

20.4 Difficulty and coverage

20.4.1 Reading

20.4.1a Range

Overall, it would seem that the range of reading to be covered is narrower in Italy than in England. There would seem to be a smaller focus on narrative texts in Italy than in England. This is suggested both by the types of texts that make up the reading 'diet' in the Italian curriculum and the number of statements that appear to refer to work on narrative texts. In contrast to the five categories of narrative texts specified in England (*a range of modern fiction by significant children's authors, long-established children's fiction, texts drawn from a variety of cultures and traditions, myths, legends and traditional stories and playscripts*), in Italy only the broad areas of '*descriptive and narrative texts from history, mythology and geography*' are specified and these are only mentioned in the context of Italian years 2 and 3, and not beyond. Within the non-narrative domain, the Italian curriculum is heavily dominated by school subject text and reference book genres: *from geography, science* (y 2/3); *multimedia texts; subjects of academic interest and/or study and research projects (dictionaries, encyclopaedias, geo-historic atlases, multimedia texts)* (y 4/5). The only exception to this is the repeated reference to multimedia texts, which, of course, also features in the English curriculum. In En 9a and 9c, the English National Curriculum also stipulates that *diaries, autobiographies, biographies, letters* and *newspapers, magazines, articles, leaflets, brochures, advertisements* are to be included in pupil's reading diet. There is no parallel to this in the Italian curriculum. However, it may be that it was not regarded as within the remit of the Italian document to provide an essential list of the range of genres to be covered in Italian schools. This conclusion is supported by the finding that even though poetry is not specifically identified as a genre to be covered, the number of statements that refer to the study of poetic works in the classroom would suggest that considerable attention is devoted to the teaching of poetry and expressive works.

20.4.1b Understanding and interpretation

Many areas of reading and understanding demonstrate considerable overlap. Being able to consult texts for information, extract the gist, summarise, follow the plot, talk about characters, setting, structure and themes are common to both countries' curricula. In England, there are two statements devoted to the area of reading beyond the literal. These are En2 2a (*use inference and deduction*) and 2b (*look for meaning beyond the literal*). The only equivalent in Italy consists of '*extrapolating data*', as stated in the year 4 / 5 curriculum, in point 9. This is clearly a narrower requirement, referring only to non-narrative texts. The Italian curriculum implies that inference and deduction skills are used in work carried out on narratives *identifying the essential elements (characters, places, times)* (y 2/3); *read texts aloud...identifying the main structural and genre features of these* (y 4/5). It would not be possible to do work of this nature without exercising inferential skills but the Italian document does not explicitly associate inference with literary works and it would seem that there is less instruction targeted at the skills of inference and deduction.

There also appears to be no equivalent to the English statements that pupils can / should '*use their knowledge of other texts they have read*' (En2 2d) and *respond imaginatively, drawing on the whole text and other reading* (En2 4h). Again this involves inferential skill, through the application of which pupils make reasonable assumptions, draw conclusions about a given text based on the experience of reading they have already accumulated. There is nothing in the Italian curriculum, which requires pupils to regard and interpret a text in the context of others they have already read.

Associated with this, however, is the use of other contextual cues and clues in order to derive meaning. In Italy, pupils have to make use of all advance information in a text (context, type, theme, title …) to hold attention, prepare for comprehension, prepare to listen actively (y2/3 point 13). In England, pupils have to practise contextual understanding (En2 1d) and draw on different features of texts, including print, sound and image, to obtain meaning (En2 3d). This highlights one of the more interesting differences in emphasis between the two curricula: what is covered in the single word (sound) in this statement from the English document, receives considerably more attention in the Italian across several statements: Understanding and using the sound content of texts (timbre, intonation, intensity, accentuating, pauses) and the figures of sound (rhyme, assonance, rhythm) in expressive/poetic texts (y4/5 point 8). This focus on using and conveying the sound qualities and oral aspects of text is also evident in the Italian writing curriculum, eg pauses, intonation, gesture as a resource in spoken language (writing y4/5 (phological level) point 28) and prosodic features: intensity, speed, rhythm, timbre and methods of partially translating these into writing by means of punctuation and typographic devices (y 2/3 point 1) and conscious use of prosodic features (writing y4 / 5 point 7 & point 9 & (phonological level) point 30). It is this stress on 'prosodic features' that gives rise to what appears to be a heavier diet of poetry in Italy. As a corollary to this, there also appears to be a greater emphasis on the distinction between reading aloud, reading silently, reading and reciting as a performance, which is not reflected with the same force in the English national curriculum, although we know that it is touched upon in the Primary strategy.

20.4.1c Thinking skills

In the reading curriculum in England the need to challenge children and to stretch their intellect is present in the National Curriculum notes to teachers and in En2 4e, eg: *increase their ability to read challenging and lengthy texts independently* and *engage with challenging and demanding subject matter.* To some degree, thinking skills are also developed in work associated with En2 5d: *identify links between ideas and sentences in non-chronological writing.* Although the introduction would indicate that this area of development is central to the aims of Italian education and therefore underlies all the objectives, the concept of using reading to help and extend thinking is not present in the *specified learning objectives* of the Italian reading curriculum. It should be noted that in the writing curricula of both countries, there is mention of thinking and learning skills. In England, this is seen in En3 10: *pupils should also be taught to use writing to help their thinking, investigating, organising and learning.* In Italy, the closest equivalent seems to be: *gathering ideas for written work by means of reading, recovery from the memory and invention.* (y 2/3 point 20); *introductory operations for making summaries and synthesising* (y4 / 5 point 5)*; given an oral / written text, produce an effective and meaningful oral / written summary* (y 4/5 point 11).

20.4.1d Vocabulary

Vocabulary development in relation to both reading and writing is seen as important in both countries. 'Broadening the vocabulary' appears in both national documents, although the English curriculum provides more explicit guidance on what teachers can do to this end. Interestingly, the English document appears more demanding in that it also stipulates using vocabulary it *in inventive ways* (En3 1b), while the Italian mentions only the acquisition. In both countries, there appears to be equal attention given to the affective aspects of vocabulary choice, as made explicit in *recognise the choice, use and effect of figurative language, vocabulary and patterns of language* (En2 4a) and *some significant figures of speech: onomatopoeia, simile, metaphor* (y 4/5 point 4). Likewise, in both countries vocabulary work involves coverage of aspects of morphology, semantics and linguistics and there are numerous statements in both language curricula relating to features such as antonyms, synonyms, homophones, hyper / hyponyms etc. However, the English curriculum also contains explicit instruction on how ideas are communicated in language through the use of specific and specialised vocabulary in En2 3c: *identify the use and effect of specialist vocabulary* and En2 5a: *identify words associated with reason, persuasion, argument, explanation, instruction and description.* This does not appear to feature in the Italian primary curriculum at all. By contrast, there is in the Italian language curriculum a greater interest in vocabulary in relation to linguistic variety: standard Italian versus local dialects, written versus oral, formal versus informal. This field of study is not restricted to vocabulary, but extends to grammar also and to how these aspects of language have evolved through history. This is seen also in the English curriculum in relation to standard versus non-standard language, but seems to have a lower priority (En3 6a and 6b).

At the risk of over-stereotyping, it would seem that the English reading curriculum is more analytical than the Italian. The Italian is more focused on responding to and using the text and there are also aspects of the delivery, performance and 'experience' of a text that are not present in the English curriculum. This is supported by the finding that, for example, the word 'author' or 'writer' is not used at all in the Italian document. Text is not examined from the point of view of the writer, his/her purposes, his/her techniques or effects achieved. There is nothing in the Italian curriculum about the reader distinguishing between fact and opinion or about recognising the difference between the writer, narrator and the characters. By contrast, the Italian reading curriculum is about using and understanding the text and is richer than ours in how to 'experience a text.'

20.4.2 Writing

Unavoidably some areas of writing have already been touched upon in the section above. Amongst others, aspects relating to planning and drafting, prosodic features, audience, for example, have been discussed.

20.4.2a Range of purposes

In most of the other areas of writing, there is significant overlap in the requirements of the two curricula. It is noticeable that Italian children are required to write for a range of purposes not dissimilar to that required in England: *creative, describing actions, processes, occurrences, properties* (y 2/3 point 10)*, making summaries and synthesizing (*wtg y4 / 5 point 5 & point 11) *setting out particular arguments expressing opinions* (reporting, synthesis, etc.) *states of mind* (wtg y4 / 5 point 7)*.* These correspond generally to the purposes listed in the English curriculum*: to imagine and explore, to inform and explain,* and *to persuade.* It is also worth noting that the first five of those listed here are required in Italian years 2 and 3, therefore indicating a level of demand that is equivalent to that seen in England, or perhaps even slightly more exacting. A noticeable difference between the two curricula is that there is no Italian equivalent to *review and comment on what has been read, seen or heard, focusing on both the topic and the writer's view of it* (En3 9d), which might suggest that the English curriculum is more demanding in this regard. Related to this is the finding that the Italian document also demonstrates no parallel to *discuss and evaluate their own and others' writing* (En3 2f). Overall, it would seem that Italian pupils are not required to evaluate others' writing - neither in the reading or writing objectives.

20.4.2b Text types

As well as listing purposes, both curricula also specify a range of text types. The purposes outlined above suggest that Italian children are required to produce a range of text types as varied as that seen in this country. The Italian curriculum document actually identifies by name: simple descriptive, narrative and regulatory written texts, autobiography, biography, stories, reporting, synthesis. This demonstrates considerable overlap with those stipulated in the English curriculum: *the range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries*. (En3 12)

20.4.2c Spelling

Other aspects of language instruction that differ between the two countries may arise from the difference in the nature of the two languages. Without knowing more about the spelling patterns and grapheme-phoneme correspondence in Italian, it is not possible to comment on the significance of the national differences in what is required in spelling. There appears, however, to be no Italian equivalent to the following statements in the English curriculum:

- to sound out phonemes (En3 4a)
- to analyse words into syllables and other known words (En3 4b)
- the spelling of words with inflectional endings (En3 4h)

On the other hand, it is clear that work in spelling is required in Italian classrooms from the objectives stipulated for years 2 and 3: *writing conventions (accent on monosyllables, elision, scanning consonant nexus, use of letter 'h', exclamations, redundancy in grapheme groups)* (y 2/ 3 point 4).

20.4.2d Language Structure

The Italian curriculum places substantial emphasis on aspects of grammar, probably more so than the English. This impression stems from the finding that grammar, unlike other areas of language instruction, is broken down into sections and considerable detail is provided about what to teach. Again, lack of familiarity with the Italian language makes it impossible to gauge the level of difficulty of the individual statements. A sample of grammar-related objectives, and the years to which they apply, are listed here:

- grammar and syntax (y 2/3)
- sentence concepts (simple, complex, nuclear), subject and predicate (y 2/3)
- verb conjugation: person, tense, indicative mood (y 2/3)
- nouns and articles (y 2/3)
- parts of discourse and grammatical categories (y 4/5)
- methods and procedures for structuring a simple sentence and for recognising the basic constituents of a minimal sentence (y 4/5)
- function of the subject, predicate and adjuncts (y 4/5).

All the above, as well as other areas of grammar, can be matched up with aspects of En3 7 (language structure) in the English curriculum, although as stated above, it is not possible to measure the relative levels of demand between the two curricula. It is interesting to note, however, that the Italian objectives most often cite grammatical

knowledge in the context of *simple* sentences, whereas the English document explicitly mentions only *complex* sentences in the grammar strand.

There remains one area of language structure which only appears in England. This relates to the higher level of structure: paragraphing. While structure at the sentence level is clearly dominant in the Italian curriculum, structure at the paragraph / text level is not seen in connection with writing: only in recognition of structure in reading.

20.5 Order of Teaching and when Taught

Both the English and Italian curriculum documents are unspecific about when the contents are to be taught. The Key Stage 2 Programmes of Study cover four academic years and the contents can be delivered at any time during those years, with topics introduced and 'revisited' at the discretion of the teacher. The Italian curriculum document makes much of the fact that it is the school's responsibility to establish the order of delivery: *the psychological and didactic order is… entirely under the control of the professional school staff and teachers* and the document warns against *transforming activities into an obsessive and mechanical series of exercises/tests that would rob the school experience of all its educational and cultural freshness*. This is reiterated with even greater emphasis later in the document: *it is the sole responsibility of every school, with its own degree of autonomy, to exercise the freedom to mediate, interpret, order, distribute and organise the specific learning objectives*. The order of teaching seems to be dictated by the interplay between two factors: the *specific national learning objectives* and the *personalised educational objectives* for each child. No mention appears to be made of the fact that the *personalised educational objectives* for each child will differ and how these differences are to be reconciled.

In order to attempt to identify some concrete points of comparison, the Primary Strategy (which provided a more precise indication of what is taught when), was consulted for a handful of specific areas. For these aspects of the curriculum we have found, as far as can be determined, that most - but not all - areas are covered at roughly equivalent times, within one or two years of each other. However, as has been pointed out before, this is not sufficient a guide to assessing equivalence of difficulty, as this is heavily text-dependent.

Using the Primary Literacy Strategy, some differences in time of delivery have been noted. One of these comes under *contextual understanding* (En2 1d). In Italy pupils are taught to make *use of all advance information in a text (context, type, theme, title …) to hold attention, prepare for comprehension, prepare to listen actively* (y 2 /3 point 13) in the equivalent of years 3 and 4. By contrast in England, much of this is covered in the third term of year 1, as indicated in the Primary Strategy statement to *use all advance information* and *to use titles, cover pages, pictures and blurbs to predict the content of unfamiliar stories*. If this comparison is accurate, this difference would constitute a major discrepancy in what is required of children in the two countries in this aspect of language learning. Another dissimilarity detected through the use of the Primary Strategy revolves around puns, riddles and the playing of word games. While this appears in years 3 and 4 classrooms in England, it is mentioned only in the context of older children (equivalent of

years 5 and 6) in Italy. Likewise, there are facets of grammar that appear to be taught at a younger age in England, even though Italy has a stronger emphasis on grammar overall. These pertain to the *relevance of word families, roots and origins of words* (En3 4i), which is covered in early Key Stage 2 in England, but not until children reach the equivalent of years 5 and 6 in Italy.

20.6 Integration of Subjects

As indicated in section 1.2 of this report, the Italian curriculum is highly integrated. For the first two years of the equivalent of Key Stage 2, the Italian document makes no attempt to segregate the different elements of the language curriculum, and emphasises the connectedness of all school subjects - not just the inter-dependence of language skills.

20.7 Differentiation

Although there is only one literacy curriculum in Italy, there is a requirement on teachers to choose and adapt its contents to the needs of each individual pupil. For each pupil the teacher creates a *Personalised Study Plan*, containing *personal educational objectives with the mediation of the appropriate leaning units, planned and designed by teachers, to promote each one of their pupils' personal skills.* Teachers are to *assume responsibility for identifying the most suitable and significant educational objectives for individual pupils.* The educational objectives have to be within the reach of the pupil's abilities but, at the same time, must consist of the greatest number of *specified learning objectives* that is achievable by that individual, so that he/she can fulfil his / her maximum potential. The *Personalised Study Plan* has to take two aspects into consideration: the starting point of each child (his/her *educational, cultural and professional profile*) and the national curriculum, as enshrined in the *specified learning objectives,* which are regarded as *essential performance levels that Italian state schools are required in general to guarantee Italian citizens.* For each pupil a portfolio is maintained (*Individual Skills Portfolio*), containing representative samples of the pupil's work, tests, comments by staff and family and observation reports.

There is a compulsory lesson timetable (see below in section 3.1). There is a 15% variation permitted from the timetable to allow schools *the opportunity to organise the compulsory educational and didactic activities… in order to meet the learning needs of individuals: whole class groups, groups within a single class, or interclass groups, selected according to level, particular task or by choice.*

20.8 Mandatory or recommended time for Subjects

Interestingly, despite the fact that the order of teaching is left entirely up to the schools and teachers, there is an annual compulsory lesson timetable, which allows a maximum variation of 15% from all the limits set out in the Italian Education Ministry school guide. The document does not indicate what proportion of time is spent on literacy or any other subject.

20.9 Guidance or Compulsion of Teaching Methods

The local expert confirms that considerable autonomy is given to schools:

" It is the sole responsibility of every school, with its own degree of autonomy, and of teachers, taking into account their particular history and territory, to exercise the freedom to mediate, interpret, order, distribute and organise the specific learning objectives within the educational objectives, in terms of the content, methods and testing for the learning units, taking into consideration, on the one side, the overall ability of each pupil, all of whom must be developed to their maximum possible potential, and, on the other, to apply the pedagogical teaching theories and teaching practices most appropriate for transforming this development into personal skills. However, the each school and all of the teachers must take on the responsibility for giving an account of the choices they have made and make the pupils, their families and the local community in general, full aware of these and able to share in them."

At the beginning of school years, the teachers' teams gather to plan the Learning Units for the classes they teach to. While planning the Learning Units, Teachers teams decide and agree about time, topics, methods, organisational solution, activities to be proposed, resources to be used and ways of assessment.

"The degree of autonomy given to schools by Italian Presidential Decree 275/99 … gives individual schools the opportunity to organise the compulsory educational and didactic activities in classroom format or in workshops/ laboratories, and in order to meet the learning needs of individuals: whole class groups, groups within a single class, or interclass groups, selected according to level, particular task or by choice. "

21 Literacy Comparison: Latvia

21.1 Introduction

This comparison considers those elements of the curriculum that relate to reading and writing, as laid out in National Curriculum Programmes of Study for English, and the following documents:

- Latvian language standard for compulsory education, grades 1–9 (February 2004)
- Literature, standard for compulsory education, grades 4-9 (January 2004).

Table 21.1: Age and English year group equivalents to the Latvian Grades 1-6

Latvia Grade	Age (years)	English year group equivalent
Grade 1	6/7 → 7/8	Year 2/3
Grade 2	7/8 → 8/9	Year 3/4
Grade 3	8/9 → 9/10	Year 4/5
Grade 4	9/10 → 10/11	Year 5/6
Grade 5	10/11 → 11/12	Year 6/7
Grade 6	11/12 → 12/13	Year 7/8

Source: http://www.euroeducation.net/prof/latviaco.htm

The Latvian education system combines pupils in grades that cross two 'year groups' in the English system. This mixed-age structure suggests, perhaps, that the curriculum and assessment are tied less closely to specific ages, with broader age-bands of pupils working alongside each other, and with the potential for flexible rates of development and achievement to be acknowledged.

21.2 Structure

In the Latvian curriculum, there are two separate component parts to the literacy curriculum: Latvian language and Literature. These two components incorporate skills relating to speaking and listening, reading and writing.

The curriculum for Latvian language is structured in the following sections:

- Subject area aim
- Subject area objectives
- Subject area compulsory content

- Communicative competence
- Language competence
- Socio-cultural competence.

- Subject area main requirements – these are specified across three grades (grades 3, 6 and 9).
- Communicative competence
- Communication
- Language skills
- Listening
- Speaking
- Reading
- Writing
- Language competence
- Issues of general linguistics
- Text
- Sentence
- Word
- Socio-cultural competence.

The curriculum for Latvian Literature is structured in sections with main requirements given at two grade points: Grade 6 (Year 7-8) and Grade 9 (Y10-11) as follows:

- Literature as an art of writing
- Comprehension of a literary work, creative activity
- Literature as a part of culture.

The division of the Latvian Language curriculum suggests less separation of speaking, listening, reading and writing as aspects of literacy. Although distinct subsections exist for each of these elements, additional sections (word, sentence and text, as well as socio-cultural competence and communication) indicate a different approach to considering literacy. The focus on word, sentence and text level skills (in the Language competence section) is closer to the model used in the original Literacy framework in England, although this distinction does not exist explicitly in the English NC.

The Latvian curriculum gives a distinct place to elements that focus on knowledge of culture and the role of language in national identity; also, it highlights communication in its broader sense, for example, the role of non-verbal communication. This structure means that in order to locate all requirements relating to reading or writing, it is necessary to look through different sections; material relevant to both can be found in the 'text' subsection, for example.

The Latvian Literature curriculum focuses on Grades 4-9, with Main requirements specified only for Grade 6 (Years 7-8) and Grade 9 (Years 10-11). The subsections within this framework again incorporate reading and writing elements. Reading skills appear in the Literature as an art of writing subsection, while reading and writing are incorporated in Comprehension of a literary work, creative activity. In Literature as a part of culture, there is a range of skills related to reading and general attitudes and knowledge of culture. For example, this subsection includes the following: 'Knows the cultural and historic sites in his/her district (town, village)'.

Across both curricula (Language and Literature) some skills are italicised and designated as 'requirements describing students' attitudes'. For example, in Literature, 'When reading literary texts, is interested in creative self-expression'.

Both Latvian curriculum documents include the following sections before laying out detailed requirements:

- Introduction
    - overview of structure of the curriculum and the curriculum document
    - description of broad aims/content
    - description of proportion of curriculum time (this appears in the literature curriculum only)
- Subject area aim
    - one-sentence summary of aim, drawing on the various subsections of each curriculum;
    - for Language, this includes: 'realise the role of language in the development of his / her personality, retention of national identity and development of intercultural dialogue'
    - for Literature, this includes: 'To foster students' emotional and intellectual development'
- Subject area objectives
    - list of four broad objectives for each curriculum, drawing on content of the main requirements
- Subject area compulsory content
    - for Language, this consists of a list of subsections in the curriculum
    - for Literature, this consists of brief lists summarising the content of each subsection.

21.2.1 Assessment

Each curriculum includes a section, Forms and methodological techniques for the assessment of learning. This covers the types of assessment to be carried out, and includes details of 'final' assessments, set by schools, with the Board of Education, and of National assessments; the latter occur in Grades 3, 6 and 9 in Language (corresponding with the three Grades for which requirements are specified in the curriculum. For Literature, national assessments occur in Grade 9 (whereas the curriculum gives requirements for Grades 6 and 9).

The curriculum for Latvian Language consists principally of 'Subject area main requirements', expressed as descriptions of pupils' competences, e.g., 'Reads correctly, consciously, fast and with expression.' By contrast, the English NC gives descriptions of what pupils should be taught to do or to know.

The curriculum provides requirements at two points in the 7-11 age-range, at grade 3 (Years 4-5) and grade 6 (Years 7-8). This suggests that the specified skills and competences are the aim for teaching and that teachers will need to plan learning activities that will support children's progress toward these points of achievement.

This structure differs from the English National Curriculum in its focus on learning outcomes rather than programmes of study. It is similar, however, to the English National Curriculum's focus on 'stages' or phases that do not entail the specification of curriculum content for each year / age. The specification of requirements for Grade 3 suggests that greater focus is placed on achievement 'mid KS2' than is the case in the NC for English.

21.2.2 Terminology

The Latvian curriculum is referred to as the 'Standard' and learners are called 'students'. The most substantial component of the curriculum specifying what is to be learned is headed, 'Subject area main requirements'. These are descriptions of what learners know or can do, and are thus closer to learning outcomes than requirements. 'Competence' is used for subsets of skills, such as 'Language competence'. In many respects, terminology appears to resemble that used in the English curriculum.

21.3 Aims and rationale for the curriculum

The Latvian curriculum for reading and writing is framed within a philosophical context that places value on cultural transmission, national awareness and personal development.

21.3.1 Language curriculum

This curriculum incorporates the following key statements that give an insight into its rationale:

Language plays an essential role in the **development of a student's personality**, **self-expression** and in the acquisition and **understanding of the culture of a student's nation**. Studying the Latvian language, a student has the possibility to develop his/ her

mother tongue skills, **realise that language is of value and part of a nation's cultural heritage, and become aware of the responsibility for maintaining it within a multicultural society**. Mother tongue promotes the acquisition of other languages and subject areas.

The focus on personal development and self-expression is more marked than in the English NC, which incorporates in the subject statement ('The importance of English') reference to the curriculum enabling pupils to 'express themselves creatively and imaginatively and […] effectively'. The NC also focuses on enabling pupils to become 'enthusiastic and critical' in their reading.

In the Latvian curriculum, maintaining cultural heritage and reinforcing national identity through language knowledge, are stressed. The Socio-cultural competence subsection of the curriculum incorporates much of this material. The NC for English does not focus on the promotion of language learning as a means of cultural transmission.

21.3.2 Literature curriculum

The introduction to this curriculum includes the following key statements:

When learning Literature, a student has an opportunity to acquire knowledge about literature and implement **his/her creative self-expression**, as well as to develop his/her interests, **spiritual needs** and enrich his/her experience as a reader, by establishing his/her own **values and attitudes**.

The incorporation of 'spiritual needs' and of 'values' differs from the emphasis in the English NC – the closest aspects in the NC are the development of opinions and preferences, and engagement with challenging themes and ideas. Developing or supporting beliefs or values are not specified as aims of the English curriculum.

In addition, the Literature curriculum (as with Language) focuses on cultural and national characteristics and values.

In order that students may recognise and **respect the cultural values not only of their own nation but also those of other nations** and be oriented towards **intercultural dialogue**, the Standard for compulsory education in Literature includes learning about **folklore**, mythology and literature.

The English NC introductory statement is not explicit about 'intercultural' communication, or about engendering 'respect' for others' cultural values, but does include references to the importance of English as a language, internationally, and the richness and influence of literature written in English by those 'from many countries and times'. At Key Stage 2, specific English writers/works or key elements of folklore are not specified. Knowledge of what constitutes standard and non-standard English focuses on context and common features, rather than cultural transmission. Similarly, while the reading curriculum incorporates the study of literature from a range of cultures, no explicit aim of engendering understanding or respect is stated.

In broad terms, compared with the NC for English, the curricula for reading and writing in Latvia focus more centrally on developing the individual within Latvian society and culture, and on building national and cultural identity.

21.3.3 Reading curriculum: content

This section of the report uses the NC subsections for reading as the starting point for comparison.

What is covered in both curricula?

Most aspects of the English NC for reading are addressed in the Latvian curricula for Language and Literature. The two countries share the broad areas of learning - skills needed to decode print, understand and evaluate texts, acquire information, extend knowledge and experience of different text types. The following list demonstrates the points of commonality:

En2 1) Reading strategies

Phonemic awareness and phonic knowledge

Graphic knowledge

Knowledge of grammatical structures

En2 2) Understanding texts

Look for meaning beyond the literal

Make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing]

En2 3) Reading for information

Obtain specific information through detailed reading

Use organisational features and systems to find texts and information

Distinguish between fact and opinion [for example, by looking at the purpose of the text, the reliability of information]

En2 4) Literature (all aspects of this subsection are covered)

Recognise the choice, use and effect of figurative language, vocabulary and patterns of language

Identify different ways of constructing sentences and their effects

Identify how character and setting are created, and how plot, narrative structure and themes are developed

Recognise the differences between author, narrator and character

Evaluate ideas and themes that broaden perspectives and extend thinking

Consider poetic forms and their effects

Express preferences and support their views by reference to texts

Respond imaginatively, drawing on the whole text and other reading

Read stories, poems and plays aloud.

En2 5) Non-fiction and non-literary texts

Identify the use and effect of specialist vocabulary

Identify words associated with reason, persuasion, argument, explanation, instruction and description

En2 8) Literature

Texts drawn from a variety of cultures and traditions

Myths, legends and traditional stories

Playscripts

Note to the reading curriculum

Reading: during Key Stage 2 pupils read enthusiastically a range of materials and use their knowledge of words, sentences and texts to understand and respond to the meaning. They increase their ability to read challenging and lengthy texts independently.

What is covered in the English curriculum for reading, but not in the Latvian curriculum?

The following aspects are addressed in the English NC, but not in the Latvian curricula for Language and Literature.

En2 1) Reading strategies

Word recognition

Contextual understanding

En2 2) Understanding texts

Use inference and deduction

Use their knowledge of other texts they have read

Comment: The Latvian reading curriculum must presumably address these skills, but they are not made explicit in the documentation. The tendency for some processes or competences to be expressed globally in the Latvian curricula possibly accounts for these elements, for example: Reads correctly, consciously, fast and with expression. The Latvian focus on outcomes/competences and the English curriculum's specification of teaching requirements also contributes to the mismatch - the Latvian curriculum tends not to specify skills in terms of strategies and processes.

En2 3) Reading for information

Scan texts to find information

Skim for gist and overall impression

Draw on different features of texts, including print, sound and image, to obtain meaning

Comment: Again, the Latvian curriculum makes more broad reference to pupils' skills in understanding and extracting information from non-fiction texts, while the English NC tends toward more specificity.

En2 5) Non-fiction and non-literary texts

Recognise phrases and sentences that convey a formal, impersonal tone

Identify links between ideas and sentences in non-chronological writing

Evaluate different formats, layouts and presentational devices [for example, tables, bullet points, icons]

Engage with challenging and demanding subject matter

Comment: There are some surprising references here, and again the Latvian curriculum is likely to address some aspects of these skills, without them being explicitly referenced. However, levels of formality and impersonality do not seem to be covered; evaluation of the layout and presentation of non-fiction texts is also absent.

En2 6) Language structure and variation

To read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology [for example, how adjectives and adverbs contribute to overall effect, the use of varying sentence length and structure, connections between chapters or sections].

Comment: The point of difference here is the explicit teaching of this skill, based on use of appropriate vocabulary. The Latvian curriculum addresses knowledge of features at word, sentence and text level but does not focus on pupils undertaking such analysis.

En2 8) Literature

A range of modern fiction by significant children's authors

Long-established children's fiction

A range of good-quality modern poetry

Classic poetry

En2 9) Non-fiction and non-literary

Diaries, autobiographies, biographies, letters

Print and ICT-based reference and information materials [for example, textbooks, reports, encyclopaedias, handbooks, dictionaries, thesauruses, glossaries, CDROMs, internet]

Newspapers, magazines, articles, leaflets, brochures, advertisements.

Comment: Interestingly, despite the separate curriculum focusing on literature, the Latvian curriculum for reading doesn't specify the range of literature given in the English NC. The suggestion of pupils reading poetry and fiction is certainly present, but the kinds of fiction or poetry are not specified. Similarly, there is very little reference to non-fiction text types - the Latvian curriculum refers only to descriptive or informative texts.

What is covered in the Latvian curriculum for reading but not in the English curriculum?

LAT.LANG Language skills, Reading 15

Comprehends the idea expressed in the given text, interconnection between the title and theme.

Identifies the theme and main idea of the given text.

LAT.LANG Language competence, Text 28

Identifies the theme of a text, appropriateness of the title to the theme of a text.

Comment: Somewhat surprisingly, these skills are not specifically addressed in the English curriculum, although similar elements appear in the Framework for literacy in Understanding and interpreting Years 5-6.

LAT.LANG Socio-cultural competence 45

Identifies the information on a nation's history and culture in a text.

Identifies cultural information in a text.

Comment: Nothing similar appears to be covered in the English curriculum or in the Framework for literacy.

LIT. Literature as an art of writing 1

Distinguishes fiction/literary texts from other text types.

LIT. Literature as an art of writing 14

Comprehends the comic and tragic in a literary work.

LIT. Comprehension of a literary work, creative activity 17

Understands the emotional mood of a literary work.

Comment: For these skills, some level of coverage in the English curriculum can be assumed, but no explicit reference arises in the reading curriculum or Framework for literacy. The Engaging with and responding to texts objectives for Y3-4 include skills relating to empathy.

LIT. Literature as an art of writing 2

Understands what is common and different in literature and other forms of art (music, painting, sculpture).

LIT. Literature as an art of writing 8

Recognises the themes from the folklore of different nations within literary works.

Comment: These references are not addressed in the reading curriculum and reflect the Latvian focus on literature as part of the arts more broadly, and the focus on culture and transmission.

LIT. Comprehension of a literary work, creative activity 19

Assesses his / her own reading of a text or that of others, following the given criteria or the criteria devised together with the teacher.

Comment: While self-assessment and target setting in reading are widespread in England, they are not explicit in the reading NC. There is, however, a section of guidance on this process in the Framework for literacy.

LIT. Comprehension of a literary work, creative activity 20

Relates the content of a literary work, revealing the given information about the place and time of action, characters and events.

LIT. Literature as a part of culture 36

Chooses book appropriate to his/her reading interests.

LIT. Literature as a part of culture 43

Is interested to expand his / her understanding of an author's personality by reading his/her literary work.

Comment: These features do not appear explicitly in the English NC, but there are related references in the Framework for literacy.

21.3.4 Reading curriculum: difficulty and coverage

En2 1) Reading strategies

For Phonemic awareness and phonic knowledge, the closest Latvian language reference is for G3/Y4-5 and incorporates reading and writing. It highlights both correct identification and writing of sounds. The NC, with its focus on teaching requirements, rather than learning outcomes or competence, establishes that pupils should be able to use this knowledge, but it is not specific about how well they should do this. Potentially the statement about reading and writing 'correctly' for the age group is more demanding than the NC.

In relation to other elements (Word recognition and graphic knowledge, Knowledge of grammatical structures), the Latvian curriculum seems less demanding or similar overall in terms of demand. The English NC here is broader in the terms it uses, while equivalent references in the Latvian curriculum are more specific, for example, particular parts of speech are named. The breadth of a reference such as ‘grammatical structures’ leaves much open to interpretation.

En2 2) Understanding texts

The skill, Look for meaning beyond the literal, is addressed most closely by the G6 (Y7-8) reference in the Latvian curriculum, suggesting that the latter curriculum is less demanding in this aspect of reading.

In relation to ‘Make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing]’ the English curriculum focuses on fiction and non-fiction - the Latvian curriculum is focusing on non-fiction only. It is difficult to isolate a fully corresponding reference in the Latvian curriculum, which suggests that there is a less marked focus on this skill overall.

En2 3) Reading for information

There are slight differences in focus between the English reference: Obtain specific information through detailed reading, and the Latvian equivalent, which incorporates 'using' information in activities as well as first locating it. The English NC highlights detailed reading, which foregrounds reading skills explicitly. Generally here, the demand at Grade 3 (Y4-5) in the Latvian curriculum seems broadly similar to that in the English curriculum.

In relation to the English skill, Use organisational features and systems to find texts and information, the Latvian curriculum at Grade 6 (Y7-8) goes beyond the school environment, focusing on use of local libraries explicitly. This is implied in the English curriculum. The Latvian curriculum provides less direct reference to information retrieval, so this skill may be considered less prominent in the curriculum overall.

Perhaps surprisingly, the Latvian curriculum makes no direct reference to fact and opinion (English curriculum: Distinguish between fact and opinion [for example, by looking at the purpose of the text, the reliability of information]), with the closest skill relating more generally to evaluating a non-fiction text. There is no element of evaluating reliability in the Latvian curriculum, which suggests it is less demanding overall, in this respect.

En2 4) Literature

In relation to the English skill, Recognise the choice, use and effect of figurative language, vocabulary and patterns of language, the Latvian curriculum appears less demanding overall. For the corresponding Latvian references, 'identify', is the key skill. This matches 'recognise', in the NC, but the NC also focuses on the 'effect' of these techniques.

For the following English objectives - Identify how character and setting are created, and how plot, narrative structure and themes are developed; Recognise the differences between author, narrator and character - the Latvian equivalent focuses more on the *roles* of characters. The Latvian curriculum seems less focused on the process by which character and theme are developed.

The skill of evaluating ‘ideas and themes that broaden perspectives and extend thinking’ is less fully addressed in the Latvian curriculum, with the focus at Grade 6 being on identification; even at Grade 9, evaluating or extending thinking are not present. This suggests that the English reading curriculum is more demanding with regard to this skill.

While both of the following skills are addressed in part by the Latvian curriculum, it is important to note that the two elements of considering ‘effects’ and providing supportive textual references (which have become increasingly prominent in reading assessment in England, are absent in the Latvian curriculum. This suggests that the Latvian curriculum is less demanding in these respects, when compared with the English NC -

Consider poetic forms and their effects

Express preferences and support their views by reference to texts.

The English reference, Read stories, poems and plays aloud, is very specific and relates only to reading aloud, while the Latvian curriculum focuses also on understanding and expression. The latter gives more attention to the value of reading aloud as an aspect of appreciation.

En2 5) Non-fiction and non-literary

Generally, this section of the curriculum demonstrates that while correspondence can be found between many skills, the Latvian curriculum tends to be broader in its treatment of aspects of non-fiction texts. This makes it very difficult to make judgments about precise difficulty levels and coverage. Skills including recognition of specialist vocabulary, and the identification of words associated with reason, persuasion, argument, explanation, instruction and description are not explicitly addressed, but the broad reference, Knows the features of the functional styles of a language, can be said to encapsulate these elements. At Grade 3 (Y4-5) the reference, Recognises the significance of the choice of words and sentence types… in the comprehension and creation of a text, also implies similar knowledge, and indeed, the level of demand may be higher because pupils are required to consider the significance of word choices, rather than simply to identify them.

In terms of understanding the structure and organisation of non-fiction texts, again, the Latvian curriculum specifies far less, referring only to paragraphs, title/title page and 'reference elements' in a book as features; no mention is made of electronic texts. This implies that the Latvian curriculum may give less time and emphasis to these skills.

En2 8) Literature

For those aspects that are common to both curricula, it is important to highlight the more specific focus on folklore, sayings, proverbs, riddles, tales, legends, folk songs and anecdotes in the Latvian curriculum. The English curriculum does not refer to so long a list in this category of literature (although the Framework for literacy does include some elements). It seems clear that these forms occupy a more substantial position in the Latvian curriculum than in the English reading curriculum.

Note on the Reading National Curriculum

This section of the reading Programme of Study incorporates a focus on reading independently - this is not mentioned at all in the Latvian reading curriculum.

21.3.5 Writing curriculum: content

This section of the report uses the NC subsections for writing as the starting point for comparison.

Overall, there is a high degree of commonality between both curricula, with the key skills at text, sentence and word level, being present in both. As was observed for reading, there are variations in the degree of specificity in each curriculum in relation to particular skills.

What is covered in both curricula?

En3 1) Composition

Choose form and content to suit a particular purpose [for example, notes to read or organise thinking, plans for action, poetry for pleasure]

Broaden their vocabulary and use it in inventive ways

Use language and style that are appropriate to the reader

Use and adapt the features of a form of writing, drawing on their reading

Use features of layout, presentation and organisation effectively

En3 2) Planning and drafting

Plan - note and develop initial ideas

Draft - develop ideas from the plan into structured written text

Revise - change and improve the draft

Discuss and evaluate their own and others' writing

En3 3) Punctuation

Pupils should be taught to use punctuation marks correctly in their writing, including full stops, question and exclamation marks, commas, inverted commas, and apostrophes to mark possession and omission.

En3 4) Spelling strategies

To sound out phonemes

To analyse words into syllables and other known words

To apply knowledge of spelling conventions

To use knowledge of common letter strings, visual patterns and analogies

Morphology

The meaning, use and spelling of common prefixes and suffixes

The spelling of words with inflectional endings

The relevance of word families, roots and origins of words

The use of appropriate terminology, including vowel, consonant, homophone and syllable.

En3 5) Handwriting and presentation

Write legibly in both joined and printed styles with increasing fluency and speed

Use different forms of handwriting for different purposes [for example, print for labelling maps or diagrams, a clear, neat hand for finished presented work, a faster script for notes]

En3 6) Standard English

How written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display]

En3 7) Language structure

Word classes and the grammatical functions of words, including nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, articles

The features of different types of sentence, including statements, questions and commands, and how to use them [for example, imperatives in commands]

The grammar of complex sentences, including clauses, phrases and connectives

The purposes and organisational features of paragraphs, and how ideas can be linked

Breadth of study

En3 9) Range of purposes

To imagine and explore feelings and ideas, focusing on creative uses of language and how to interest the reader

To inform and explain, focusing on the subject matter and how to convey it in sufficient detail for the reader

To review and comment on what has been read, seen or heard, focusing on both the topic and the writer's view of it

En3 10) Pupils should also be taught to use writing to help their thinking, investigating, organising and learning

En3 12) The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries

What is covered in the English curriculum for writing, but not in the Latvian curriculum?

The following aspects are addressed in the English NC, but not in the Latvian curricula for Language and Literature.

En3 2) Planning and drafting

Proofread - check the draft for spelling and punctuation errors, omissions and repetitions

Present - prepare a neat, correct and clear final copy

En3 4) Spelling strategies

To check their spelling using word banks, dictionaries and spellcheckers

To revise and build on their knowledge of words and spelling patterns

Comment: There is clearly a more pronounced emphasis on the processes of drafting and editing in the English curriculum as compared with the Latvian curriculum. The lack of reference in the latter, to 'publishing' work, and meeting criteria for presentation is noticeable. Similarly, while developing and using spelling skills is part of the Latvian curriculum, actively checking spelling is not included. The Latvian curriculum does incorporate broad references to writing and spelling accurately, without reference to this process of correction and amendment.

En3 6) Standard English

Some of the differences between standard and non-standard English usage, including subject-verb agreements and use of prepositions

Comment: Despite the general focus in the Latvian curriculum on cultural awareness and the sense of pride in the Latvian language, standard usage is not covered. There does not seem to be the same interest in establishing what characterises standard usage or analysing language usage as exists in the English curriculum.

En3 9) Range of purposes

To persuade, focusing on how arguments and evidence are built up and language used to convince the reader

Comment: Surprisingly perhaps, persuasion, one of the principal writing purposes in the English curriculum is not included explicitly in the Latvian writing references. As is the case at other points, some broader references in the Latvian curriculum, such as the ability to write texts to suit different purposes, could be assumed to include this kind of writing. Nevertheless, it does not have the same emphasis as in the English requirements.

En3 11) Range of audiences

The range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers

Comment: This absence in the Latvian curriculum for writing must be viewed as significant. While the curriculum mentions the requirement to write texts suited to different purposes and addressees, there is no reference to specific readers. As noted earlier, there is a far more pronounced focus in the English curriculum on writing with the aim of successfully meeting the expectations of an intended audience.

What is covered in the Latvian curriculum for writing but not in the English curriculum?

LIT Comprehension of a literary work, creative activity 33

Enjoys creative self-expression during the text formation process.

Comment: The elements of self-expression and enjoyment are not specified in the English writing curriculum or in the Framework for literacy. The general emphasis is more focused on successfully creating particular effects and serving particular purposes.

21.3.6 Writing curriculum: difficulty and coverage

En3 1) Composition

Among the elements of composition that are common to both countries' curricula there are varying degrees of agreement and match. In relation to the English requirement to Choose form and content to suit a particular purpose, the Latvian equivalent reference, for G6 (Y7-8) specifies writing 'appropriately' as well as choosing appropriately. Conversely, for the English curriculum reference, Broaden their vocabulary and use it in inventive ways, the nearest matching Latvian reference does not include any suggestion of 'inventive' usage.

It is notable too that while the Latvian curriculum includes references that address the English requirement, Use and adapt the features of a form of writing, drawing on their reading, they focus more on replicating or summarising an existing text, than on adaptation.

In relation to the requirement, Use features of layout, presentation and organisation effectively, the Latvian curriculum uses more global descriptions of a complete, successful text, incorporating purpose, audience as well as layout and organisation. There is some suggestion that the Latvian curriculum gives less weight to layout and organisation in writing, with fewer concrete indicators of success in this area being evident in the curriculum.

En3 2) Planning and drafting

Both countries' curricula incorporate the process of planning a text and developing it through drafting, although there is less emphasis given to this process in the Latvian curriculum. Indeed, for the three references in the English curriculum (Plan - note and develop initial ideas; Draft - develop ideas from the plan into structured written text;

Revise - change and improve the draft) , only one Latvian reference serves as a match, Uses an outline and/or draft in the creation of a text.

En3 3) Punctuation

While both the English and Latvian curricula address punctuation as a set of skills, the former is more specific in providing a list of punctuation marks to be taught. In the Language curriculum in Latvia, sentence punctuation is mentioned in Grade 3 (Y4-5), in

broader terms, and the lack of reference to, for example, commas or the punctuation of lists, phrases or clauses, suggests that the Latvian curriculum is less demanding at this phase. These elements appear in Grade 6.

En4 4) Spelling strategies

Morphology

The English curriculum for writing is more specific and detailed in its coverage of spelling and word knowledge. The emphasis on spelling strategies contrasts with the Latvian focus (determined in part by its inclusion of outcomes and competences rather than teaching requirements) on knowledge and accuracy. The Latvian curriculum specifies the correct pronunciation and spelling of words. While both curricula include knowledge about inflections and other features, the English curriculum tends to relate this more directly to spelling. In addition, it mentions explicitly the need for pupils to use terminology such as vowel, consonant, homophone and syllable, while knowledge of such terminology has to be assumed from the Latvian reference to knowledge about language and spelling.

En3 5) Handwriting and presentation

In relation to handwriting, similar differences can be noted to those discussed above – the Latvian curriculum specifies in less detail what skills or aspects should be achieved, for example, while the English curriculum mentions the use of print or joined style being used for different contexts, the Latvian curriculum refers to pupils adapting style as needed. Nevertheless, at one point, for Grade 3 (Y4-5), it does specify writing ‘words and sentences accurately and correctly’, which might suggest more demand than the English curriculum.

En3 6) Standard English

The English curriculum’s explicit reference to variation in formality (How written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display]) is matched with a Latvian reference that is much more global, focusing on pupils matching a written text to the addressee, theme, purpose, place and time of communication. The suggestion of adaptation to account for formality/informality is implicit, but its lack of presence in the curriculum suggests that it would receive less direct attention.

En3 7) Language structure

There is a reasonable degree of commonality in this category, with each curriculum specifying different elements at word and sentence level, though with different degrees of specificity. The English curriculum specifies several examples of word class and grammatical function: nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, articles. For various skills, it appears that the Latvian curriculum is more demanding, for example by specifying that pupils should write sentence types correctly and express them with correct intonation (in Grade 3). At other points, the Latvian

curriculum appears to be less demanding than the English writing requirements, for example, in its specification of when pupils should know the parts of sentences and form them - simple sentences are mentioned in Grade 3, and more complex forms in Grade 6 (Year 7-8). The Key Stage 2 curriculum emphasises the learning of complex sentences, and this tends to become prominent certainly before Year 7.

En3 9) Range of purposes

Generally, this aspect of writing is more detailed and given greater prominence in the English curriculum than in the Latvian documents. A more global Latvian reference to matching writing to purpose and audience is set against more specific references to types of writing and purposes in the English document. Notable here is the tendency for the English curriculum to bring the audience (reader) into each requirement, so that writing is directed toward specific readers. The Latvian curriculum includes reference to describing and informing, and to summarising and commenting, but does not focus directly on instructing, persuading or explaining.

En3 10) Pupils should also be taught to use writing to help their thinking, investigating, organising and learning

Once again, for this reference, the Latvian curriculum is less detailed and perhaps less demanding. While a range of processes that writing can support are given in the English curriculum, the Latvian curriculum focuses on pupils writing down ‘information’ for ‘everyday life and learning’.

En3 12) The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries

An important distinction in the level of detail in each curriculum arises in this section - the English curriculum once again provides more information about text types to be covered, with the Latvian documents for Language and Literature proving to be narrower overall. In terms of non-fiction texts, the Language curriculum refers only to informative and descriptive texts and summaries/resumes. The Literature document is at times highly specific about forms relating to folklore, and to poetry (at Grade 9), but this suggests narrowness in the sense that the English curriculum, for example, refers to ‘narratives’, incorporating a range of fiction (and non-fiction).

21.4 Order of teaching and when taught

In the Latvian curriculum, the use of Grade bands at which requirements are specified (two grades in the Literature curriculum, three grades in the Language curriculum) gives rise to a ‘spiral’ organisation in which learning descriptors can be traced up from lower to higher levels of demand (although not every requirement appears in every Grade). The NC Programmes of Study for reading and writing do not use such organisation, although the NC Level descriptions for reading and writing do repeat and extend key elements through the Levels from 1 to 8. Similarly, the Framework for literacy incorporates repetition and extension of elements across each year.

As noted in the discussion of relative difficulty in section 1.4, there are points at which each of the curricula makes higher demands than the other. This judgement is difficult to make in many cases, because of the broad nature of some curriculum references, and the lack of Year-specificity in the English curriculum. Additionally, because the curricula are organised by teaching requirement (England) and learning outcome (Latvia), there is again, difficulty in specifying when a particular skill might be taught in each system.

21.5 Integration of subjects

The Latvian curriculum separates Latvian Language from Literature. Within the Language curriculum framework, there is reference to 'Mother tongue', 'state language' and 'ethnic minority language' in the description of Socio-cultural competence. Specific requirements for Language competence are given in an appendix to the curriculum, and these focus on applying existing language skills in the acquisition of a different language. Although this is not made clear, it seems that this is provided to support the teaching of pupils whose first language is not Latvian. There is no indication of cross-curricular organisation or of how teaching programmes that cover language and literature are to be planned.

21.6 Differentiation

The curricula for Language and Literature in Latvia are specified by outcome / competence for different Grades. There is no specific content or guidance designed to support differentiation according to pupils' abilities. The acknowledgement of second language acquisition in the Language curriculum, and the appendix of Learning competences related to additional language learning, imply an awareness (and presumably) a differentiation of the curriculum for those whose first language is not Latvian. In the Literature curriculum, the introduction does, however, include information about the time allocations for language and literature being variable, according to whether schools are providing 'curricula for ethnic minorities'. See the following section.

21.7 Pedagogy and time allocations

There are mandatory time allocations for teaching Latvian. In terms of periods these are 6 periods per week for grades 1 to 4, 5 periods for grade 5 and 4 periods for grade 6. This is rather more than for mathematics, 4 or 5 periods and considerably more than science, 2 periods per week.

The curricula for Language and Literature in Latvia do not specify pedagogical approaches. The documents do not make clear, for example, the balance between independent, group or class instruction. There are also no specific time allocations for reading in terms of percentage of time during a day/week/term etc. However, in the introduction to the Literature curriculum, some specific information about proportions of time to be allocated to different literature elements is given:

- 'in the programmes with Latvian as the language of instruction' - 2/3 of time for studying Latvian folklore, mythology and literature, 1/3 for folklore, mythology and literature of other nations

- ‘in the programmes with the language of instruction that of ethnic minorities’ - 1/3 of time for Latvian folklore, mythology and literature, 2/3 for folklore, mythology and literature of own nation and other nations.

In addition, ‘schools providing curricula for ethnic minorities’ have different requirements, with Latvian folklore, mythology and literature being studied in ‘the classes of Latvian language’.

It is not clear whether these specifications relating to time and organisation are mandatory, although the following text suggests that they have the status of recommendations: ‘it is advisable to bear in mind the following principles’.

21.8 Guidance or compulsion of teaching methods

The local expert reports that there are no mandatory elements:

“ There are sample programmes developed for each subject by the Centre for Curriculum Development and Examinations under the Ministry of Education and Science Republic of Latvia. These programmes also have recommendations on the learning methods which might be used in the learning process. At the moment there are two sample programmes for Latvian for grades 1-9 developed and teachers can use them as a basis for their own programmes. ”

22 Literacy Comparison: The Netherlands

22.1 Structure

Although primary education in the Netherlands is compulsory from ages 5-12, nearly all 4-year-olds are in primary school education. Primary education is structured by year groups, with grade 1 being the pre-compulsory year for 4- to 5-year-olds, and grade 8 (the final year of primary education) being equivalent to Year 7 in English schools.

An overall introduction outlines the principles on which the primary curriculum is based.

Fifty eight attainment targets, divided into seven subject areas, indicate the basic minimum that schools are required to teach by law. However, schools have considerable freedom in the choice of methods and resources and may emphasise different areas of the curriculum, as they see fit. Twenty-two targets relate to languages (Dutch, English or Friesian), and specific mention is made under the heading of expressive activities.

As well as Dutch language - which is also the language through which other subjects are taught - the curriculum includes: physical education; mathematics and arithmetic; English (in the last two years); expressive activities (language, music, drawing, handicrafts, play and movement); self-reliance; healthy living; and a number of factual subjects, (eg geography, history, science, social and religious education). In Friesland the entire curriculum may be taught through, and include teaching of, the Frisian language.

The primary curriculum for Dutch language is made up of twelve attainment targets or ‘core objectives’. The ‘Core Objectives’ come under the headings of Oral education (three targets), Written Education (six targets) and Linguistics, including strategies (three targets). The Written education section covers both reading and writing in an integrated way: by contrast, linguistics is a separate section, although the first linguistics target refers back to the content of both oral and written education sections. The Dutch language curriculum differs in both these respects from the English National Curriculum (NC).

An introduction (entitled ‘Characteristics’) which precedes these objectives establishes the relationship between the individual targets / areas and outlines the philosophy behind the structure of the Dutch language section.

The aim is to turn children into ‘increasingly competent language users’ both within the school and outside it. Language is described as playing a crucial role in the acquisition of knowledge and skills in all subjects, and there is an emphasis on expression and on the role of language teaching in supporting disadvantaged students is emphasised. Four key competences are identified: the ability to copy, describe (report, give information, or ask questions), structure and assess.

Since the objectives are brief, learning outcomes are specified in the broadest terms, giving just a few examples of text types or other specifics. For example, pupils need to know ‘rules for spelling’: which rules, or whether phonic or other strategies should be

used, is not specified. Throughout the primary curriculum, detailed guidance for teaching is specifically *not* given, as 'didactics' are left to the discretion of the school or teacher.

Almost three quarters of Dutch primary schools use national tests to assess pupils' level of attainment at the end of primary schooling. Results of these tests, together with the head teacher's recommendation, are used to determine the most appropriate type of secondary education for the pupil concerned. It may well be that these tests have as much influence on teaching as any other aspect of the system.

In relation to the use of key terminology (bearing in mind the issue of translation), it is to be noted that learners are called children *or* pupils, at primary level. As mentioned above, 'attainment targets' may also be translated as 'core objectives'.

22.2 Aims and rationale for the curriculum

As mentioned, the stated aim of Dutch primary education is provide a broad education, addressing children's emotional and intellectual development, the development of their creativity and their acquisition of social, cultural and physical skills.

The core objectives area said to provide targets for schools, but do not prescribe methods or resources for teaching. Instead, the philosophy behind teaching is outlined, namely to address and stimulate children's curiosity and their need for development and communication. Teaching should be structured and interactive, based on interesting them and activities to stimulate children's development, and should make use of 'exploratory' education.

In teaching, content should be relevant, the importance of cross-curricular links is emphasised, and language is mentioned as important in all subjects

The curriculum also identifies a number of over-arching study goals of primary education. These include a positive attitude to work, learning strategies, and children's ability to reflect on their own actions and learning. As well as reference to acquiring and processing information, there also seems to be an emphasis on the social and expressive aspects of children's development. The development of self-confidence is considered an overall aim of education, as is respect for, and responsible dealing with, others. A part of respect for others is learning to listen to - and criticise - others' opinions. Finally, the teaching should aim to foster care and appreciation for the 'living environment'.

Within the context of the Dutch language curriculum, there is recognition of the part language contributes to success in school and position in society. The social and communicative function of language is recognised, and teachers are reminded to provide interesting learning experiences where there is opportunity for real spoken and written communication - about books or subjects, or socially - with other children. Language education is also recognised as an iterative process.

The importance of language education is outlined: language is important in acquiring content and skills. Emphasis is placed on oral language skills as a precondition for written work, and the role of pre-school experience of language is acknowledged. The curriculum stresses the importance of developing oral work through expanding vocabulary, listening skills, and 'telling' and reading aloud. The relationship between language and thought is also developed through oral work.

In addition, the lessons of second language teaching (greater work on vocabulary, different programme) are cited as important in working with disadvantaged pupils whose language experience at home may have been impoverished. The emphasis is on their acquisition of language skills to help them access other curriculum subjects.

22.3 Content

Because the approach is broad, the Dutch language curriculum does not go into the same level of detail as the English NC. Much may be inferred to be comparable with the English curriculum, but the level of confidence cannot be high, and there are far fewer specifics. The following discussion therefore necessarily infers that certain skills are covered, even though they may not be specified.

Of the twelve *Core Objectives* (CO) relating to Dutch language teaching, CO1-3 relate to oral education; CO4-9 to 'written education' (including both reading and writing); and Linguistics (CO10-12).

Although reading and writing are taken together in the Dutch curriculum (CO4-9, Written Education) they will be dealt with separately in this discussion, following the structure of the English NC. In the Dutch curriculum, only C06 refers to reading alone and the remainder deal with reading and writing in an integrated way.

In relation to reading strategies (En 2.1), the linguistics section of the Dutch curriculum (specifically CO 11-12) covers a similar range of issues. Rules for spelling and linguistic principles, including knowledge of sentence structure, are included. It is not specified that these will be addressed to support understanding and reading strategies, though it seem reasonable to infer this.

Where En 2.1d refers to contextual understanding, however, the Dutch CO12 refers only to the much narrower concept of strategies for understanding unfamiliar words.

Where the English NC details a number of skills in relation to the understanding of texts (En 2.2), the Dutch curriculum's nearest equivalent is that 'pupils learn to compare and assess information and opinions in different text forms' (CO7). This is a specific way of using textual knowledge, rather than the broad concept of using textual knowledge to support understanding that is specified in En 2.2d.

The Dutch curriculum does not include any mention of skimming and scanning (En2.3a and b. It does mention retrieving information from different features of text (C04) and although the use of 'detailed reading' (En 2.3c) is not specifically mentioned it may

reasonable be inferred. The English NC's reference to organisational features and systems does not appear in the Dutch curriculum, though it may be implied in C04.

One area where there is perhaps a surprising level of detail is in relation to spelling. Dutch spelling is far more phonetic than English, as spelling has been substantially reformed for consistency and user-friendliness, although some homophones remain. The spelling of verbs is specifically mentioned: in practice, the final consonant of the past participle of weak verbs may be either *d* or *t*, so this is an important aspect in an otherwise largely phonetic system.

The only aspect of En 2.4 (developing understanding and appreciation of literary texts) to be mentioned specifically in the Dutch curriculum is reading aloud (En2.4i), which is mentioned in the *Characteristics* section that introduces the Core Objectives. Nevertheless, the Dutch curriculum specifically mentions deriving pleasure from reading stories and poems (C09). Some of the 'literary criticisms' aspects of the English NC may be implied in the Linguistics sectioned the Dutch curriculum, where CO10 refers back to the ability to 'recognise, express, use and assess' (which could perhaps be translated as to *recognise, describe, use and evaluate*?) strategies for written education. This suggests that pupils are learning to make judgements and talk about what they read, although it does not appear to cover 'creative' response to reading.

Similarly, the Dutch curriculum does not specify the levels of textual understanding detailed in the English NC in reaction to non-fiction and non-literary texts. The overall comment in the linguistics section, that pupils acquire vocabulary which 'includes terms that allow pupils to think and talk about language' may be seen as implying the identification of words associated with different text types (En 2.5b), although this is not clear.

As regards language structure and variation (En 2.6) the Dutch curriculum specifies the ability and terminology to talk and think about language (co10, c012), but there is nothing approaching the English NC's reference to *effective* language use, unless this is implied in CO10's reference to pupils' learning to 'recognise, express, use and assess' strategies relating to the preceding Core Objectives.

In terms of range, whereas the English En 7 specifies different types of literary text, the Dutch curriculum mentions only 'deriving pleasure from.stories and poems *intended for them*'. The focus on texts written for children implies a narrower focus than the English curriculum. In addition, there is no specific mention of plays in the Dutch curriculum as there is in the English, neither are plays specified in the objectives that deal with Art, CO54-56).

There is a similar dearth of detail in relation to the range of non-fiction and non-literary texts mentioned in the Dutch curriculum. Whereas the English NC specifies a range of text types, the Dutch refers only to 'informative and instructive texts' (C04); 'educational and other instructive texts' (CO6) and 'different textual forms' (CO7).

The notes on reading in the English curriculum refer to pupils reading ‘enthusiastically and responding to meaning’: this equates most closely to the Dutch CO9 - that pupils derive pleasure from reading. The Dutch curriculum implies the use of words, sentences and texts to understand and respond to meaning.

The English NC attainment targets relating to writing are separate from those for reading and are covered mainly by CO4-9 (Written Education) in the Dutch curriculum, with some aspects covered in the linguistics objectives (CO10-12). Co1 (Oral education) also mentions writing in relation to reproducing information that has been acquired form spoken language (an aspect that is covered in En 3.9 in the English NC.

As with reading, the English NC is more specific and suggests a greater depth of coverage, partly because of that level of details. As with reading, too, the English NC may focus more on specifying theoretical understanding of the process of writing.

In relation to composition (En 3.1), the Dutch curriculum requires that children structure work appropriately in different forms (CO8), but not that they be able to choose form (En 3.1a). The English curriculum specifies ‘inventive’ use of language in writing (En 3.1b) which the Dutch refers only to extending vocabulary (CO12). Adaptation for the reader (En 3.1c) is perhaps implied but not specified in C08, that pupils learn to write ‘meaningful and attractive texts’ En 3.1e refers to features of ‘layout, presentation and organisation’, and this is paralleled by the Dutch curriculum’s reference to ‘typeface, images and colour’. The organisation of texts, however, is not specified in the Dutch document.

Planning, drafting, revising and proofreading are not detailed in the Dutch curriculum although they may be implied by the reference to pupils ‘paying attention to syntax and correct spelling’ (CO8). Presentation, in terms of neatness (En 3.2a) may also be inferred from CO8, or from CO5’s reference to writing ‘attractive’ texts. The discussion of writing may be seen as being covered by the linguistics section of the Dutch curriculum, which refers to pupils’ ability to talk about language and - allowing for translation issues - to the requirement that children ‘recognise, express, use and assess’ all aspects of their oral and written language education (CO10). The English NC refers specifically to working on screen: although the Dutch curriculum refers to aspects of digital texts (typeface, image, colour) again, the skills of drafting, revising etc are not specified.

In relation to punctuation (En 3.3) the Dutch curriculum is not specific, requiring that pupils ‘know the rules for punctuation marks’ (CO11).

With regard to spelling (En 3.4a-f) the Dutch curriculum only specifies that pupils ‘know the rules for spelling’. As mentioned, Dutch spelling is far more phonetic than English, as spelling has been substantially reformed for consistency and user-friendliness, although some homophones remain. Aspects of morphology (En g-j) may be inferred from the Dutch CO11-12. Where the spelling of verbs is specifically mentioned, this may parallel the English reverence to inflectional endings (En 3.4h).

Writing legibly (En3.5a) is covered in the Dutch curriculum (CO8) but the detailed requirements of varying fluency, speed and style of handwriting are not covered.

There is no equivalent to the requirement for Standard English (En 5.6).

In terms of language structure (En 3.7) main aspects of this are covered in a general way in CO11 (pupils learn linguistic principles and rules.. distinguish between subject, verbal predicate…). Paragraphing, however (En 3.7d) is not specifically mentioned in the Dutch curriculum, though it may be perceived as part of learning to 'structure informati9on and opinions (CO8).

The English NC goes into substantial detail about the range of purposes, readers (or audiences) and forms that should be addressed in teaching writing (En 3.8-3.12). As would be expected, there is far less specific direction in the Dutch curriculum. Nevertheless, it covers a range of purposes, producing texts 'including informative, instructive, convincing [possibly a mis-translation of *persuasive*?] or enjoyable' (CO5). Specific forms mentioned are letter, report, form [possibly *brochure*?] and paper [possibly *article*?]

Where the English curriculum specifies pupils should use writing to review or comment on what they have 'read, seen or heard' (En 3.9d), this is paralleled by CO1 (writing to reproduce information from spoken language) and CO6 (structuring information and opinions when reading), although clearly in the latter case the use of writing is not explicit.

The use of writing to help 'thinking, investigating, organising and learning' (En 3.10) is similar to the Dutch curriculum's reference to 'structuring information and opinions in writing (CO8) .

The English NC specifies that the range of readers should include adults, the wider community and imagined, readers (En 3.11). The Dutch curriculum, however, seems only to identify children as a specific audience (for correspondence, or for stories and poems).

22.4 Difficulty and coverage

In all areas, the coverage of the English curriculum is far more detailed than the Dutch, so it appears that coverage is broader. The range of purposes, audiences and forms specified in the Dutch curriculum, for example, as well as the details of punctuation etc, are far narrower that in the English curriculum. However, it is fair to assume that many aspects are covered in Dutch schools that are not specified.

The level of difficulty is very difficult to gauge from the broad statements of the Dutch curriculum. The use of assessment at the end of primary schooling presumable helps Dutch teachers to gauge the standards expected of pupils.

22.5 Order of Teaching and when Taught

Since the Dutch curriculum covers the whole of primary schooling with one set of Attainment Targets, there is no indication of when particular areas are covered. Nevertheless, the *Characteristics* section specifies that language acquisition and education is 'circular', that 'content may be similar while complexity and command increases'. This implies progression in the way that aspects of language use and understanding are introduced and revisited.

22.6 Integration of Subjects

The Dutch curriculum focuses on the Dutch language as the basis for literacy, whether children are experiencing it as a first or second language. The relationship between langue and thought is mentioned, as is the role of Dutch as the medium through which other subjects are taught. In this way, the language curriculum as a whole is seen as integrated into the teaching of other subjects. Cross-curricular links are expected to be made by teachers, as is indicated in the preamble.

The relationship of oral language work to reading and writing is also made explicit, even though the core objectives for oral work are in a separate section from written work for the language curriculum. This relationship is covered in the *Characteristics* section of the Dutch curriculum document, and outlined in Section 1.2, above.

22.7 Differentiation

The Dutch curriculum specifically avoids prescribing 'didactics. It is therefore impossible to state with certainty how content is tailored to children's ability. Nevertheless, the generally child-centred approach that permeates the curriculum document, and the willingness not to prescribe, suggests that teachers are expected to be aware of the stage of learning of the child.

As far as possible, children with learning and behavioural difficulties are integrated into mainstream schools, within Dutch primary education. After a previous rise in the numbers of such children entering special education, numbers at special schools have begun to fall as children increasingly remain in the mainstream. Again, this may suggest that a differentiated approach would be needed within the classroom.

22.8 Pedagogy and Time Allocations

Schools are free, within the framework set by central government, to decide how much time is spent on the various subjects and areas of the curriculum. They have also been given more flexibility regarding the length of the school day so that timetables can reflect the specific needs and wishes of the school and the community. They still have to provide at least 7,520 teaching periods over the eight years that children attend school, but the distribution of periods between the first four years and the last four years is flexible. Schools can reduce the total number of teaching periods in the last four years to 3,760. The minimum number of periods over the first four years remains unchanged at 3,520. The maximum of 5.5 hours of teaching a day has been abolished.

22.9 Guidance or Compulsion of Teaching Methods

The curriculum is specifically not prescriptive about teaching methods. There is, however, reference to interesting activities, interactive teaching and exploratory methods, which use real life and ‘concrete’ education.

www.essex.ac.uk/guest/aua**netherlands**/Documents/Diploma%20Supplement%20NL.pdf

A recent survey quoted the Netherlands as the having the best quality of life for children: close family bonds, more time spent at home. Given the recognition of pre-school experience, it may be that this is one of the sources of success in literacy. In addition, there is a recognised ‘reading habit’ - high level of reading newspapers etc.

23 Literacy Comparison: Ontario

23.1 Reading in Ontario

This comparison is based on the version of the Ontarian curriculum taught prior to 2003. This was superseded in 2006 by a new Language curriculum. This comparison is in two parts, reading followed by writing.

23.2 Structure: Reading

Like its writing counterpart, the Ontario reading curriculum is structured by grades and then subdivided into 'Overall Expectations' and 'Expectations in Specific Areas.' The Overall Expectations are set out at the beginning of each grade, as a set of seven bullet points. Throughout the grade ranges looked at (grades 3 to 6), the subject area of each bullet remains the same with some development. The Expectations in Specific Areas are further subdivided into:

- Reason and Critical Thinking
- Understanding of Form and Style
- Knowledge of Language Structures
- Vocabulary Building
- Use of Conventions

As with the Overall Expectations, these categories remain constant throughout the grades and are expected to be achieved by the end of the grade. Each grade builds upon the previous grade and appears to be spiral in nature (unlike the equivalent writing curriculum).

23.3 Content: Reading

Although the Ontarian curriculum is structured differently from England's own, the areas of learning covered by both countries are broadly similar. The following areas of learning taken from the Ontarian document (Overall Expectations) are also covered in the English National. As the Canadian document does not contain generic headings for this section, the Overall Expectations for grade 5 (equivalent to Year 6) are reproduced below:

By the end of Grade 5, students will:

- Read a variety of fiction and non-fiction materials (e.g., novels, short stories, biographies, editorials) for different purposes;
- Read aloud, adjusting speed according to purpose and audience;
- Read independently, selecting appropriate reading strategies;
- Explain their interpretation of a written work, supporting it with evidence from the work and from their own knowledge and experience;

- Decide on a specific purpose for reading, and select the material that they need from a variety of appropriate sources;
- Understand the vocabulary and language structures appropriate for this grade level;
- Use conventions of written materials to help them understand and use the materials.

All of the Overall Expectations can be found in the English National Curriculum for reading in some form.

The descriptors for the Ontarian curriculum did not include any reference to the following areas as described in the English National Curriculum:

- Word recognition and graphic knowledge (En2 1b)
- Look for meaning beyond the literal (En2 2b)
- Obtain specific information through detailed reading (En2 3c)
- Obtain specific information through detailed reading (En2 3d)
- Distinguish between fact and opinion [for example, by looking at the purpose of the text, the reliability of information] (En2 3f)
- Recognise the choice, use and effect of figurative language, vocabulary and patterns of language (En2 4a)
- Identify different ways of constructing sentences and their effects (En2 4b)
- Evaluate ideas and themes that broaden perspectives and extend thinking (En2 4e)
- Respond imaginatively, drawing on the whole text and other reading (En2 4h)
- Identify words associated with reason, persuasion, argument, explanation, instruction and description (En2 5b)
- Recognise phrases and sentences that convey a formal, impersonal tone (En2 5c)
- Identify links between ideas and sentences in non-chronological writing (En2 5d)
- Valuate different formats, layouts and presentational devices [for example, tables, bullet points, icons](En2 5f)
- Engage with challenging and demanding subject matter (En2 5g)
- Texts drawn from a variety of cultures and traditions (En2 8e)

- Diaries, autobiographies, biographies, letters (En2 9a)
- Print and ICT based reference and information materials [for example, textbooks, reports, encyclopaedias, handbooks, dictionaries, thesauruses, glossaries, CDROMs, internet] (En2 9b)
- Newspapers, magazines, articles, leaflets, brochures, advertisements (En2 9c).

The main area of difference, between the content of the two reading curricula, is the lack of reference to non-fiction texts in the Ontarian document.

23.4 Difficulty and Coverage: Reading

The Ontarian document does not offer as much detail as the English National Curriculum. It is therefore somewhat problematic to come to a conclusion as to how easy/difficult elements of the curriculum are. However, based on the information given, as to when each element is introduced, we judge that the two curricula are broadly similar in their levels of difficulty.

23.5 Order of Teaching and When Taught: Reading

The grade system is followed in Ontario. The areas of the curriculum remain constant across the grades and spiral approach to teaching is more evident in the reading document than it is in the writing document. There was very little reference to revising topics. The differences between the grades appeared to be cumulative.

23.6 Writing in Ontario

This comparison is based on the version of the Ontarian curriculum taught prior to 2003. This was superseded in 2006 by a new Language curriculum.

23.7 Structure: Writing

The Ontario ‘curriculum’ (the documentation available does not have a title - it is therefore unclear whether Ontario follows a curriculum or a syllabus) is structured by grades and then subdivided into ‘Overall Expectations’ and ‘Expectations in Specific Areas.’ The Overall Expectations are set out at the beginning of each grade, as a set of ten bullet points. Throughout the grade ranges looked at (grades 3 to 6), the subject area of each bullet remains the same with some development. The Expectations in Specific Areas are further subdivided into:

- Grammar
- Punctuation
- Spelling
- Word Use and Vocabulary Building
- Visual Presentation

As with the Overall Expectations, these categories remain constant throughout the grades and are expected to be achieved by the end of the grade. Each grade builds upon the previous grade but does not appear to be consistently spiral in nature.

23.8 Content: Writing

Although the Ontarian curriculum is structured differently to England's own, the areas of learning covered by both countries are broadly similar. The following areas of learning taken from the Ontarian document (Overall Expectations) are also covered in the English National Curriculum. As the Canadian document does not contain generic headings for this section, the Overall Expectations for grade 5 (equivalent to Year 6) are reproduced below:

By the end of Grade 5, students will:

- Communicate ideas and information for a variety of purposes (e.g., to present and support a viewpoint) and to specific audiences (e.g., write a letter to a newspaper stating and justifying their position on an issue in the news);
- Use writing for various purposes and in a range of contexts, including school work (e.g., to summarize information from materials they have read, to reflect on their thoughts, feelings, and imaginings);
- Organize information to convey a central idea, using well-developed paragraphs that focus on a main idea and give some relevant supporting details;
- Use simple, compound, and complex sentences;
- Produce pieces of writing using a variety of forms (e.g., stories, poems, reports), narrative techniques (e.g., first- and third-person points of view, dialogue), and materials from other media (e.g., illustrations);
- Produce media texts using writing and materials from other media (e.g., an advertisement for radio or television);
- Revise and edit their work, seeking feedback from others and focusing on content, organization, and appropriateness of vocabulary for audience;
- Proofread and correct their final drafts, focusing on grammar, punctuation, and spelling;
- Use and spell correctly the vocabulary appropriate for this grade level;
- Use correctly the conventions (spelling, grammar, punctuation, etc.) specified for this grade level (see below).

All of the Overall Expectations can be found in the English National Curriculum.

The descriptors for the Ontarian curriculum did not include any reference to the following areas as described in the English National Curriculum:

- plan - note and develop initial ideas (En3 2a)
- draft - develop ideas from the plan into structured written text (En3 2b)
- use and adapt the features of a form of writing, drawing on their reading (En3 1d)
- present - prepare a neat, correct and clear final copy (En3 2e)
- to revise and build on their knowledge of words and spelling patterns (En3 4f)
- the spelling of words with inflectional endings (En3 4h)
- the relevance of word families, roots and origins of words (En3 4i)
- the use of appropriate terminology, including vowel, consonant, homophone and syllable.(En3 4j)
- use different forms of handwriting for different purposes [for example, print for labelling maps or diagrams, a clear, neat hand for finished presented work, a faster script for notes]. (En3 5b)
- how written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display] (En3 6a)
- some of the differences between standard and non-standard English usage, including subject-verb agreements and use of prepositions (En3 6b)
- to review and comment on what has been read, seen or heard, focusing on both the topic and the writer's view of it (En3 9d).

When looked at further, it can be seen that these ‘omissions’ can be grouped under the following headings: planning and drafting; morphology; use of terminology; handwriting; use of Standard English and authorial viewpoint.

23.9 Difficulty and Coverage: Writing

As the Ontarian document does not offer as much detail as the English National Curriculum, it is somewhat problematic to come to a conclusion as to how easy/difficult elements of the curriculum are. However, based on the information given, as to when each element is introduced. We judge that the two curricula are broadly similar in their levels of difficulty.

23.10 Order of Teaching and When Taught

The grade system is followed in Ontario. Although, the areas of the curriculum remain constant across the grades, a spiral approach to teaching was not evident. There was very little reference to revising topics. The differences between the grades appeared to be cumulative.

23.11 Integration of Subjects

There were no other links found to other subject areas other than recognising mathematical and scientific vocabulary.

23.12 Differentiation and Tailoring Content to Ability

The Ontarian curriculum does not make explicit reference to pupils with different abilities. This may be because the grade system addresses differentiation to some extent within itself.

23.13 Pedagogy and Time Allocations

No information available.

23.14 Guidance or Compulsion of Teaching Methods

There did not appear to be any guidance or compulsion in this curriculum. This may be reproduced outside of the curriculum document.

24 Literacy Comparison: Singapore

The comparison with Singapore is in two parts, reading and then writing.

24.1 Reading in Singapore and England

The overlap between the curricula of the countries is made hard to gauge by the fact that they are not organised in the same way. Repeated reviews of the documents of all countries indicate that largely the same areas are covered and held important, but that the way this is conveyed to the reader differs. There will be references to Standard English, for example, in all documents but where this is to be found differs and perhaps reflects the degree of importance given to it in the respective countries. Unless it is a very stark difference, then little importance has been assigned to matters of presentation.

24.1.1 Similarities

Like the English curriculum, the Singaporean also defines the curriculum by learning outcomes; for the end of Primary 4, (equivalent of year 5) and the end of primary 6 (equivalent of year 7). Neither curriculum breaks down into year by year outcomes, reflecting the fluid and gradual nature of the development of literacy skills over the years. There is, however, a split in the Singaporean curriculum for the less academic (EM3). Both national curricula distinguish similar areas of content. The English document, for example, separates two main areas: 'knowledge, skills and understanding', from 'breadth of study' (ie distinguishing skill outcomes from materials). This distinction is also reflected in Singapore in the two main domains: 'skills, strategies and attitudes' and 'text types'. Like the English National Curriculum, in Singapore also distinguishes between the language of literary texts and language for information (In England this is called 'Reading for information' and 'non-fiction and non-literary text' in contrast to 'Literature', while in Singapore, the distinction is between 'Language for Information' and 'Language for Literary Response and Expression'.)

(It should be noted that the Literacy strategy, which imposed a meticulous timetable for the teaching of skills, was in operation during the pertinent years).

24.1.2 Differences

The English curriculum is divided very rigidly into Speaking & Listening, Reading and Writing, although there is an occasional reminder to teachers that the three skills should be taught in an integrated fashion. On the national curriculum websites, the information is divided into a skill by skill break down. In Singapore the areas of literacy are integrated. There may be points relating to two or more literacy skills listed together, e.g. 'read and respond …,' 'develop ideas in speech / writing…,' 'listen to / read…' Furthermore, in addition to the literary / non-literary divide outlined above - which is shared with the English NC - there is a separate and dominant 'Language for Social Interaction' component which runs parallel to the literary / non-literary strands. Although much of what is in this strand equates to the Speaking and Listening element of the curriculum in this country, it differs in that it also covers social interaction conducted through the medium of reading and writing.

24.2 Aims and rationale for the curriculum

24.2.1 Philosophy

The philosophy or rationale of the English National Curriculum for England is hard to find. The **Singaporean** view of language is presented in the introduction, as are the underlying principles:

- Language is a system for making meaning
- It is a means of communication and expression
- Language use is determined by purpose, audience, context and culture
- Language has a grammar and linguistic structures and patterns, which can be used to create various discourse forms or text types depending on the linguistic choices to suit purpose, audience, context and culture
- The principles of the syllabus are leaner centeredness, orientation to process, integration of reading, writing and oral communication, everything must be contextualised to demonstrate how purpose, audience, context and culture determine the linguistic outcome, spiral progression, learners' participation and interaction

24.2.2 Aims of the curriculum

- Listen to, read and view with understanding, accuracy and critical appreciation, a wide range of fiction and non-fiction texts from print, non-print and electronic sources.
- Speak, write and make presentations in internationally acceptable English that is grammatical, fluent and appropriate for purpose, audience, context and culture
- Think through, interpret and evaluate fiction and non-fiction texts from print, non-print and electronic sources to analyse how language is used to evoke responses and construct meaning; how information is presented; and different modes of presentation create impact.
- Interact effectively with people from their own or different cultures

24.3 Content

For reading, all the topics in the English curriculum (listed in the table below) are also covered to some degree in Singapore:

Knowledge, skills and understanding	Breadth of study
Reading strategies	Literature
Understanding texts	Non-fiction and non-literary texts
Reading for information	
Literature	
Non-fiction and non-literary texts	
Language Structure and variation	

Because of the nature of the subject, there are few 'topics' in reading and it is hard to imagine any national language curriculum which does not include the same skills and genres of texts to be read that are listed in the English curriculum. What might differ is the content coverage within each and the emphasis given to the aspects within them. Some aspects of the English and Singapore curricula are identical or very similar. For example, there is considerable overlap in their requirements for 'Reading strategies' (i.e. phonemic awareness and phonic knowledge, word recognition and graphic knowledge, knowledge of grammatical structures, contextual understanding). Likewise, reference to skills of skimming and scanning in the 'Reading for information' statement in the English Programmes of Study is exactly matched in Singapore. Similarly, the text types to be covered, though not outlined to the same level of detail, clearly manifest significant areas of commonality.

The precise coverage of each of the reading topics is to be discussed in the next section.

It is interesting to note the difference in language in which the reading documents are written. The opening statement in the Singaporean syllabus includes the words '*positive attitude*', '*enjoy*', '*creatively and imaginatively.*' The English document is not phrased in such terms at all. There is one mention about attitude. This is to be found in the Notes section where it states that '*pupils read enthusiastically a range of materials*'. In the same paragraph, it is clear that the stress is equally on challenge as it is on enjoyment: '*they increase their ability to read challenging and lengthy texts independently.*'

An comprehensive separate section is devoted to grammar in the Singaporean syllabus. This presents a thorough breakdown of grammatical teaching points and provides a rough indication of when they should be taught during the primary curriculum and how often they need to be re-visited during the primary years. This part of the curriculum is clearly written for a country in which English is not the home language of the majority and is being taught as a foreign language to many. The closest English equivalent is to be found in the Primary Strategy for literacy, where there is a term-by-term breakdown of the areas to be covered in 'Grammatical awareness' and 'Sentence construction and punctuation.' Probably to be transferred to a writing section.

24.4 Difficulty and coverage

One of the problems in comparing language curricula across countries is that with the focus on skills, so little of the subject matter consists of concrete comparable content areas. In the absence of the actual texts that children read, it is not possible weigh up the relative level of demand in the two countries. As there are few explicitly comparable aspects of the curriculum, perceptions of the relative levels of difficulty are more impressionistic than measurable. One of the few definite insights arises from the statement in the Singaporean Primary Four (year 5) syllabus that by the time children are aged 9/10 years, they should be able to read common irregular sight words such as: *the, have said*. The curriculum, and more explicitly the Literacy Framework, in this country, would place mastery of this much earlier in a child's life during Key Stage 1.

As a crude measure, the frequency with which some activities are mentioned can be regarded as an indication of their relative importance within the curriculum and there are some activities which seem to receive more attention in Singapore. For example, work which involves inference and deduction and analysis of characters, plots and settings is of a high priority. The English National Curriculum covers these areas in En2 2a and b and En2 4c, while in Singapore the greater emphasis on these areas is reflected by the fact that they are mentioned in 8.1.d; 8.2.d, e; 8.3.c 8.2.a, b, 8.1.a, b; 8.3.a,c and 8.2 b & c & d; 9.2.d. By contrast, areas related to an author's use of language, intention and the ways in which effects are achieved are more emphasized in this country. For example, statement En2 3f, in the English curriculum, *distinguish between fact and opinion [for example, by looking at the purpose of the text, the reliability of information]* can be matched with the Singaporean statement 9.1.d: *evaluate information for exaggeration, eg claims in advertising*. It is clear that exaggeration is much narrower in scope and is only one facet of the British equivalent.

Both curricula refer explicitly to inference. In Singapore it features frequently as part of several statements relating to different activities at the end of both the syllabi for end of Primary 4 (equivalent Y5) and end of Primary 6 (equivalent Y7), eg *infer and draw conclusions about characters*, *infer meaning using contextual clues* etc. In England, it forms a separate focus: *use inference and deduction* and is alluded to in other statements such as: *look for meaning beyond the literal.* Though nothing like this exists in Singapore, one assumes that it draws very much on the same inferential skills that are used for other purposes in Singapore.

The emphases in the two countries clearly lie on different skills. Table 24.1 below provides one indication of how the two countries differ in this respect: there are some aspects of topics that appear to be uncovered in Singapore.

Table 24.1 Components of topics that appear to have no direct counterpart at this Key Stage in the other country.

England		Singapore	
Make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing]	En2 2c	Follow a set of instructions	8.1.e
Recognise the differences between author, narrator and character	En2 4d	Give reasons to support a response / an opinion when reading language for information	9.1.c
Evaluate ideas and themes that broaden perspectives and extend thinking	En2 4e		
Consider poetic forms and their effects	En2 4f		
Identify the use and effect of specialist vocabulary	En2 5a		
Identify words associated with reason, persuasion, argument, explanation, instruction and description	En2 5b		
Understand the structural and organisational features of different types of text [for example, paragraphing, subheadings, links in hypertext]	En2 5e		
Engage with challenging and demanding subject matter	En2 5g		

This table suggests that there is more required of English children than of the children studying in Singapore. The areas that appear to be uncovered in Singapore are those that pertain to authorial technique and purpose and to the close study of the use of vocabulary. There also seems to be no equivalent to the English statements relating to extending children's potential for complex thought (*evaluate ideas and themes that broaden perspectives and extend thinking*). It could be argued that these differences might suggest that the English curriculum is more demanding at this stage.

Table 24.2 'Breadth of study' areas that appear to have no direct counterpart at this Key Stage in the other country.

England	Singapore
• Long-established children's fiction • Texts drawn from a variety of cultures and traditions • Playscripts	• Language for information by end of Y5: general knowledge texts, e.g. instructions, rules of games, lists, e.g. catalogues • Language for information by end of Y7: expositions e.g. debates, instructions e.g. how-to-do kits • Narrative genres by end of Y5: expositions e.g. reviews of books / TV programmes • Narrative genres by end of Y7: expositions e.g. reviews of books / films.

Overall, it would seem that the English child is required to focus more on authorial intent, the author's craft, the effect of linguistic choices, the organisation and structure of the text. While the Singaporean curriculum puts much emphasis on reading the text, responding to it, talking about the characters and the plot, finding and manipulating the information in an expository text, the emphasis in England is much more on the author, the purpose / the effects of the text both at word and sentence and whole text level. To put it crudely, in Singapore the focus is on the text while in England it is on the writer. If one had to compare the difficulty, one would be tempted to say that what children in England are required to do is harder and they are asked to do these things at an earlier age.

24.5 Order of Teaching and when Taught

In both countries, the delivery of the curriculum is 'spiral'. The nature of reading is such that it favours this approach. In the Singaporean syllabus, this is evidenced by the fact that elements of the curriculum that are stipulated for the end of the year 4 phase, reappear in year 6 with a complement of further requirements suitable for older pupils. For example, this development is shown in point in 9.2.b in the Singaporean syllabus for the end of both phases. The table below highlights how the same content area is developed between the phases.

End of primary 4 (equivalent year 5)	End of primary 6 (equivalent year 7)
Organise information: list, sequence, classify information about characters and their actions, events	Organise and summarise information: list, sequence, compare, contrast, classify information about events, characters and their actions

Given, the difference in emphasis and the focus on characters and plot, it is surprising to note that Singapore does not specify the reading of stories until the end of its primary 6 phase (equivalent year 7). At the end of the primary 4 curriculum, the only forms of narrative texts that are listed are: myths and legends and narrative poems. The list in the Singaporean document is only intended to be illustrative and therefore does not preclude the use of stories. However, given the substantial weight given to elements of the story form - in sections 8.2 and 9.2 - it is unexpected that stories, which are such a staple of the English curriculum, do not appear explicitly mentioned until the end of the primary 6 in Singapore. This may be partly explained by the fact that for many Singaporean children, even for those in English medium education, English may not be their mother tongue. While they may be able to tackle myths, legends and narrative poems, they may not develop the stamina to read longer stories until they are older.

24.6 Writing in Singapore and England

The Singaporean curriculum (known as a *syllabus*) comprises of a single document for primary and secondary levels. It is organised differently to the English national curriculum. It focuses on language use, learning outcomes, text types and grammar.

The main difference between the two curricula is that the separation of the reading and writing sections of the curriculum is not as explicit in the Singaporean document as it is in its English counterpart.

Both curricula are structured around learning outcomes. The Singaporean syllabus has learning outcomes for the end of Primary 2, 4 and 6 (P2, P4, P6) which correlates to years 3, 5 and 7 of the English system. This allows for a spiral structure of revisiting subjects. In contrast to the English curriculum, the Singaporean syllabus is 'streamed' into EM1&2 and EM3. EM3 is the curriculum followed by less able pupils in Singapore.

The Singaporean equivalent to, *Knowledge, Skills and Understanding* in the English curriculum appears to be *Skills / Strategies and Attitudes*. *Breadth of study* is encapsulated in the three headings used to further subdivide the Singaporean curriculum - *Language for Information, Language for Literary Response* and *Language for Social Interaction.* The final strand roughly equates to *Speaking and Listening* in the English curriculum but it also includes some elements of textual social interaction.

In the Singaporean document *Grammar* is afforded its own discrete chapter, which is further broken into its component parts with direction as to when these elements should be taught and revisited. This chapter bears more of a resemblance to the National Literacy Strategy (NLS) than the National Curriculum, which only provides end of Key Stage statements about grammar.

Spelling is another area which brings to light differences in approach/structure of the curricula. The Singaporean model provides a *Starter List* of words for (P1-4) which again is more in line with the NLS than the National Curriculum.

24.7 Aims and rationale for the curriculum

The principles which underpin the Singaporean syllabus are outlined in the introduction to the document (p4). They refer to the principles of both learning and teaching. They are as follows:

Learner Centeredness

The learner is at the centre of the learning process. Teaching approaches, lessons and curriculum materials are differentiated according to learners' needs and abilities.

Process Orientation

Language skills are process skills. Teaching and modelling the processes of reading, writing and oral communication are as important as testing the acquisition of these skills.

Integration

The integration of reading, writing and oral communication as well as the integration of language materials and areas of language use in a lesson or context contribute to meaningful learning.

Contextualisation

Language skills, grammatical items and structures are taught and learnt in the context of language use. Contextualisation demonstrates how purpose, audience, context and culture determine the register or appropriateness of speech and writing in both formal and informal situations.

Spiral Progression

Language skills, grammatical items and structures, text types and other language components are taught and revised at increasing levels of difficulty and sophistication.

Interaction

Learners' participation and interaction are important in language learning, and in fostering self confidence and social relationships among pupils from different cultural backgrounds and religions. Such social relationships and interaction, within the context of learning English, will nurture in pupils a sense of their common Singaporean identity.

The aims and rationale for the syllabus are also outlined in the introduction:

Language Use

Pupils need to know how to communicate fluently, appropriately and effectively in internationally acceptable English. They need to understand how the language system works and how language conventions can vary according to purpose, audience, context

and culture, and apply this knowledge in speech and writing in both formal and informal situations.

Language for Information

As speaker, writer, reader, listener and viewer, the learner will access, retrieve, evaluate, apply and present information derived from print, non-print and electronic sources.

Language for Literary Response and Expression

As speaker, writer, reader, listener and viewer, the learner will respond creatively and critically to literary texts, relate them to personal experience, culture and society, and use language creatively to express self and identity.

Language for Social Interaction

As speaker, writer, reader, listener and viewer, the learner will use English effectively, both in its spoken and written form, to establish and maintain positive interpersonal relationships, taking into account purpose, audience, context and culture.

Although the National Curriculum in England does have a section on 'Values and Purposes underpinning the school curriculum' and 'Aims for the school curriculum' (p10) these do not exclusively refer to the subject of English. The closest match to the Singaporean statements can be found on the title page (p42) of the English section of the English National Curriculum which states,

> *English is a vital way of communicating in school, public life and internationally. Literature in English is rich and influential, reflecting the experience of people from many countries and many times.*
>
> *In studying English pupils develop skills in speaking, listening, reading and writing. It enables then to express themselves creatively and imaginatively and to communicate with others effectively. Pupils learn to become enthusiastic and critical readers of stories poetry and drama as well as non-fiction and media texts.*
>
> *The study of English helps pupils understand how language works by looking at its patterns, structures and origins. Using this knowledge pupils can choose and adapt what they say and write in different situations.*

Although there is some overlap here between the philosophies underpinning the curricula, the Singaporean document gives a much clearer picture of the rationale for its syllabus.

24.8 Content

For writing, all the topics in the English curriculum (listed in the table below) are also covered to some extent in Singapore:

Knowledge, skills and understanding	Breadth of study
Composition Planning and Drafting Punctuation Spelling Handwriting and Presentation	A range of: Purposes Readers Forms of writing

The main differences / omissions are to be found in Spelling, Presentation and Purposes of Writing.

Although spelling is covered in the Singaporean syllabus, it seems to come under the Reading umbrella. Unlike its English counterpart, the Singaporean syllabus does not use morphological knowledge as a spelling strategy. It appears to rely on early phonic strategies alongside some 'whole word' teaching. The list of these 'whole words', which are mostly high frequency words, appears on p138 of the syllabus. The National Curriculum for England does not specify such words but they can be found in the NLS.

Presentation is given far more weight in the English National Curriculum which emphasises the need for fluency and joined handwriting. In the Singaporean syllabus the pupils are only expected to use cursive writing by the end of P6. Unlike the English curriculum there is no mention made of using different handwriting for different purposes.

In the English National Curriculum pupils are expected to use writing to help their thinking, investigating, organising and learning (En3 10). This skill is not echoed in its Singaporean counterpart.

The National Curriculum in England contained all the significant areas of the Singaporean writing syllabus. Some things were however, covered to a greater or less degree, as examined in the next section.

24.9 Difficulty and coverage

This section will address the level of difficulty and coverage afforded by the Singaporean syllabus. This comparison will focus on the skills so far discussed, as neither curriculum provides detail of actual content.

Composition

Both countries have similar coverage of this area. However, the curriculum in England seems to place more emphasis on addressing the reader at an earlier stage of teaching.

Planning and Drafting

In both curricula there is some reference to Planning and Drafting. However, the English curriculum goes further than its counterpart in that it requires proofreading, polished final copies and some element of self / peer evaluation.

Punctuation

Punctuation is covered by both curricula. It is mentioned in the Programme of Study for Singapore and elaborated on in the chapter on Grammar. This chapter covers a wider range of punctuation than the English National Curriculum, but a similar amount to the NLS.

Spelling

The teaching of spelling in Singapore is probably the area which differs most significantly to that of England. Spelling strategies appear to be taught under the heading of 'reading' in the first instance. These skills are then transferred to the pupils' writing. For example; at P2 and P4 the syllabus requires pupils to 'Apply knowledge of spelling conventions and strategies to their own writing.' In the English curriculum these skills would be taught concurrently.

At P2 and P4 the Singaporean system uses phonological strategies alongside whole word recognition (which is presented in a separate section 'Starter list for Primary One to Four' p138). Both of these strategies are used in England, alongside more detailed morphological knowledge, which is absent from the Singaporean syllabus. The words which are included in the 'Starter List' are at a much lower level of difficulty than the words which are outlined in the NLS for the equivalent ages.

Handwriting and Presentation

Handwriting and presentation are only touched upon in the Singaporean syllabus. In P2 pupils are expected to write in printed script and by P4 they are expected to write in cursive script. In England pupils are expected to be able to write both in joined and printed script by the end of KS2 and to use different forms of handwriting for different purposes. The English curriculum also places an emphasis on 'fluency and speed'.

Standard English

Aspects of Standard English are explicitly taught in the Programmes of Study in England. For example; how written and standard English varies in degrees of formality and the differences between standard and non-standard usage. It is also important in the Singaporean syllabus, although not explicitly taught in the Programmes of Study it is mentioned in the Aims (p3). Students should be able to:

'speak, write and make presentations in internationally acceptable English* that is grammatical, fluent and appropriate for purpose, audience, context and culture.'

* ‘Internationally acceptable English that is grammatical, fluent and appropriate for purpose, audience, context and culture’ refers to the formal register of English used in different parts of the world, that is, standard English.

Language Structure

Although some elements of Grammar are included in the Programmes of Study, the vast majority of the guidance for this subject is presented in a separate chapter. The chapter is split into *Conventions for Grammar* and *Grammatical Features of Text Types*. It is described as ‘the scope and sequence of the grammatical items and structures that pupils need to learn’. Grammatical items are introduced then revisited and revised at a more sophisticated level (described as a spiral progressive approach). The Singaporean syllabus gives a more comprehensive coverage of different aspects of grammar than the English National Curriculum. However, the NLS covers broadly the same range of aspects. The Singaporean syllabus emphasises that teachers use the ‘appropriate terminology’ (p97) with pupils. This is not made explicit in the National Curriculum for England but is more a feature of the NLS.

Breadth of Study

Both curricula cover writing for a similarly broad range of purposes. The National Curriculum in England is more specific in its emphasis on identifying the reader / audience. The English curriculum, unlike its counterpart, states that pupils should be ‘taught to use writing to help their thinking, investigating, organising and learning.’ (En3 10). This feature of writing is not echoed in the Singaporean syllabus.

24.10 Order of Teaching and when Taught

As already highlighted, the teaching of the various aspects of the Singaporean syllabus is spiral. This approach is set out clearly in its aims and made explicit in the syllabus, particularly with reference to the chapter on Grammar. However, the information given in the Programmes of Study in the English curriculum relates to what has to be taught by the end of a Key Stage and, therefore, does not provide information on the exact timings of when a particular aspect is taught. However, in practice, the delivery of the National Curriculum through the medium of the NLS is also spiral in structure. The year groups for England referred to in Appendix xx (Excel table) are taken from the NLS.

Both curricula appear to be teaching the same concepts over the same span of age ranges.

24.11 Integration of Subjects

The Singaporean syllabus advocates an integrated approach to ‘Literacy’. It states that Literacy acquisition is dependent on the integrated teaching of listening, reading, viewing, speaking and writing, and the engagement of learners because,

What pupils know about, they can talk about; what they can talk about, they will read and write about. (p7)

It is also noted in the introduction to the syllabus that the national initiatives of National Education, Thinking Skills and Information Technology have been incorporated into the syllabus in the areas of Language Use, Learning

Outcomes, Skills and Text Types.

24.12 Differentiation

The Learning Outcomes are the expected attainment targets for pupils at the end of each two year period (P2, P4, P6). This two-year period is designed to give teachers time and flexibility to cater to the different learning needs and abilities of their pupils. There is a parallel syllabus called EM3, which caters for pupils of below average attainment. This appears to cover exactly the same content as the mainstream syllabus with elements introduced at a slower pace and revisited more often. There is no guidance given in the syllabus as to how such pupils are identified or at which stage.

24.13 Pedagogy and Time Allocations

There are no recommendations in the Singaporean document outlining time allocations.

There does not appear to be any element of compulsion in the Singaporean syllabus regarding teaching methods. The introduction to the syllabus states that,

> Teaching approaches, lessons and curriculum materials are differentiated according to learners' needs and abilities. (p4)

However, some guidance is offered,

- Language skills are process skills. Teaching and modelling the processes of reading, writing and oral communication are as important as testing the acquisition of these skills. (p4)

25 Literacy Comparison: Sweden

25.1 Structure

In Sweden there is a ‘curriculum’ which sets out, ‘the fundamental values that are to permeate the school’s activities and the goals and guidelines that are to be applied.’ In addition to these generic guidelines there are also the ‘syllabuses’ which are, ‘binding regulations containing the requirements that the state imposes on education in different subjects’. This study will use the syllabus for Swedish as its frame of reference.

The introduction to the syllabus covers *The Aim of the Subject* and *Its Role in Education.* This focuses on how it fulfils the overarching requirements of the curriculum and how the subject fulfils its different societal and civic needs.

The syllabus is then split up as follows:

Goals to aim for outlines the direction the subject should take in terms of developing pupils' knowledge. It sets out the quality of knowledge which is integral to the subject. These goals form the basis for teachers’ planning but, interestingly do not set any limits to the pupils' acquisition of knowledge.

The section on *The structure and nature of the subject* deals with specific aspects of the subject, as well as what are called ‘essential perspectives’, which provide the basis for teaching in the subject.

Goals to attain defines the minimum knowledge to be attained by all pupils in the fifth (equivalent to Year 7) and ninth year of school. The goals thus set out a basic level of knowledge required in the subject.

The Swedish educational system places great emphasis on an altogether more holistic approach to learning than its English counterpart. In the introduction to the syllabuses, it states:

The division into subjects is a practical way of organising the contents of the education, but the aim is not, however, to create boundaries between them. Co-operation across subjects is necessary in order to make possible the all-round, meaningful development of knowledge in accordance with the fundamental values of the curriculum, its goals and guidelines.

In particular reference to the syllabus for Swedish it points out:

In the subject of Swedish, language and literature are treated as a whole. For this reason, Swedish cannot be divided up into pre-determined parts building on each other in a given sequence.

Therefore, as dictated by the structure of the Swedish syllabus, this comparison will focus on both Reading and Writing.

The syllabuses set out what all pupils should learn. Teachers are given the freedom to choose their own materials and working methods. The syllabuses do not lay down ways of working, organisation or methods. However, they do provide an outline of the qualitative knowledge which teaching should develop. The choice of materials and methods are locally determined. At each school and in each class, the teacher is allowed to interpret the national syllabuses and together with the pupils, 'plan and evaluate teaching on the basis of the pupil's preconditions, experiences, interests and needs.'

This degree of autonomy and respect for teachers' professional judgement is not echoed in England, due to the prescriptive nature of the National Curriculum and the National Literacy Strategy (NLS).

25.2 Aims and rationale for the curriculum

The introduction of the Swedish syllabus sets out the principles underlying both the curriculum and the syllabuses:

Both the curriculum and the syllabuses should serve as the foundation for planning teaching. Fundamental values such as people's inviolability, the freedom and integrity of the individual, the equal value of all people, equality between women and men, and solidarity with the weak and vulnerable, should not only permeate all teaching in each subject, but should also influence the organisation and co-ordination of teaching in different subjects, as well as the choice of working methods.

The aims, in particular reference to the subject of Swedish, echo and develop those stated above. They include:

- Providing experiences in reading, films and the theatre, and also the opportunity to exchange experiences because Language skills are seen to be of great importance for all work in school and the future life and activities of the pupils.
- Developing a sense of personal identity by promoting pupils' ability to speak and write well, and to respect with understanding different ways of expressing oneself in speech and writing.
- Developing the pupils' communicative ability, thinking and creativity.
- Encouraging the exchange of different experiences, views and values. The subject of Swedish aims at strengthening the pupils' identity and their understanding of people from different cultural backgrounds.

25.3 Content

Due to the fact that Swedish teachers are at liberty to devise their own content to meet the aims and goals of the syllabus, it is difficult to make a comprehensive comparison of the Swedish and English curricula. However, despite their very different structures, the areas of learning covered by both countries are broadly similar. The following areas of

learning taken from the Swedish document (Goals to aim for) are also covered in the English National Curriculum.

- Develop their imagination and desire to learn through reading literature, as well as reading on their own for personal enjoyment.
- Develop their imagination and desire to create using language, both individually and in co-operation with others.
- Develop correctness in their spoken and written language, and have the courage, desire and ability to express themselves in many different contexts, and by means of writing acquire an instrument for thinking, learning, communicating and exercising influence.
- Develop their ability to develop texts they have written based on their own critical reflection and advice from others.
- Develop their ability in a dialogue with others to express feelings and thoughts, arising from texts with a variety of purposes, as well as be stimulated into reflecting and evaluating these.
- Develop their ability to read, understand, interpret and experience texts of different kinds and adapt their reading and work on texts to its purpose and character.
- Have the opportunity of understanding cultural diversity through exposure to literature and authors from different times and in different forms from Sweden, the Nordic area and other parts of the world.
- Acquire a knowledge of the Swedish language, its ongoing development, structure, origins and history, as well as develop their understanding of why people write and speak differently.
- By means of their own writing, deepen their insight into basic patterns and grammatical structures in the language, as well as develop their ability to apply the standards of written language in different contexts.
- Gain experience of languages in the neighbouring Nordic countries, as well as an orientation to the Sami language and other minority languages in Sweden,
- Develop their ability to write legibly and use computers as an aid.
- Develop the ability to use different opportunities to obtain information, acquire knowledge of the language and functions of the media, as well as develop their ability to interpret, critically examine, and evaluate different sources and their contents.

The following aims did not have a close counterpart in the English National Curriculum:

- are encouraged to be personally creative and search on their own for meaningful reading, as well as take part in cultural activities,
- acquire an insight into their learning, and reflect over their own development, and learn both on their own and together with others to use their experiences, thinking and language skills to form and maintain their knowledge.

The ‘Goals that pupils should have attained by the end of the fifth year’ (aged 11-12) did have corresponding statements in the English curriculum:

- be able to read with fluency, both aloud and to themselves, and understand events and meaning in books and non-fiction written for children and young persons, and be able to discuss their experiences from reading, as well as reflect over texts.
- be able to produce texts for different purposes as a tool for learning and communication.
- be able to apply the most common rules of the written language and the most common rules of spelling, as well as be able to use dictionaries.

This section also has a fourth bullet point covering ‘Speaking and Listening’.

- be able to orally relate and present something so that the contents are understandable and brought to life.

As the Swedish syllabus is not content based, descriptions of what it does not include are problematic. It may be the case that areas which do not appear to be covered in the syllabus may, in practice, be covered by individual teachers.

Therefore, the following list gives details of areas of the English National Curriculum which do not comfortably fit into the broad descriptions of the Swedish ‘Goals’.

For writing:

- broaden their vocabulary and use it in inventive ways (En3 1b)
- use language and style that are appropriate to the reader (En3 1c)
- use features of layout, presentation and organisation effectively (En3 1e)
- plan - note and develop initial ideas (En3 2a)
- draft - develop ideas from the plan into structured written text (En3 2b)
- revise - change and improve the draft (En3 2c)

- proofread - check the draft for spelling and punctuation errors, omissions and repetitions (En3 2d)
- present - prepare a neat, correct and clear final copy (En3 2e)
- pupils should be taught to use punctuation marks correctly in their writing, including full stops, question and exclamation marks, commas, inverted commas, and apostrophes to mark possession and omission. (En3 3)
- to sound out phonemes (En3 4a)
- the meaning, use and spelling of common prefixes and suffixes (En3 4g)
- the spelling of words with inflectional endings (En3 4h)
- the use of appropriate terminology, including vowel, consonant, homophone and syllable.(En3 4j)
- use different forms of handwriting for different purposes [for example, print for labelling maps or diagrams, a clear, neat hand for finished presented work, a faster script for notes]. (En3 5b)
- how written standard English varies in degrees of formality [for example, differences between a letter to a friend about a school trip and a report for display] (En3 6a)
- word classes and the grammatical functions of words, including nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, articles (En3 7a)
- the features of different types of sentence, including statements, questions and commands, and how to use them [for example, imperatives in commands] (En3 7b(
- the grammar of complex sentences, including clauses, phrases and connectives (En3 7c)
- the purposes and organisational features of paragraphs, and how ideas can be linked. (En3 7d)
- the range of readers for writing should include teachers, the class, other children, adults, the wider community and imagined readers. (En3 11)
- The range of forms of writing should include narratives, poems, playscripts, reports, explanations, opinions, instructions, reviews, commentaries. (En3 12)

For reading, the areas which are not covered by the learning 'Goals' for Sweden are:

- phonemic awareness and phonic knowledge (En2 1a)
- make connections between different parts of a text [for example, how stories begin and end, what has been included and omitted in information writing] (En2 2c)
- can texts to find information (En2 3a)
- skim for gist and overall impression (En2 3b)
- obtain specific information through detailed reading (En2 3c)
- identify how character and setting are created, and how plot, narrative structure and themes are developed (En2 4c)
- consider poetic forms and their effects (En2 4f)
- identify the use and effect of specialist vocabulary (En2 5a)
- identify words associated with reason, persuasion, argument, explanation, instruction and description (En2 5b)
- recognise phrases and sentences that convey a formal, impersonal tone (En2 5c)
- identify links between ideas and sentences in non-chronological writing (En2 5d)
- valuate different formats, layouts and presentational devices [for example, tables, bullet points, icons](En2 5f)
- engage with challenging and demanding subject matter (En2 5g)
- language structure and variation. To read texts with greater accuracy and understanding, pupils should be taught to identify and comment on features of English at word, sentence and text level, using appropriate terminology [for example, how adjectives and adverbs contribute to overall effect, the use of varying sentence length and structure, connections between chapters or sections. (En2 6)

25.4 Difficulty and coverage

Due to the very different structure of the Swedish curricula and the fact that it does not use levels of attainment criteria; it is not possible to properly evaluate whether the syllabus is easier or harder than the English National Curriculum. However, the four goals which should be met by the end of the fifth year in Sweden do not appear to be as challenging as those expected of the same age pupils in the English curriculum. It must be noted, that this judgement is not based on a truly 'like for like' comparison.

25.5 Order of Teaching and when Taught

The Swedish syllabus does not offer a breakdown of when particular topics should be taught. This appears to be left up to the schools themselves. For the same reason, it is not possible to say whether Swedish is taught in a spiral nature or not.

25.6 Integration of Subjects

As discussed in Part 1.1, the Swedish system encourages integration across all subjects. Language and literature are treated as a whole and are not divided up into Reading and Writing.

25.7 Differentiation

The syllabus itself does not make reference to pupils with different abilities. However, the teachers are allowed to tailor the content of the curriculum to individual's needs and interests. There are also 'Special Schools' and 'Compulsory School' for pupils with learning disabilities. Pupils in these schools are entitled to an extra year at school.

25.8 Pedagogy and Time Allocations

The Swedish document provides a minimum number of guaranteed teacher-directed instruction hours for all subjects. Swedish is allocated 1490 hours out of 6665. These are mandatory minimum figures. .

25.9 Guidance or Compulsion of Teaching Methods

The syllabuses are designed to clarify what all pupils should learn but they provide:

'Great scope for teachers and pupils to choose their own materials and working methods. The syllabuses do not lay down ways of working, organisation or methods. On the other hand, they lay down the qualitative knowledge which teaching should develop and thus provide a framework within which the choice of materials and methods are to be locally determined. At each school and in each class, the teacher must interpret the national syllabuses and together with the pupils plan and evaluate teaching on the basis of the pupil's preconditions, experiences, interests and needs.'

The same cannot be said for the English National Curriculum and the National Literacy Strategy.

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