The Challenges of Implementing the New Primary National Curriculum

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Contents

ACME - Advisory Committee on Mathematics Education
http://www.acme-uk.org

NCETM - National Centre for the Excellence of Mathematics Teaching
https://www.ncetm.org.uk

PISA - Program for International Student Assessment
http://www.oecd.org/pisa/

Summary

On 11th September 2013 the coalition government published a new National Curriculum for Primary Schools in England. Although it will not become a statutory requirement to teach it until 2014, schools were advised to start teaching it immediately to lower year groups who will be assessed on it when they are in year 6.

Schools are struggling to cope with this new curriculum. This report attempts to provide insight into the issues they face by exploring the statutory mathematics content for year 2 and contrasting it with the curriculum it replaces and with respected international curricula. The way in which the mathematics curriculum has been created and the support available for schools as they attempt to implement it are also explored.

The evidence presented here gives some insight into the extent to which this curriculum not only fails to achieve the purposes that ministers stated but in fact achieves the opposite of these aims.

It also raises concerns regarding whether this curriculum meets statutory requirements.

The analysis presented here is disturbing and I am aware schools may find it distressing to read. I have therefore concluded this report with some practical suggestions which I hope will stimulate constructive discussion regarding ways forward.

Context for this Curriculum Review

In April 2009 the long awaited Rose Review Primary Curriculum (appendix 1) was published after years of vibrant debate, consultation and research. It was a widely accepted compromise between the previous curriculum and the well evidenced but more radical recommendations of the Cambridge Primary Review. Many primary schools made substantial efforts to implement it rapidly.

One of Michael Gove's first moves as Secretary of State for Education after his appointment in May 2010 was to cancel this reform and insist schools return to the previous curriculum which was the one which had been in place since 1999 (appendix 2).

On 20 January 2011 Michael Gove launched a review of the National Curriculum. His stated purpose for this review was:

> "Our review will examine the best school systems in the world and give us a world-class curriculum that will help teachers, parents and children know what children should learn at what age."[1]

In mathematics it was decided that there would be a clear focus on arithmetic proficiency. This was explained by Nick Gibb MP (Schools Minister) in his speech to the conference of the Advisory Committee for Mathematics Education (ACME) on 10 July 2012 when he restated the aims of the National Curriculum Review as being: [2]

- "First, to close the attainment gap between those from poorer and wealthier backgrounds.
- Second, to ensure our education system can compete with the best in the world.
- And third, to trust the professionalism of teachers and raise the quality of teaching."

The statutory underpinnings of National Curriculum defined in Section 78 of the Education Act 2002 have remained unchanged and are that the National Curriculum must be:

> "a balanced and broadly based curriculum which:
> - promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society; and
> - prepares pupils at the school for the opportunities, responsibilities and experiences of later life." [3]

The new National Curriculum (appendix 3) was published on 11 September 2013 with schools being advised to start teaching it immediately to students in years 3 and 4 because they will face high stakes assessments on it when they are in year 6.

Focus on the Mathematics Curriculum for Year 2

The year 2 mathematics content of the Rose Review Curriculum, the currently outgoing National Curriculum and the new National Curriculum, the equivalent content from the Finnish Curriculum which has been in place since 2000 and the new US Common Core which has been widely consulted and developed with the objective of improving PISA scores are included as appendices to this report.

The issue which stands out at first glance is the very substantial increase in the amount and difficulty of the content to be presented to students in aged 6-7 years (year 2) which is demanded by the new curriculum. Ministers claimed that this curriculum was developed by consideration of the best international examples of curriculums but I have been unable to find any curriculum which expects this amount or level of content to be taught to children in year 2. I have asked extensive questions to those who should have been able to identify a curriculum which could have provided a context for this content existing but have drawn blanks everywhere. It has been suggested by some that this content might have come from the year 2 content of a curriculum for a country where students in year 2 are older than 6-7 years. This has been denied but no alternative explanation has been provided.

The next issue which becomes apparent to those who have studied primary mathematics education is that this curriculum demands that students who are six years old are taught abstract mathematics. It is widely recognised that some students will need to work with concrete and visual mathematics (mathematics studied in real situations or with objects, pictures or diagrams) until they are at least age seven. All the other curricula I can find clearly understand this and either specifically require that students are taught mathematics within concrete or visual contexts until they are seven or are clearly written in ways which allow teachers to use these contexts should they wish to do so. Our new curriculum not only requires that students aged six are taught abstract mathematics, it requires that they are taught to calculate with two digit numbers mentally. Teachers are expected to assume that all children aged six can mentally manipulate numbers using our base ten number system. While many students will cope well with this challenge we know that others will not yet be ready to cope. The statutory requirements of this curriculum mean that teachers are denied the right to modify it to make it appropriate for their students in cases where they know that some or all of their students cannot cope with its demands.

In response to concerns raised about these issues ministers have stated that allowing students to work in concrete and visual contexts to the age of seven will hold back those children who are ready to progress. In fact the opposite is true because when students work in contexts they securely understand, they can access, explore and come to understand mathematics which is beyond that expected of them. When young students are presented only with specific abstract mathematics they are generally limited to coming to understand the content they are presented with.

The Finnish curriculum (appendix 4) provides clear evidence to substantiate this point. Like our outgoing curriculum it has been in place long enough to have been received by 15 year old students taking PISA tests in 2009 and 2012.

PISA Mathematics Results

	Mean Score	% Low Achievers (Below PISA Level 2)	% High Achievers (PISA Level 5 or 6)
Finland 2012 [4]	519	12.3	15.3
UK 2012 [4]	494	21.8	11.8
Finland 2009 [5]	540*	9*	21*
UK 2009 [5]	493*	20*	10*

* results estimated from charts.

The US Common Core (appendix 5) is presented here because it highlights another key problem with our new curriculum. As an experienced analyst of research in mathematics education I recognise immediately that the technical points it makes relate to internationally respected research such that which compares and contrasts the knowledge of US and Chinese primary teachers and that which underpins the curriculum in Singapore.

I know that teachers who take time to analyse the content of the US Common Core will discover interesting, wise and well proven ways to teach which others are keen to discuss with them. I can also clearly see how the visual methods for teaching described in this curriculum are coherently developed across the primary years.

Our new curriculum shows none of these insights. Instead its notes and guidance contain many inconsistent and some incoherent statements such as this one which accompanies the Year 2 mathematics content:

"They count in multiples of three to support their later understanding of a third"

This statement fails to recognise that when children learn to find a third of an amount, many naturally visualise sharing that amount into three equal parts and finding the size of one part. Requiring them to perform this task by counting in threes instead is a substantial challenge even if the contrast between what they naturally want to do and what they are being asked to do is acknowledged.

In conclusion I can find no evidence to suggest that this curriculum delivers on any of its stated or legal objectives and no evidence to suggest that the changes it makes creates a curriculum which is similar to that used in any high achieving country. Reason dictates that it will work against the achievement of its stated objectives even if we do not factor in the time, effort and financial resource schools will need to allocate for its implementation and which they will therefore not be able to direct towards pursuing other beneficial objectives.

While the Rose Review curriculum and many other recent curriculums moved towards giving schools the right to vary the times at which content is taught, this curriculum strictly prescribes content by year. It seems obvious to me that the requirement to teach abstract mathematics which requires confident calculation with base 10 to children aged six in cases where their teachers know they are not ready to cope with this challenge is a clear violation of the statutory requirement that this curriculum must promote the mental development of students.

Witness Statement Regarding the Consultation Process

20 January 2011, the date when the Review of the Primary National Curriculum was formally announced, predated the legal judgement which condemned Michael Gove for his abuse of power due to his failure to consult on education policy issues. [6]

Appearing to be duly chastened Michael Gove then appointed a panel of respected experts to assist consultation on his National Curriculum Review.

The first discussions about the National Curriculum Review which I attended took place at the annual conference for the Advisory Committee on Mathematics Education (ACME) on 15th March 2011. During questions I asked Elizabeth Truss MP (Parliamentary Under Secretary of State for Education and Childcare) to reassure the experts on mathematics education in front of her (of which there were about 200 present) that they would be properly consulted regarding the new curriculum. She refused the opportunity to commit to consultation and instead she chose to express her frustration regarding her perception of the damage which she felt had been done to education due to experts having been consulted in the past.

In April 2011 I attended a consultation on this curriculum with a member of the Expert Panel. Hastily arranged and scheduled for 7:30am, many still attended only to find themselves restricted to an agenda which clearly prevented any relevant discussion. In October 2011 the process of consultation collapsed as the key credible members of the Expert Panel resigned issuing a damning condemnation of the process underway and the content being developed. [7]

The online consultation which was due to be hosted by the National Centre for the Excellence in the Teaching of Mathematics (NCETM) was delayed and then disappeared from their agenda.

At the ACME conference which took place on 10th July 2012 Nick Gibb MP (Schools Minister) held forth on the lofty aspirations for the curriculum which have previously been listed in this report. Instead of presenting any real insight into or understanding of the international evidence regarding Mathematics Curricula he chose to focus on one particular study which linked the attainment of some US students in the long division algorithm (in the equivalent of Year 6) with their later attainment in algebra. I remember the collective sense of horror that this minister was clearly incapable of engaging with the insight that there were underlying factors which lead to high attainment in both tests. He was instead determined to believe that he had identified a simple causal effect and that forcing students to learn the long division algorithm in year 6 will create a great leap forward in progress no matter how it is taught. [8] This disturbing dogma still underpins the new curriculum. The question I have asked about the origins of the year 2 content of this curriculum have lead me back to the DfE, indicating that it could be the case that this content has come from people who have

no knowledge of teaching classes of young children or of the underlying structures of division, but who have nonetheless written a curriculum which they believe will ensure students are ready to study the long division algorithm in year 6.

On February 14th 2013 I attended my second Westminster Education Forum Consultation on the review of the Primary Mathematics Curriculum. The clear conclusion of this consultation was that this curriculum had no rationale or mechanism for implementation. Informal discussion during the breaks focused on how long it would take for it to collapse. A representative of the DfE did make one attempt to define a rationale for the curriculum by stating that it would improve professional freedom, however when I asked him to unpack the logic of the route by which this improvement in professional freedom would be achieved his attempt collapsed and he resorted to suggesting that it may be something to do with 'upside down picnic tables'.[9]

During the various stages of consultation I have read the advice on the mathematics curriculum provided by ACME and from the professional bodies which represent mathematics teachers such as the Association of Teachers of Mathematics. These have been deeply critical but only minor superficial notice has been taken of the concerns they raise. [9]

I have watched the government's strategy of allowing extra periods of consultation which, according to national briefings for education advisors which I have attended, wouldn't lead to any significant revisions (an assertion which proved correct). These 'periods of consultation' seemed to serve only to prevent criticism of the final curriculum by presenting it as being a work in progress until after schools were being instructed to implement it, so that there would be no window during which they could feel it was appropriate to spend energy on publicly criticising it.

The government's response to this situation has been to shift attention to other areas of substantial reform such as assessment and the secondary curriculum. ACME has continued to raise concerns regarding the content which is to be delivered to young children and on 8th August 2013 wrote to Elizabeth Truss MP to express its concerns that its recommendations had been ignored and to suggest that the primary content be rescheduled to be delivered over years 1-7 instead of years 1-6. [11]

Elizabeth Truss replied rejecting their concerns. In her reply she comments on the government's decision to fund the NCETM to run training for Professional Development Leaders and for the creation of a Microsite to support implementation of the New Curriculum.[12] She has clearly failed to notice that delivery of the training she refers to commenced in 2012, nearly a year before this curriculum was finalised on 11 September 2013. This training focused on how to administrate high quality professional development and on sharing and developing resources and training ideas which support the development of arithmetic proficiency, a key stated aim of the curriculum. It did not address and could not have addressed the detail of implementing this curriculum. The NCETM Microsite

presents good resources for mathematics teachers, information on how to implement curricula and some interesting videos of mathematics teaching. Again the provision of any of the analysis schools would actually need to understand what needs to change for them to be compliant with the requirements of this new curriculum is notably absent.[13]

Because this curriculum has not been trialled or developed by people involved in mathematics education there are no mathematics specialists available who know it. Courses that initially appear to be about the implementation of the curriculum have cunning titles like “Working with the New Curriculum” which allow them to focus on good mathematics teaching despite the curriculum. Unsurprisingly publishers also appear to be in complete disarray regarding the provision of materials for this curriculum. It is my perception that many have serious concerns regarding the investments they need to make to create materials for this curriculum, given that in 2010 a curriculum which was had been properly developed and consulted was abolished at no notice during implementation. Many of the people who would ordinarily have been employed in writing materials for a new curriculum are showing little interest in analysing the content of, or writing for this new curriculum. The evidence presented here gives some insight into why this is the case.

It is worth noting the way in which those who can understand, interpret and analyse mathematics curricula have been subjected to attacks by key individuals in government when they have dared to voice reasonable concerns regarding government policy.

It is also worth considering the balance of media coverage between of Michael Gove’s claims about the quality and expected benefits of the new curriculum and the comments experts such as the internationally renowned professor of mathematics education Anne Watson who has been involved in developing this curriculum and whose opinion can be gleaned from a rare Guardian article:

> "Why on earth is a government interfering at this level with the teaching of a subject?" she asks, adding that there appears to have been a "blatant disregard" for what is known about how children learn maths by either ministers, their advisers, or both. [14]

If the same process were applied to teaching children to swim, it might involve ministers watching a class of happy six year olds jumping in at the deep end of a swimming pool without floats or support, being told that those who can do this tend to be better swimmers than their peers at age 12 and therefore deciding to improve swimming standards by legally requiring that all children aged six be taught to jump into the deep end of a swimming pool without help. All criticisms and concerns about this policy would be ignored with those who raised them being labelled ‘enemies of progress’, and teachers and the public would be bombarded with articles and speeches claiming that this policy would give us a world class education system, would close the attainment gap between the rich and the poor and would trust the professionalism of teachers to raise the quality of teaching.

Staying Positive – What Can Schools Do?

1. Be realistic about how much time you allocate to implementing this curriculum and the benefits you expect from that commitment.

2. Do use the new videos from the NCETM website for CPD. They are here: https://www.ncetm.org.uk/resources/40529

3. Put pressure on your unions to challenge the legality of this curriculum and raise awareness regarding its failings.

4. Continue to work on the use of formative assessment and in particular consider using web based tools. Rapid progress is being made in the development of online teaching packages which tailor the experience of each child to match their current attainment and which provide teachers with detailed feedback on progress. The efficiency of these tools opens up curricular time which can be used to focus on high quality whole class teaching.

5. Work to ensure your governors, associated bodies, parents/carers and associates understand the challenges you face regarding the implementation of this curriculum.

6. Continue to value and develop activities which generate students talk time. For great example look at 'Number Talks' videos on YouTube. International research repeatedly demonstrates the great value of high quality student talk.

7. Visit your MP and gain their understanding and support for your predicament. If possible encourage representatives from other schools or others who support your school to visit or lobby them too.

8. Remember that research shows the value of all students engaging in a rich curriculum where mathematics is embedded in real situations and exploits mathematical apparatus. Be aware that some students are likely to be seriously disadvantaged if they are forced to work on abstract mathematics before they are seven and that the numbers who will be affected in this way are likely to be higher where there are language issues or where students have had a relatively restricted breadth of experience.

9. Sign, support and publicise the campaign against this curriculum: http://you.38degrees.org.uk/petitions/re-formulate-the-proposed-new-national-curriculum-primary

10. Do continue to use and develop the use of the visual models which underpin mathematics (e.g. the idea of division being either chunking or sharing fairly, the use of the open number line and the use of base 10 materials) and which help children in a class to communicate their own ideas and to understand each other. These are fundamental to teaching in The Netherlands, Singapore and China, which achieve outstanding PISA results.

Appendix 1: Rose Review Primary National Curriculum: Mathematics (Approx Key Stage 1: age 5-7) [15]

Finalised version:

E1. to estimate the number of objects and count them, recognising conservation of number

E2. to read, write and order numbers to 100 and beyond using a range of representations

E3. to explore and explain patterns , including number sequences in the counting system

E4. to group, match, sort, partition and recombine numbers, developing an understanding of place value

E5. a range of strategies for combining, partitioning, grouping and sharing (including doubling and halving) and increasing and decreasing numbers, to solve practical problems.

E6. to use number bonds to ten to add and subtract mentally whole numbers with one or two significant figures

E7. to represent addition and subtraction as number sentences including finding missing numbers and understanding the equals sign

E8. to use coins of different values and recognise the equivalence of different combinations of coins

E9. to compare and order costs of different items

E10. to compare and order objects and events

E11. to create and use whole number scales to measure

E12. to identify, group, match, sort and compare common shapes using geometric properties

E13. to identify, reproduce and generate geometric patterns including the use of practical resources and ICT

E14. to generate instructions for straight and turning movement

E15. to generate and explore questions that require the collection and analysis of information

E16. to collect, group, match, sort, record and represent information for a purpose and store it using ICT

E17. to interpret and draw conclusions from information they have collected

Appendix 2: Primary National Curriculum 1999 – [16] Mathematics (Key Stage 1: age 5-7)

Blue text is used to highlight student entitlements which are to be removed in 2014.

Using and applying number
Pupils should be taught to:

Problem solving

a. approach problems involving number, and data presented in a variety of forms, in order to identify what they need to do
b. develop flexible approaches to problem solving and look for ways to overcome difficulties
c. make decisions about which operations and problem-solving strategies to use
d. organise and check their work

Communicating

e. use the correct language, symbols and vocabulary associated with number and data
f. communicate in spoken, pictorial and written form, at first using informal language and recording, then mathematical language and symbols

Reasoning

g. present results in an organised way
h. understand a general statement and investigate whether particular cases match it
i. explain their methods and reasoning when solving problems involving number and data.

Numbers and the number system
Pupils should be taught to:

Counting

a. count reliably up to 20 objects at first and recognise that if the objects are rearranged the number stays the same; be familiar with the numbers 11 to 20; gradually extend counting to 100 and beyond

Number patterns and sequences

b. create and describe number patterns; explore and record patterns related to addition and subtraction, and then patterns of multiples of 2, 5 and 10 explaining the patterns and using them to make predictions; recognise sequences, including odd and even numbers to 30 then beyond; recognise the relationship between halving and doubling

The number system

c. read and write numbers to 20 at first and then to 100 or beyond; understand and use the vocabulary of comparing and ordering these numbers; recognise that the position of a digit gives its value and know what each digit represents, including zero as a place-holder; order a set of one and two-digit numbers and position them on a number line and hundred-square; round any two-digit number to the nearest 10.

Calculations

3. Pupils should be taught to:

Number operations and the relationships between them

a. understand addition and use related vocabulary; recognise that addition can be done in any order; understand subtraction as both 'take away' and 'difference' and use the related vocabulary; recognise that subtraction is the inverse of addition; give the subtraction corresponding to an addition and vice versa; use the symbol '=' to represent equality; solve simple missing number problems [for example, 6 = 2 + ?]

b. understand multiplication as repeated addition; understand that halving is the inverse of doubling and find one half and one quarter of shapes and small numbers of objects; begin to understand division as grouping (repeated subtraction); use vocabulary associated with multiplication and division

Mental methods

c. develop rapid recall of number facts: know addition and subtraction facts to 10 and use these to derive facts with totals to 20, know multiplication facts for the x2 and x10 multiplication tables and derive corresponding division facts, know doubles of numbers to 10 and halves of even numbers to 20

d. develop a range of mental methods for finding, from known facts, those that they cannot recall, including adding 10 to any single-digit number, then adding and subtracting a multiple of 10 to or from a two-digit number; develop a variety of methods for adding and subtracting, including making use of the facts that addition can be done in any order and that subtraction is the inverse of addition
e. carry out simple calculations of the form 40 + 30 = ?, 40 + ? = 100, 56 - ? = 10; record calculations in a number sentence, using the symbols +, -, x , ÷ and = correctly [for example, 7 + 2 = 9] .

Solving numerical problems

4. Pupils should be taught to:

a. choose sensible calculation methods to solve whole-number problems (including problems involving money or measures), drawing on their understanding of the operations

b. check that their answers are reasonable and explain their methods or reasoning.

Processing, representing and interpreting data

5. Pupils should be taught to:

a. solve a relevant problem by using simple lists, tables and charts to sort, classify and organise information

b. discuss what they have done and explain their results.

Using and applying shape, space and measures

1. Pupils should be taught to:

Problem solving

a. try different approaches and find ways of overcoming difficulties when solving shape and space problems

b. select and use appropriate mathematical equipment when solving problems involving measures or measurement

c. select and use appropriate equipment and materials when solving shape and space problems

Communicating

d. use the correct language and vocabulary for shape, space and measures

Reasoning

e. recognise simple spatial patterns and relationships and make predictions about them

f. use mathematical communication and explanation skills.

Understanding patterns and properties of shape

2. Pupils should be taught to:

a. describe properties of shapes that they can see or visualise using the related vocabulary

b. observe, handle and describe common 2D and 3- shapes; name and describe the mathematical features of common 2D and 3D shapes, including triangles of various kinds, rectangles including squares, circles, cubes, cuboids, then hexagons, pentagons, cylinders, pyramids, cones and spheres

c. create 2D shapes and 3D shapes

d. recognise reflective symmetry in familiar 2D shapes and patterns.

Understanding properties of position and movement

3. Pupils should be taught to:

a. observe, visualise and describe positions, directions and movements using common words

b. recognise movements in a straight line (translations) and rotations, and combine them in simple ways [for example, give instructions to get to the headteacher's office or for rotating a programmable toy

c. recognise right angles.

Understanding measures

4. Pupils should be taught to:

a. estimate the size of objects and order them by direct comparison using appropriate language; put familiar events in chronological order; compare and measure objects using uniform non-standard units [for example, a straw, wooden cubes], then with a standard unit of length (cm, m), weight (kg), capacity (l) [for example, 'longer or shorter than a metre rule', 'three-and-a-bit litre jugs']; compare the durations of events using a standard unit of time

b. understand angle as a measure of turn using whole turns, half-turns and quarter-turns

c. estimate, measure and weigh objects; choose and use simple measuring instruments, reading and interpreting numbers, and scales to the nearest labelled division.

Knowledge, skills and understanding

1. During the key stage, pupils should be taught the knowledge, skills and understanding through:

a. practical activity, exploration and discussion

b. using mathematical ideas in practical activities, then recording these using objects, pictures, diagrams, words, numbers and symbols
c. using mental images of numbers and their relationships to support the development of mental calculation strategies
d. estimating, drawing and measuring in a range of practical contexts
e. drawing inferences from data in practical activities
f. exploring and using a variety of resources and materials, including ICT
g. activities that encourage them to make connections between number work and other aspects of their work in mathematics.

Appendix 3: 2014 Primary National Curriculum [17]

Mathematics (Year 2: age 6-7)

Purple text is used to highlight points which contain some content which is beyond that in the 1999-2014 curriculum.

Number – number and place value
Statutory requirements
Pupils should be taught to:

- count in steps of 2, 3, and 5 from 0, and in tens from any number, forward and backward
- recognise the place value of each digit in a two-digit number (tens, ones)
- identify, represent and estimate numbers using different representations, including the number line
- compare and order numbers from 0 up to 100; use <, > and = signs
- read and write numbers to at least 100 in numerals and in words
- use place value and number facts to solve problems.

Number – addition and subtraction
Statutory requirements
Pupils should be taught to:

- solve problems with addition and subtraction:
- using concrete objects and pictorial representations, including those involving numbers, quantities and measures
- applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
- a two-digit number and ones
- a two-digit number and tens
- two two-digit numbers
- adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

Number – multiplication and division
Statutory requirements
Pupils should be taught to:

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot
- solve problems involving multiplication and division, using materials, arrays,

repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Number – fractions
Statutory requirements
Pupils should be taught to:
- recognise, find, name and write fractions 1/3, ¼, 2/4 and ¾ of a length, shape, set of objects or quantity
- write simple fractions for example, 1/2 of 6 = 3 and recognise the equivalence of ½ and 2/4

Measurement
Statutory requirements
Pupils should be taught to:
- choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature (°C); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels
- compare and order lengths, mass, volume/capacity and record the results using >, < and =
- recognise and use symbols for pounds (£) and pence (p); combine amounts to make a particular value
- find different combinations of coins that equal the same amounts of money
- solve simple problems in a practical context involving addition and subtraction of money of the same unit, including giving change
- compare and sequence intervals of time
- tell and write the time to five minutes, including quarter past/to the hour and draw the hands on a clock face to show these times
- know the number of minutes in an hour and the number of hours in a day.

Geometry – properties of shapes
Statutory requirements
Pupils should be taught to:
- identify and describe the properties of 2-D shapes, including the number of sides and line symmetry in a vertical line
- identify and describe the properties of 3-D shapes, including the number of edges, vertices and faces
- identify 2-D shapes on the surface of 3-D shapes, [for example, a circle on a cylinder and a triangle on a pyramid]
- compare and sort common 2-D and 3-D shapes and everyday objects.

Geometry – position and direction
Statutory requirements
Pupils should be taught to:
- order and arrange combinations of mathematical objects in patterns and sequences
- use mathematical vocabulary to describe position, direction and movement, including movement in a straight line and distinguishing between rotation as a turn and in terms of right angles for quarter, half and three-quarter turns (clockwise and anti-clockwise).

Statistics

Statutory requirements

Pupils should be taught to:

- interpret and construct simple pictograms, tally charts, block diagrams and simple tables
- ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity
- ask and answer questions about totalling and comparing categorical data.

Appendix 4:
Finland: National Curriculum for Mathematics age 6-7[18]

(Finnish students attend pre-school from the ages of 6-7 – equivalent to our year 2)

Pre-school education shall create and consolidate a foundation for learning mathematics. Children shall be guided to pay attention to mathematical phenomena that can be seen in natural everyday situations.

Children shall have an active role in learning situations.

Natural ways to expand children's understanding of mathematics include inducement mainly by means of play, stories, songs, physical exercise, small tasks, discussions and games and ample use of illustrative examples. Children's positive attitude towards mathematics shall be supported. They should perceive learning mathematics to be an interesting and challenging activity, which is significant and meaningful.

Learning mathematics requires understanding of concepts. Children shall be provided with diverse experiences of the different manifestations of a concept. Carefully considered and consistent teaching methods, aids and language play a central role in the concept formation process. With the aid of classification, comparison and sorting, children will explore and analyse objects, organisms, bodies, figures, materials and phenomena on the basis of shapes, quantities and other properties.

In pre-school education, it is important to develop children's concentration, listening, communication and thinking skills. In terms of the development of mathematical thinking, it is important that children will also learn to observe their own thinking. Children shall be encouraged to talk about what they are thinking or how they were thinking. The role of adults is to build a learning environment, which will support and promote the development of each child's individual mathematical thinking.

Appendix 5:
US Common Core (Year 1: age 6-7) Mathematics[19]

Represent and solve problems involving addition and subtraction.

- CCSS.Math.Content.1.OA.A.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
- CCSS.Math.Content.1.OA.A.2 Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Understand and apply properties of operations and the relationship between addition and subtraction.

- CCSS.Math.Content.1.OA.B.3 Apply properties of operations as strategies to add and subtract. Students need not use formal terms for these properties. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*
- CCSS.Math.Content.1.OA.B.4 Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.*

Add and subtract within 20.

- CCSS.Math.Content.1.OA.C.5 Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
- CCSS.Math.Content.1.OA.C.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Work with addition and subtraction equations.

- CCSS.Math.Content.1.OA.D.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.
- CCSS.Math.Content.1.OA.D.8 Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = _ – 3, 6 + 6 = _.*

Extend the counting sequence.

- CCSS.Math.Content.1.NBT.A.1 Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral.

Understand place value.

- CCSS.Math.Content.1.NBT.B.2 Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:
  - CCSS.Math.Content.1.NBT.B.2a 10 can be thought of as a bundle of ten ones — called a “ten.”
  - CCSS.Math.Content.1.NBT.B.2b The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.
  - CCSS.Math.Content.1.NBT.B.2c The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).
- CCSS.Math.Content.1.NBT.B.3 Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <.

Use place value understanding and properties of operations to add and subtract.

- CCSS.Math.Content.1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.
- CCSS.Math.Content.1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.
- CCSS.Math.Content.1.NBT.C.6 Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Measure lengths indirectly and by iterating length units.

- CCSS.Math.Content.1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.
- CCSS.Math.Content.1.MD.A.2 Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps*.

Tell and write time.

- CCSS.Math.Content.1.MD.B.3 Tell and write time in hours and half-hours using analog and digital clocks.

Represent and interpret data.

- CCSS.Math.Content.1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

Reason with shapes and their attributes.

- CCSS.Math.Content.1.G.A.1 Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.
- CCSS.Math.Content.1.G.A.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.[1]
- CCSS.Math.Content.1.G.A.3 Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.

[1] Students do not need to learn formal names such as “right rectangular prism.”

- **Mathematical Practices**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

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