

Response to the consultation on the Early Years Foundation Stage

The **Children's Mathematics Network** is an international, non-profit-making organization for teachers, practitioners, students, researchers and teacher educators working with children in the birth – 8 year age range. It is a grassroots network, with children and teachers at the heart of it. The Network focuses on children's mathematical graphics and the meanings children make and based on extensive, evidence-based research with children, teachers and families and within the context of homes, nurseries and schools. www.childrens-mathematics.net

This response is submitted on behalf of the members of the Children's Mathematics Network.

Overview of draft document:

We recommend that:

- the curriculum takes a clear child development perspective
 - building on children's own interests and patterns of learning is highlighted
 - young children have highly complex minds is emphasised
 - greater emphasis be given to the role of thinking
 - creativity be woven through the curriculum and not limited to the arts
 - far greater emphasis is given to meaning-making – both within sections on play and throughout the curriculum, highlighting 'multi-modal meaning
 - children's mark-making and drawing are emphasised for their highly significant role in their understanding of many aspects of learning and development
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Overview of Problem Solving, Reasoning and Numeracy

We have focused on the section concerning **Problem Solving, Reasoning and Numeracy** since this area is of particular interest to the members of the CMN. However, we also make reference to other areas of the curriculum where we believe they hold particular relevance for Problem Solving, Reasoning and Numeracy.

We recognize that a concerted effort has been made to develop the document to support recent and current changes within the 0 – 5 year old age range and to meet the needs of infants and children in this age group. We should like to make several observations regarding the draft document:

1. During the birth to 7/8 years children focus on personal meaning-making through explorations with a range of 'multi-modal' explorations **(1)**. They interact with people and explore meanings through different media including talk, piles of things, dens they build, role play, cutting out, junk models and drawings. We would like to see this highlighted in a specific section, highlighting the importance of this for their developing understanding and the way in which meaning-making links all curricula areas.
2. Understanding of different symbol systems such as writing and 'written' mathematics grow from multi-modal play
3. Children's early marks explored through drawing and painting **(2)** are significant for all drawing and writing and 'written' mathematics
4. The 'Communication, Language and Literacy' section of the curriculum emphasises the importance of communicating, making marks and personal writing symbols: we would like to emphasise the need for these aspects to be given greater emphasis to the importance of communicating and developing children's own mathematical graphics.
5. We recommend that in the Creativity section of the curriculum greater emphasis be made that the focus of creativity needs to be much more about processes such as creative thinking, than products. It also needs to give greater emphasis to the fact that creativity is not only linked to the arts.

The introduction to the **Problem Solving, Reasoning and Numeracy** of the curriculum is very limited in comparison the *Communication, Language and Literacy*. We should like to make the following recommendations concerning this area of the curriculum:

Draft document, p. 59

That the description under the heading '*What Problem Solving, Reasoning and Numeracy means for children*' is developed to provide a more detailed account of this curriculum area and include:

- Written mathematics including numerals, mathematical signs, various systems for counting, algebraic symbol systems, writing, diagrams, algorithms and ways of representing data are all symbolic 'tools'. Mathematics as a subject has been described as 'problem solving with symbolic tools **(3)**. Young children's own mathematical graphics **(4)** are an important stage in supporting understanding of this
- Children's own patterns of behaviour (schemas) **(5)** explored through play, support their early understanding of mathematical concepts

That the following bullet point be added to the list beneath the heading 'How settings can effectively implement this Area of Learning and Development':

'... practitioners should give particular attention to:'

- children's earliest marks and their developing mathematical graphics by recognizing, observing and understanding children's representations of their mathematical thinking.

- planning appropriate opportunities and experiences based on their observations of what children show that they already know and understand
- support and extend children's understanding through their knowledge of how young children's early 'written' mathematics develops

Note 1: Kress, 1997 and Pahl, 1999

Note 2: Matthews, 199 and 2003

Note 3: Oers, 2001, p. 63).

Note 4: the term '*children's mathematical graphics*' developed by Worthington & Carruthers, 2003 & Carruthers & Worthington, 2005, (see end of paper for full references).

Note 3: Athey, 1990 and Nutbrown, 1994

In the *Communication Language and Learning* section of the EYFS curriculum there is a separate section on 'writing'. This section needs to make clear that in this phase, the emphasis *Problem Solving, Reasoning and Numeracy* focuses not only on 'practical activities' but also supports the development of children's mathematical graphics as the beginnings of 'written' mathematics. We propose that there is a new, specific section on this important aspect of early development.

Children's Mathematical Graphics (early 'written' mathematics)

Introduction

Practical mathematics (e.g. play with blocks, sand, water and games) provide valuable mathematical experiences, but are not directly related to children's understanding of *written* mathematics. Children learn about 'written' mathematics through using their own marks to explore their thinking (children's mathematical graphics).

What are Children's Mathematical Graphics?

Children's mathematical graphics are the marks and representations children choose to use to represent, explore and communicate their mathematical thinking. These include a range of representations such as early marks, iconic marks, pictures, writing, personal mathematical symbols and standard symbols. These representations help children to solve problems, to develop their reasoning and to gradually understand the 'written' language of mathematics and to develop their numeracy.

How do children's mathematical graphics support their understanding of 'written' mathematics?

- Through using their own mathematical graphics in their own ways, children build on the early understanding they bring to their setting
 - Using their own marks and making their own meanings – shared, discussed and negotiated with their peers and familiar adults enables children to ‘translate’ from their informal, home mathematics to the abstract mathematics of school
 - This helps children to ‘bridge the gap’ and build strong foundations for later development
 - Using their own mathematical graphics helps children to develop their understanding of standard written language of mathematics (i.e. symbols, calculations and all areas of mathematics) at a deep level
 - Children’s mathematical graphics provide strong foundations for later development and for the mathematical they will meet in school
 - **The development of children’s development and understanding of mathematics through their own mathematical graphics as not hierarchical: children do not develop in neat ‘stages’**
 - **Adults should not directly teach children how to represent their mathematical thinking**
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To support children’s mathematical graphics:

Play

Practitioners should:

- Recognize and value the personal meanings children make within their multi-modal play
- Recognize that understanding of symbol systems such as writing and ‘written’ mathematics have their foundations in multi-modal play

Development matters

Practitioners should:

- Understand the relationship between children’s drawings, early writing and their own mathematical graphics
- Understand the importance of children’s spontaneous mathematical graphics explored in their play
- Recognize children’s own mathematical graphics from their earliest marks
- Understand that it is the children’s meanings that they assign to their own mathematical marks that are important
- Collect and annotate children’s own mathematical graphics to build a portfolio: this will help you understand each child’s developing understanding
- Build on the mathematical understanding that children bring to the setting
- Value the range of ways of children choose to represent their mathematical thinking (the *forms*)
- Understand and value the development of mathematical understanding from their earliest marks to later standard, abstract symbols and written mathematics (later in Key Stage 1)
- Recognize that children have individual ‘pathways’ to understanding ‘written’ mathematics

- Understand how children's own mathematical graphics supports their numeracy
- Recognize how children's early understanding develops from their own mathematical graphics to support later understanding of standard, abstract symbols and written mathematics at a deep level
- Discuss examples and children's developing understanding with your team

Effective practice

Practitioners should:

- Create real purposes for children to explore their thinking about all areas of mathematics as they mature, to reason and to solve problems that have real meaning to them
- Build a positive culture in which children develop confidence in using their own marks and mathematical graphics to explore their thinking and mental methods
- Model a range of ways of representing mathematics, appropriate to the children in your setting (to solve problems, to help them reason and develop numeracy)
- Assess children's mathematical graphics from a positive perspective, focusing on what their marks show that they already know and understand
- Recognize the importance of talk and of sustained, shared thinking
- Emphasize children's thinking and meanings through their graphics, rather than pretty pictures

Professional development

Practitioners should:

- Develop understanding of this important aspect of mathematical development through reflection and discussion with colleagues and through professional reading
- Develop and refresh understanding through appropriate Inset and CPD
- Collaborate with colleagues in other settings
- Practitioners may also choose to carry out their own small action research projects within their settings to support their growing understanding of children's mathematical graphics and ways to support children's growing understanding

Inclusion

Practitioners should:

- Recognize that *all* children can succeed in mathematics at their own level by using and exploring their personal ways of representing their own mathematical thinking and mental methods (i.e. whatever the child's particular culture, gender, language, background, ability, strengths or needs)
- Value children's own mathematical graphics and symbols made by children whose first language uses a different alphabet / symbols system (e.g. Arabic, Urdu, Greek, Chinese) and be aware of the ways in which they combine their understanding of their first written language with written mathematical symbols, calculations and other areas of mathematics

Planning and resourcing

Practitioners should:

- Create rich mathematical learning environments (e.g. resources to create dens, for role play, large cardboard boxes, a wide range of junk materials and tools for making things and cutting out, materials and tools for drawing and painting)
- Provide an appropriate range of resources to support children's mathematical graphics, indoors and out (e.g. blank paper of different sizes, whiteboards, surfaces outside and a range of mark-making tools)
- Display a range of numerals, and mathematical texts and pictures including number lines and larger numbers
- Encourage use of I.C.T. (e.g. paint and draw software for PCs, Tablet PC, interactive whiteboards) for children to represent their mathematical thinking
- Display the children's marks and mathematical graphics
- Provide a range of appropriate and real resources (e.g. real coins, analogue and digital clocks, tape measures)

Parents and carers

Practitioners should:

- Recognize the importance of children's home and community cultures in helping shape their attitudes and understanding of mathematics and mark-making
- Support parents and carers in recognizing the value of children's early marks
- Listen to what parents and carers say about their children's early mark-making and mathematical interests at home
- Share information with parents and carers about their children's mark-making and mathematical interests in the setting
- Show parents and carers how children explore mathematical meanings and solve simple problems through their own mathematical graphics

Key references:

Athey, C. (1990) *Extending Thought in Young Children: a Parent-Teacher Partnership*, London: Paul Chapman.

Carruthers, E. and Worthington, M. (2005) 'Making Sense of Mathematical Graphics: the Development of Understanding Written Mathematics', in *European Early Childhood Education Research Journal*, Volume 13, No.1 2005, p. 57 – 79.

Hughes, M. (1986) *Children and Number: Difficulties in Learning Mathematics*. Oxford: Blackwell.

Kress, G. (1997) *Before Writing: Re-thinking the Paths to Literacy*, London: Routledge

Matthews, J. (1999) *The Art of Childhood and Adolescence: The Construction of Meaning*, London: Falmer Press.

Matthews, J. (2003) *Drawing and Painting: Children and Visual Representation*, London: Paul Chapman.

Nutbrown, C. (1994) *Threads of Thinking: Young Children Learning and the Role of Early Education*, London: Paul Chapman.

Oers, B. van. (2001a) 'Educational forms of initiation in mathematical culture', *Educational Studies in Mathematics*, **46**: 59-85,

Pahl, K. (1999) *Transformations: Making Meaning in Nursery Education*, Stoke-on-Trent: Trentham Books

Worthington, M. and Carruthers, E. (2003) *Children's Mathematics, : Making marks, Making Meaning*. London: Paul Chapman. (Second edition, Carruthers and Worthington, 2006)

Note: see second attachment for further details related to children's progression in **Problem Solving, Reasoning and Numeracy**.