

Maulfry Worthington

Creativity meets Mathematics

Creativity and mathematics

Have you wondered, “Can mathematics be creative?” and decided, “well, we do butterfly prints”, or “the children love making patterns!”

We believe children need to go beyond making things - *products* - and develop creative mathematical thinking and problem-solving – or *processes*. You will be helping them build strong foundations for learning mathematics. At the same time your understanding of their development will grow.

Teaching mathematics in the Foundation stage

The EPPE Project (1) found effective pre-school settings put special emphasis on children’s development of mathematics. Focusing on individuals led to ‘better outcomes for children’s mathematical understanding in the longer term’.

Another study found that practitioners were not aware of the ‘rich, informal knowledge’ of mathematics children brought into school. Other researchers found that Reception class children learning ‘low-level numeracy skills’ without meaningful contexts.

Mathematical graphics

Children’s own marks and drawings are powerful ways for them to represent their feelings, experiences and ideas. Writing their own language can cause difficulties but emergent writing has been shown to help children develop understanding.

Mathematics also has a written language with numbers and signs that make it difficult for young children to understand. Exploring meanings through their own mark-making - or *mathematical graphics*, ‘builds on what children already know and can do’ (2). We are not suggesting that children in the nursery sit at tables to do ‘written’ mathematics, but that they begin to explore through their own marks within play.

Research into children’s mathematical graphics

We have carried out research into children’s own mathematical graphics over the past 15 years with children at home, in pre-schools, nursery classes and schools (3). Children’s graphics show their amazing creativity as they explore their mathematical thinking on paper.

Our earlier research showed that colouring in, joining up dots and worksheets actually *prevent* young children from understanding 'written' mathematics. They stop children using their own marks and making personal meanings and tell practitioners little about children's own understanding. This research showed that almost 70% of practitioners in the Foundation stage use worksheets, but children seldom have opportunities to use blank paper for their mathematical marks (3).

Matt's marks

My nephew Matt was just three years old. He was sitting on the kitchen floor surrounded by pens and covering pieces of paper with different marks. Some he said were 'drawings' and others he 'read' as written messages. He gave me this example (figure xxx) and read "I love the number 8". He asked me to draw a heart and said 'I love you!' and pointing to some marks added adding "when someone's being mean to you, you say "don't even think about it".

Matt knows that marks carry meaning that sometimes can represent numbers and sometimes a written message. Heart symbols are often seen on car stickers and he knows it can represent love. Matt is very young and we would not expect him to use standard written numerals or words.



Research on creativity in mathematics

We wanted to understand practitioners' views of creativity in mathematics:

What sort of mathematical things had they seen children do that they thought were 'creative'? What did practitioners know about official guidance on teaching early 'written' mathematics? How did their understanding of children's development – particularly child-initiated play, talk, thinking and mark-making inform their practice?

231 practitioners completed questionnaires. They were from maintained nurseries; voluntary pre-schools; private day nurseries; Reception classes and Reception / Y1 classes. Telephone interviews with 10% of the practitioners helped us explore greater detail.

'Practical mathematics'

- Many practitioners felt that Foundation stage mathematics should only be 'practical', although this is not officially recommended
- Almost 80% listed resources or activities such as role play, patterns or art as 'creative'
- Practitioners saw creativity in mathematics as specific *resources or activities* rather than creative learning *processes*

'Practical mathematics' provides valuable experiences but is not *directly* related to children's understanding of the *written* language of mathematics. Of course activities like this can be creative, but that does not mean for example, that *all* play with sand or *all* painting is creative. It also does not mean that these activities and resources always have much mathematical content.

- Mathematics through self-initiated play, talk and thinking were seen as creative by only 9% of practitioners, although the EPPE project (1) emphasises the importance of these
- Only one practitioner gave an example of a child doing something creative in mathematics. This suggests that practitioners found it difficult to 'see' mathematics when observing children.
- Just 5% referred to children's mathematical mark-making as creative. Children had only occasional opportunities to use their own mathematical marks
- Practitioners said that they did not keep children's own mathematical marks although this would help them understand the children's development

- Almost half of the practitioners were unsure or 'confused' by official guidance for teaching early 'written' mathematics

Practitioners appeared not to see children's own marks as significant for their mathematical understanding. Marks made within child-initiated play were rarely acknowledged. 'Written' mathematics was only seen as important when it was the outcome of an adult-directed activity.

Carl's parking tickets

Four year old Carl had chosen to build a car-park with small wooden bricks. Reaching out to a tray that held paper and pens he made some marks on the paper, saying they were 'parking tickets'. He then cut them out and 'read' "40p, 40p, 50p, 70p, 80p, 90p and placed each in turn on top of a toy car.

Having resources for mark-making nearby extended the possibilities of Carl's play. This helped him think about money and writing numbers.



Catherine's fractions

On her first day at school Catherine talked about her sister who was two and a half years old. She chose to draw a picture of her sister and found her own way of writing '2½'. She wrote the numeral '2' (reversed) and followed it with roughly 'a half' of the numeral '2'. At first it wasn't clear if she understood the fraction of 'a half'.

The next day she used the same idea to show that she was 'four and a half' years old. She had written the numeral '4' and followed it with approximately a half of the numeral '4'.



Louisa's strawberries (see p. 6)

In Reception children continue to explore their mathematical graphics within child-initiated play. They will also begin to think about calculations. This was a teacher-planned activity that gave the children open opportunities to count or add two quantities. Every child in the group chose different ways to explore their thinking

on paper. Louisa was just five years old when she did this.

Each child had two dishes and chose how many strawberries they put in each dish. Louisa decided to draw pictures of the strawberries and also used writing and numerals in her calculation. She read “**2 and four more, altogether 6**”. Using words to stand for the signs ‘+’ and ‘=’ makes real sense to her at this stage. When she had finished exploring her thinking about addition she enjoyed eating the strawberries!



Practical steps

Small changes you make in your setting and practice can support children's mathematical graphics.

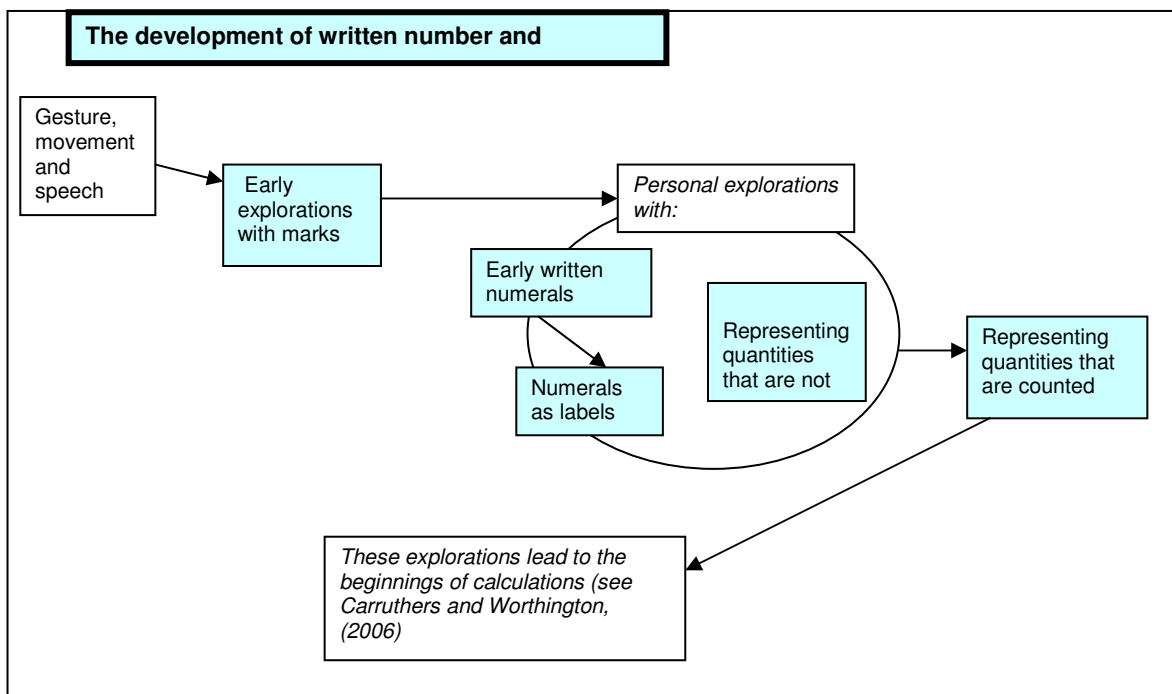
Your learning environment

- 1 Add mark-making materials to all play areas, indoors and out
2. Display numbers at child height, with numbers beyond 100
3. Add mathematical resources to your 'writing area' and develop a 'graphics area'

Understanding and assessing children's mathematical graphics

4. Write numbers and use different ways to represent quantities for real reasons when you are with the children. Talk about what you are doing
5. Plan occasional small group activities so children can use their own mathematical marks and talk about them
6. Jot down what children say about their graphics (young children do not always want to talk about the marks they make)

7. Keep children's mathematical graphics as a record of how their understanding grows. If they want to take them home you can photocopy them for your records
8. Begin to appreciate the breadth of children's mathematical marks
9. Using Table 1 (below) will help you discuss children's mathematical graphics with your team and support your understanding of their development



Official Guidance on teaching early 'written' mathematics

In *Birth to Three Matters* infants and young children are shown as '*competent learners*', '*representing*'; '*responding to the world with marks and symbols*' and as '*skilful communicators*', who '*make and communicate meanings*', (4)

The current Foundation stage document emphasises;

'Asking children to 'put something down on paper' about what they have done or have found out will allow them to choose how to record' (2).

In the revised Foundation document 'mathematics' has been renamed *problem solving, reasoning and numeracy*, highlighting important aspects of learning in this area (5). There are many positive statements in the document but it is unfortunate that the young children's representations are not given stronger emphasis in this section. In *communication, language and literacy*, 'personal writing systems', 'marks children make and the meanings they give to them' and 'marks signs and

symbols' are all highlighted. A very important statement is that children 'ascribe meanings to marks' (5). These statements are also important for *problem solving, reasoning and numeracy*. Communicating and using spoken and written language are key aspects for children's learning about mathematics.

Conclusion

Research has revealed some concerns about mathematics in the Foundation stage. It has also shown how creative children's thinking can be when explored through their marks and representations on paper.

Practitioners are often sensitive to young children's early marks as writing and drawing: now you can begin to nurture their mathematical graphics. You will help children build deep understanding and build strong foundations for the beginnings of calculations. You will also develop your own professional knowledge about your children's mathematical development.

Your children need only blank paper and pens and pencils to begin to explore their mathematical thinking on paper - the rest is up to you!

References

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 2. QCA. (2000) *Curriculum Guidance for the Foundation Phase*. London. QCA.
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