

A Consideration of the way in Images are used in Primary Mathematics Texts

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Abstract

This paper results from a study undertaken in 1998 under the auspices of QCA in UK. The study aimed to make a comparison of representative mathematics text books used in primary schools in 5 different countries – France, Hungary, Singapore, United Kingdom, United States of America. In the analysis particular attention is paid to the way in which images are used within the different cultures to represent mathematical concepts and to scaffold pupil learning

Introduction

Text books play an important role in influencing the ways in which English primary teachers think about teaching and learning mathematics. In this paper we compare primary mathematics text books from England, France, Hungary, Singapore and the USA. We take the view that what appears in a mathematics text book does not appear by chance. It is influenced by the multifaceted aspects of an educational culture. In this way mathematics text books provide a window onto the mathematics education world of a particular country.

Method of Analysis

In analysing primary mathematics text books we have focused on the ways in which mathematics is transformed and presented on the text book page. Our analysis has been framed by a consideration of *the nature of the images with which pupils engage as they read the text, this includes pictures, diagrams and symbols, the ways in which pupils are introduced to links between mathematical concepts and the role of images in this respect, the relative emphasis on mathematical structure, mathematical processes and mathematical objects, and the role of the teacher's guide and the advice which it gives about teaching and learning.*

We have also focused on the images presented on the page using the following categories which are developed from Botsmanova (1972):

- **Objective-illustrative**
 - *Purely decorative and often dominated by colour*
 - *Illustrative of the context but not the mathematics*
 - *Contains some information related to the problem being considered*
- **Object-analytical**
 - *Uses colour as an analytical tool*
 - *Uses diagrams which illustrate the mathematics of the problem under consideration*

• **Abstract spatial diagrams and sketches**

- Here the main characteristic is that the illustrations reflect abstract numerical relationships between the data.

Some concrete examples

Within this paper we will focus our analysis on the first introduction of multiplication in each of the five countries studied. The table below shows the age at which pupils start formal schooling in the countries studied and the years in bold indicate the first real introduction to multiplication.

	<i>France</i>	<i>Hungary</i>	<i>Singapore</i>	<i>U. K.</i>	<i>USA</i>
Age/school year					
4-5 years				R	
5-6 years	GS	K	K	1	K
6-7 years	CP	1	1	2	1
7-8 years	CE1	2	2	3	2

Some of the main points from the texts that were studied are as below:

Singapore

The concepts on which ideas about multiplication and division are built are clearly specified. These are - *equal groupings; arrays; sharing and grouping; wholes and parts*

The images used are intended both to help the pupils visualise the concepts under consideration and scaffold the pupil's developing understanding of both the structure of and the processes within multiplication and division.

Initially the images used are almost entirely of the **object-analytical type**. An illustration is given in figure 1:

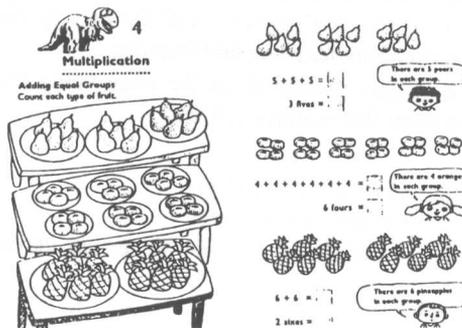


fig.1

The pictures represent the idea of equal groups and the words and the talking heads explain the pictures in terms of the mathematical structure being illustrated. Colour is not used as an analytical tool but is used sparingly in context. Diagrams and pictures are very clearly focused on illustrating the mathematical concepts being advanced. Decorative illustration is minimal – there are small pictures of dinosaurs at the start of each chapter and occasionally there are pictures which illustrate the context within which the concept is being explored. As the ideas are developed in the second year text book more abstract diagrams are used to illustrate/represent word problems. Throughout, the talking heads direct the attention of the reader to the concept that the images are designed to represent and further they help the reader to engage with the language needed to explore the ideas.

Hungary

The concepts on which ideas about multiplication and division are built are clearly specified - *equal groupings and arrays linked to this, sharing and grouping, jumps on a number line, embedding within a context – money or length.*

The images used to explore these concepts are of five kinds – words, pictures (limited use), tables of values, diagrammatic representations (e.g. number lines), symbols. These representations are all linked together right from the start with pictures, words and symbolic representations appearing together.

Initially the images are almost entirely of the **object-analytical** type. There are very few purely decorative images. Virtually all the images were representing mathematical concepts. Words were used to explain the diagrams/pictures, and there were no talking heads. There is a strong emphasis on puzzles and the solving of the puzzles is related to colour representation, with colour being an essential analytical tool - an algebraic approach with colour used instead of letters.

France

An exemplar is in figure 2 below.

Le produit de deux nombres (1)

Date _____

Avec les nombres... à partir d'un nombre donné, réviser le table des nombres de 10 à 100.

1 Des enfants ont assemblé des petits carrés pour faire une mosaïque. Complète le nombre de carrés verts.

$4 + 4 + \dots + \dots + \dots$
ou
 $6 + \dots + \dots$

Cela s'écrit : 6×4 ou 4×6

Écris, avec le signe \times , le nombre :

de carreaux jaunes. _____
de carreaux bleus. _____
de carreaux orange. _____
de carreaux roses. _____

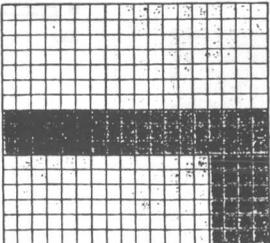


fig. 2

USA

The scheme consists of very large teachers' manuals accompanied by considerably less pupil material. The focus of the scheme is on teacher directed activities with some limited opportunities for practice in workbooks. Figure 4, below, illustrates the major approach taken to the teaching of multiplication. The only image offered to the pupils to accompany the concept of multiplication is that of an array. The main idea developed is that of equal groups – multiples of equal groups for multiplication and sharing into equal groups for division.

The pupil materials are, certainly compared to the English ones, very plain and unornamented. There are few pictures and minimal use of colour. The range of mathematical representations used in the materials is very limited. Few pages are devoted to each lesson, the main emphasis being on whole class and group activities directed by the teacher. Much work is based on discussion and generation of stories to illustrate the ideas.

Multiplication Arrays

- For each problem:
- make an array
 - fill in the number model
 - write the answer

1. The marching band has 3 rows with 5 players in each row. How many players are in the band?



___ x ___ = ___

There are ___ players in the band.

2. The orchard has 4 rows of trees. Each row has 8 trees. How many trees are there?



___ x ___ = ___

There are ___ trees in the orchard.

fig. 4

Conclusions

An important issue with regard to the images and representations in the texts is how much they direct attention towards the mathematics and how much they distract from the mathematics. In the UK texts in particular there seem to be a number of distractions or interferences:

The use of **colour** often has no significance except to brighten up the page. If this is overdone it can become the focus of attention. The use of **pictures** can have the same effect. **Layout** can also be a distraction. If it is too cluttered as it tends to be in the UK texts then again the focus of attention is diverted. It would seem that in some countries more use is made of everyday **resources** such as coins. In the Singapore and Hungary texts an understanding of the coinage system is used to help explain more abstract mathematical concepts such as distributivity. A final distraction seems to me to be a lack of a **clear teaching element** to the UK texts. In the Singapore and

French texts the teaching element was very specific and very clear. It was much more difficult to see in the UK texts.

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