

## Reflections on doing this kind of research

Having completed this project, it is apparent that there are a number of positive and negative aspects to carrying out research in this way.

It is clear that the process can be extremely helpful in focusing professional development on key areas, and research work can raise the profile of a subject within the school.

It was evident that the testing made teachers feel anxious. It also served in some cases to reaffirm their knowledge of mathematics.

*"It was a relief to find out that I knew more about maths than the 'high fliers'."*

*"I was nervous about the test. It was on my mind the night before."*

*"I felt very nervous and sick."*

Although testing is a traditional assessment tool, and movement has generally been towards a more rounded approach that involves an equal amount of on-going assessment, it has proved to be a useful diagnostic tool in this instance. In particular it allowed the school to test and ultimately support "hunches" arising from previous studies within the school.

*"It was worthwhile finding out the gaps in the children's mathematical knowledge and understanding, as highlighted by the tests."*

Year 8 Teacher.

The administration of the test was time-consuming, and it would have been better to have employed appropriate staff to complete the necessary tasks. Post-test work involved a huge amount of marking, for which a volunteer was used. It may have been better to have employed people to do this, but it would have increased the variations in marking, decreasing the reliability of the overall assessment.

All data had to be incorporated into a spread sheet, which was also time-consuming. Again, a volunteer was used. For future research it would be better to use an optical mark reading system with the results transferred automatically to the spreadsheet.

Schools are not set up to handle this amount of data. Further consideration needs to be given to the role and situation of pupils with special needs in these circumstances.

## Further reading

Cockcroft, Dr W. H., *Maths Counts*, HMSO, 1982.

Alexander, Rose and Woodhead, *Curriculum Organisation and Classroom Practice in Primary Schools*, DES, 1992.

Prais, Prof S., "Improving School Mathematics in Practice", in *A review of research and demonstration projects supported by the Gatsby Charitable Foundation*, Gatsby Charitable Foundation, 1995.

Marks, J., "Standards and Arithmetic - How to Correct the Decline", in *Centre for Policy Studies*, 1996.

## Promoting good understanding of number concepts and skills

DAWN WILSON, MEREWAY MIDDLE SCHOOL, NORTHAMPTON

### AIM

*To identify which teaching methods are more effective in promoting good understanding of number concepts and skills for pupils to make significant progress in number at Key Stage 2.*

### SUMMARY OF FINDINGS FOR THIS CASE STUDY

- ★ Pupils' perceptions about teaching strategy do not appear to be a reliable guide to the impact that different teaching strategies have on their understanding.
- ★ Pupils may, therefore, need teachers to be more explicit about what is to be learned and the purpose of various teaching and learning strategies.
- ★ Pupils appear to be good predictors of their own level of mathematical understanding. In particular, there is a close relationship between their confidence and their understanding.
- ★ Teachers may therefore be able to question pupils about their confidence when teaching in order to match work to needs.
- ★ There is a need for pupils to work with much larger numbers than we frequently present to them.
- ★ Even where pupils are able to perform key mathematical operations, they may be unfamiliar with the relevant mathematical language. This may hamper their learning.

### Contact

Dawn Wilson, Mereway Middle School, Mereway, Northampton, NN4 8EJ

Tel: 01604 702620 Fax: 01604 701668

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## Explanation of findings

While working at Mereway Middle School I have taken part in an LEA/Open University project called "The Number Project". The results from this have been published in national and local mathematics education journals. More recently the school has undertaken significant action research to analyse the effectiveness of particular teaching styles across the curriculum. In maths a recent audit focused on the confidence teachers have in using different teaching styles, and how useful pupils find these styles.

As a result of this audit it was also decided that the area of number was underdeveloped. A second audit suggested that the teaching strategies that pupils felt were most useful for their learning were very varied, and this led to the research question for this project.

This study explored the relationships between teachers' and pupils' perceptions of different teaching styles and pupils' understanding. Evidence was collected through a questionnaire which consisted of straightforward tests of understanding of maths in five separate areas; this was completed by pupils and teachers. Mereway School has made a commitment to action research and hopes to use the knowledge gained in this project to aid the future development of the school.

## The effect of pupils' perceptions of teaching strategy on their understanding

There is poor correlation between pupils' perception of the usefulness of a teaching style and the accuracy of their work, which may suggest that they need to be told more explicitly what may be learned from different teaching styles.

Children aware of different teaching styles could ask for the next step – "I think I understand the concept

of percentages, so now I need some practice." Two questions arise:

★ *Is it necessary to make both the learning styles and the content explicit?*

★ *Would children gain more from the work if the teacher made explicit what is to be learnt and how it is to be taught and learnt?*

*"There is no correlation between children's perception of the usefulness of the teaching styles and the accuracy of their work."*

## Average perceptions among pupils of the usefulness of different styles in Years 5, 6 and 7

	Year 5	Year 6	Year 7
Teacher explanation	2.3	2.3	3.1
Group work	3.2	3.3	3.4
Discussion	3.2	3.3	2.6
Practice	3.3	3.2	2.9
Puzzles and problems	2.8	3.0	2.9
Investigations	2.9	3.6	3.6

(1 = helpful, 7 = unhelpful)

The analysis of the data for Year 5 in tests with number operations, different types of numbers, relationships between numbers and recall of number facts and place value shows that there is no correlation between children's perception of the usefulness of the teaching styles and the accuracy of their work. This suggests that an open approach to teaching styles should be maintained in the teaching of number at Key Stage 2.

## Confidence and understanding

Not surprisingly, pupils recognise when they have understood an idea and are, as a consequence, more confident. This means it would be possible for teachers to ask pupils questions about their confidence as part of the process of matching work to ability. It also raises important questions about the impact that a lack of confidence may have upon ability more generally.

Evidence from the tests on different types of numbers suggests that pupils understood negative numbers and had some understanding of percentages. They felt, however, that the questions on decimals, fractions and ratios were too difficult.

## Teachers

The teachers also completed mathematical tests of their knowledge. They had reassuringly higher levels of both understanding and confidence. However, there was a greater gap between the two figures than there was for the pupils. Interestingly, pupils were better able to judge their level of understanding through their confidence than teachers were.

## Pupils' skill in using number concepts

### Place value

Pupils understand place value to hundreds, tens and units. They are less secure beyond the hundreds column. They are able to place digits to create smaller and larger numbers as required. Pupils are less able to use their understanding of place value to perform number operations without the aid of a calculator.

There was evidence of a lack of understanding of concepts arising from our number system, especially base procedures. This finding was supported by evidence from one question, which demonstrated that knowledge of how place value works with number operations up to 1,000 was insecure.

The implication of these findings is that pupils need to experience and practise working with much larger numbers.

## Mathematical language

### Relationships between numbers and recall of number facts

An example of a test which probed mental agility:

Who am I?	
The answers to these questions are the numbers one to ten. Match up the statement with the number by drawing an arrow from the sentence to the number in the list.	
Six less than half of twenty	1
An odd number a quarter of twenty	2
An even number can be divided by three	3
An even number more than six	4
Ten divided by five halved	5
Even number and also a prime number	6
First two digit number	7
Two more than one and two less than five	8
Lucky for some, next prime after five	9
Lucky for some, next prime number after five	10

The results from this test showed an improvement from Year 5 to Year 6. Pupils in Year 5 tend to understand basic language, such as "two more" or "two less", but have more difficulty with "first two digits number" or "prime number". Year 6 pupils

generally have fewer difficulties with these.

There was also evidence of an understanding of relationships in terms of halves and the division by numbers to obtain set remainders.

When focusing on the relationships between numbers multiplied or divided by ten, pupils recognised the addition or removal of zeros. For example, "If you multiply 47 by 10, the answer has a zero on the end, so the answer is 470."

They did not describe the movement of place or the change in the size of the number. This was supported by the results from the place value paper.

### Number properties

Pupils generally understood multiples, and even and odd numbers. Understanding of factors, the meaning of whole numbers, prime numbers, and square and triangle numbers was not as strong. Typical responses were, "I don't know what a factor is," "I didn't know what a prime number was," and "I don't understand what a triangle number means."

This suggests again that although pupils understood the question, they did not have a good grasp of the mathematical language and this directly inhibited their achievements in response to questions about number concepts.

## Method

This investigation took place at Mereway Middle School from May 1996 to January 1997. The specific areas of mathematics in which teachers' and pupils' perceptions about teaching style and pupils' achievements were measured was the connection between teaching methods and pupils' understanding of number at Key Stage 2.

The collected data was used to attempt an analysis of what would help pupils to be more successful at the number concept known as place value. The data gathered from questionnaires taken by pupils and teachers was extensive and was analysed to identify statistically significant correlations.

*"Pupils need to experience and practise working with much larger numbers."*