

# Using and Applying *Mathematics*

at Key Stage 2

A guide to teaching problem solving  
and thinking skills



A NACE/Fulton Publication

Elaine Sellars and Sue Lowndes

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A Guide to Teaching Problem Solving and Thinking Skills

Elaine Sellars and Sue Lowndes

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# Introduction

What are the characteristics of a mathematically able child?

- Abstract thinking
- Logical reasoning
- Application – being able to transfer skills from one area to another
- Independent thinking – being able to see things from a different perspective
- Ability to work independently
- Organisational skills
- Understanding new concepts with ease and being able to use them
- Relatively rapid mastery of mathematical techniques, knowledge and habits
- Good spatial perception
- Mathematical curiosity
- Mathematical memory of a higher order
- Ability to verbalise their thoughts; flexibility of thought; originality of thought
- Ability to find mathematical shortcuts
- Perseverance. Broad attention spans which enable them to concentrate and persevere in problem solving
- Analytical thinking – ability to evaluate, analyse and generalise

This list is not exhaustive but gives a good feel for what we know as teachers makes a child able, before we ever test them to try to prove and quantify that ability.

As teachers, we know that to teach effectively we need to start from where the child is, and then build on their current skills and knowledge. A key problem, however, is that many current teaching practices, which able pupils meet every day in their classrooms, ignore the above list. The nature and structure of the current curriculum means that there is very little time for considering how we might develop the innate abilities that a mathematically able child possesses. Much of what we teach is about content rather than the thinking process.

Look at the list again. Where does it say that an able child is born with an innate ability to 'add together  $\frac{1}{2}$  and  $\frac{1}{3}$ '? It doesn't of course. Yet at the moment we focus almost exclusively on teaching mathematical methods and knowledge rather than on helping children to improve the innate abilities that make them able. How will they reach their potential without good teaching?

Maths is about how our brains work and think. When do we teach children strategies to improve this ability?



Brilliant mathematicians throughout history have had mentors. Where are their mentors in school? Maths is a sociable subject; it is something that mathematicians do together. At a maths conference you see mathematicians doing maths, not just talking about it.

Unfortunately many of the mathematical tasks given to able pupils actually work against the abilities in the list above. For example, how will able children ever build up their stamina and perseverance if they are only ever given tasks which take seconds or at best a few minutes to complete? This is what this book is about.

## **Our philosophy**

- The majority of able children can and should be taught with their peers in order to provide for their social and emotional needs as well as their mathematical needs. This requires tasks that work in mixed ability classrooms. Only a tiny percentage of pupils require a different approach.
- Able children have a right to direct teaching in the same way that all other children do. The teacher role is pivotal in providing the necessary learning environment.
- In the classroom, being able at maths does not equal being quick at maths, i.e. if an able child is working on a task that is appropriate to them they will not necessarily take less time to complete their work than other pupils. In fact it may take them longer. Able children will not always be the first to finish.
- Practical equipment is not just for those who find maths difficult. Plenty of spatial puzzles must be provided for all pupils.
- Able pupils should be given work appropriate to their level and not be made to plough through work that is unnecessary. Also their reward for a piece of work done well should not be another worksheet; more of the same to keep them busy and quiet.
- Able pupils need to be taught strategies to enable their thinking skills to progress. Teachers would not dream of starting a fraction topic off by adding  $\frac{1}{2} + \frac{1}{3}$ ; there would be a great deal of preliminary work before this. Yet, it is quite common to find that there is no progression built in to the teaching of the using and applying part of the curriculum. Teachers and pupils often dive straight in; there is no coherence or progression from task to task and never from year group to year group.
- A sustained piece of work that requires perseverance, logical strategies, refinement of methods and extension of the original task is not the same as a 10/20-minute back-of-the-envelope type problem. Both types of problem solving need to be taught.
- The key to this is teaching. Problem solving has to be taught even though pupils are exploring maths at the same time.
- Relying purely on acceleration to meet the needs of an able child is not the best way to meet those needs. This often stores up problems for the future. There is more maths out there than that which is contained in the numeracy strategy. The numeracy strategy is a good base but an able child requires breadth and depth in their knowledge and understanding. Able pupils often require decelerating not accelerating. They need to be stretched sideways, not pushed on. Just because they can do a piece of content from Year 6 when they are in Year 4 does not mean that it is necessarily appropriate to teach

it then. Maths is a huge jigsaw puzzle. Without some of the pieces, a child may be able to guess what the picture is but they will not see the real beauty of maths. If we only think about accelerating pupils then we deny them that beauty.

The two books in this series, for Key Stage 1 and for Key Stage 2, can each be used with whole classes. They provide a basis for a structured curriculum for the teaching of problem solving. Eventually teachers will supplement these tasks to develop a broad and enriched curriculum.

Each tried and tested investigation is clearly explained, with ideas on how to introduce the task to a class. Full solutions, resource sheets and examples of children's work, where appropriate, are included.

We recommend that you try to work through four to five of the tasks with your class each year. Instead of using the 'spare week' in the timetable to play catch up, try doing this instead.

Successful teaching relies on well planned lessons. You do need to work through the tasks before giving them to your class to work on. Remember that mathematics is a sociable subject; it works best when done in collaboration with others. You could try to get thirty minutes of the weekly staff meeting set aside to work on a task together. It will be much more fun than what you usually do!

We would be very pleased to hear from you if you have any comments or questions on the activities in the books, or if you'd like to share your experiences of using the activities in school. You can contact us by email on [esltrain@btinternet.com](mailto:esltrain@btinternet.com)

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