Bar Model Activity Cards Teacher Notes

Product Code

MA02741
MA02742
MA02743
MA02744
MA02745
MA02746

How do bar models support primary children's problem solving?

Teaching pupils how to solve problems in mathematics is a problem that teachers are continually trying to solve. Learning how to calculate is not actually the main problem. The difficulty is that pupils often do not know which calculation is appropriate – they cannot reason about the relationships between the numbers involved in the problem context. The bar model is a tool to help them do that. Children can talk through a problem and use the bar model to give them something to think with when they are trying to make sense of a new concept. Teachers can question the pupils about the reasons and meanings behind calculations while using the bar model as a point of reference.

What is a bar model?

A bar model is simply an image – a diagram - which clarifies relationships between elements of the problem so that pupils can easily identify what they know, what they don't know and what they need to work out. The bar model doesn't do the calculation – pupils have other tools for that; bar models are the images that support the reasoning and decision-making that enable pupils to utilise their calculation skills. Pupils can begin to understand and construct simple bar models from Key Stage 1 and even Foundation Stage.

The TTS bar modelling kit

Children learn mathematics most effectively when they have opportunities to experience mathematical ideas concretely, using manipulatives, as well as through pictures and diagrams, symbols and words. Dr Amanda Simpson has worked with TTS to develop a manipulative bar-modelling kit for use in classrooms that gives teachers and pupils opportunities to solve problems together, at the same time introducing bar models and developing skills for constructing and interpreting them in order to solve different types of problems – from simple addition and subtraction problems to very challenging fractions and ratio problems. Bar models also develop in pupils, very naturally, an algebraic way of thinking so that progression to work on algebra is far smoother than it has traditionally been.

Developing conceptual understanding

With practise, using concrete and pictorial tools to represent problem situations, pupils learn to identify the element of the situation that needs to be evaluated. At the same time, they actually understand ('see') why it is the answer to the problem. Pupils also, quickly and spontaneously, begin to visualise these models and manipulate them 'in their mind's eye' – at this point they have been internalised as mental tools that equip them for working fluently and with conceptual understanding at all stages of mathematics.

About the Activity Cards

Each set also includes a set of 28 problems, covering a range of difficulty within each year group. presented on A4 cards. Clues and prompts are provided to help support teachers, teaching assistants and pupils and bar model diagrams at varying stages of completion are shown are the reverse of the cards.

Set 2

Set 2		
Card 1	**Two Numbers**	**Part-whole situations; addition subtraction - CHALLENGING**
Card 2	**Katie's Class**	**Part-whole situations; addition; whole unknown**
Card 3	**Seashells**	**Part-whole situations; subtraction; part unknown**
Card 4	**Rory's Birthday Party**	**Part-whole situations; subtraction; 4 parts; part unknown**
Card 5	**Reptiles**	**Part-whole situations; subtraction; 3 parts; part unknown**
Card 6	**London Marathon**	**Part-whole situations; subtraction; part unknown**
Card 7	**Rabbits**	**Part-whole situations; addition; 3 parts; whole unknown**
Card 8	**Sorting Out the Socks**	**Part-whole situations; addition; 4 parts; whole unknown**
Card 9	**Giant Onion Competition**	**Part-whole situations; subtraction; part unknown**
Card 10	**Holiday Packing**	**Part-whole situations; subtraction; part unknown**
Card 11	**Ten Pin Bowling**	**Multiple step problem; Part-whole situations; addition, subtraction; comparison**
Card 12	**Doggie Haircuts**	**Part-whole situations; subtraction; part unknown; money context**
Card 13	**Penguins**	**Part-whole situations; addition; whole unknown**
Card 14	**Butterfly Bush**	**Part-whole situations; subtraction; 3 parts; part unknown**

Card 15	**Biscuits**	**Part-whole situations; subtraction; part unknown**
Card 16	**Horses and Jockeys**	**Part-whole situations; subtraction; part unknown**
Card 17	**Toast**	**2 values – compare to find difference and add to find total**
Card 18	**Car Ferry**	**Part-whole situations; subtraction; 3 parts; part unknown**
Card 19	**Century Forest**	**Part-whole situations; subtraction; 3 parts; part unknown**
Card 20	**Special**	**2 values – compare to find difference and add to find total**
Card 21	**Diggers and Tractors**	**2 values – compare to find difference**
Card 22	**Apple Pies**	**2 values – compare to find difference**
Card 23	**Book Sale**	**2 values – add increment to find total**
Card 24	**Cake Sale**	**Part-whole situations; subtraction; part unknown**
Card 25	**Feeling Peckish**	**2 values – add increment to find total; (also, part-whole)**
Card 26	**Favourite Sport**	**2 values – subtract increment to reveal both values and find totals**
Card 27	**Tom's Fishy Friend's**	**Part-whole situations; subtraction; 4 parts; part unknown**
Card 28	**Spring at the Farm**	**2 values – subtract increment to reveal both values and find totals**

Set 3

Set 3		
Card 1	**Weighing Dogs**	**Part-whole situations; addition/subtraction; part unknown**
Card 2	**Richard's Family**	**Part-whole situations; addition/subtraction; part unknown**
Card 3	**Baking Cookies**	**Part-whole situations; addition/subtraction; part unknown**
Card 4	**Libby's Cookies**	**Part-whole situations; 2-step; addition/subtraction, multiplication/division**
Card 5	**Milly Molly Mandy**	**Part-whole situations; addition/subtraction; part unknown**
Card 6	**Muffins**	**Part-whole situations; 2-step; addition/subtraction, multiplication/division**
Card 7	**Pebbles**	**Comparison situations (addition/subtraction)**
Card 8	**Pansies**	**Comparison situations (addition/subtraction)**
Card 9	**Balls in the Park**	**Comparison situations (addition/subtraction)**
Card 10	**5K Run**	**Comparison situations (addition/subtraction)**
Card 11	**Holiday in Wales**	**Comparison situations (addition/subtraction)**
Card 12	**Boys and Girls in School**	**2 step problem: Comparison situations (addition/subtraction); looking for the relevant multiplication/division)**
Card 13	**Anna went Shopping**	**Comparison situations (before-after) same as part-whole subtraction (part unknown) * *See note below***
Card 14	**Avalon's Shells**	**Change situations fractions context; multiplication/division**
Card 15	**Sharing Crayons**	**Change situations; fractions context; multiplication/division**
Card 16	**Buying Petrol**	**Change; money context; addition/subtraction**

Card 17	**360 Girls**	**Part-whole situations; fraction complements (easy)**
Card 18	**Raffle Tickets**	**Part-whole situations; addition/subtraction; part unknown**
Card 19	**Bella's Doll**	**Part-whole situations; fractions; multiplication/division;**
Card 20	**Lucy and Penny go to the Park Again**	**Change situations; addition/subtraction, multiplication/division**
Card 21	**Driving to Italy**	**Part-whole situations; 3 parts; addition/subtraction; part unknown**
Card 22	**Buying Burgers**	**Part-whole situations; addition/subtraction; money context; part unknown**
Card 23	**Apple Picking**	**Change situations; addition/subtraction, multiplication/division**
Card 24	**Jam Tarts**	**Comparison situations (multiplication/division); proportional reasoning ** *see note below***
Card 25	**Cheetahs and Hurricanes**	**Comparison situations (multiplication/division)**
Card 26	**Watermelons**	**Part-whole situations; divide decimal by decimal**
Card 27	**Great Result for the Hurricanes**	**2 steps - Comparison situations (multiplication/division; addition/subtraction)**
Card 28	**Cinema Tickets**	**Part-whole situations – ratio and proportional reasoning**

There is often more than one way to solve a problem. Problems about 'change**', for example, might be solved by comparison – by considering the 2 values separately, as 2 bars, representing the 'before' on one and the 'after' on the other, and the difference between them. Alternatively, these problems might be considered as a part-whole situation, the 2 values might be represented on one bar with 2 parts, where the 'after' is the whole bar, the before is one part and the second part is therefore the difference between the before and the after. The problem itself will often suggest which of the 2 bar models is the most appropriate. If not, you will find that one is a more helpful image than the other and will learn, with experience, which is likely to be the right one to use. This class of problem will be referred to as 'Change' problems.*

*** In this problem, pupils adjust the segments of the bar during the solution. Without realising it, they are adjusting the denominator. They will now go on to practise this in other problems.*

Set 4

Set 4		*NB – 'additive' refers to thinking linked to addition and/or subtraction; 'multiplicative' refers to thinking linked to multiplication and/or division*
Card 1	**Driving to Scotland**	**Part-whole situations; 3 parts; part unknown**
Card 2	**Pizza Lunch**	**Part-whole situations; money context; part unknown**
Card 3	**Tigers and Cougars**	**Comparison situations (multiplicative)**
Card 4	**At the Allotment**	**Change situations; additive, multiplicative**
Card 5	**Chocolate Brownies**	**Comparison situations (multiplicative); proportional reasoning**
Card 6	**Tigers and Cougars 2**	**Comparison situations (multiplicative; additive)**
Card 7	**Strawberries**	**Part-whole situations; divide decimal by decimal**
Card 8	**Pipers School**	**Part-whole situations; part unknown**
Card 9	**Four Brothers**	**Part-whole situations; 4 parts; money context; part unknown**
Card 10	**Breakfast Cereal**	**Part-whole situations; mass/weight context; part unknown**
Card 11	**Girls Out Shopping**	**Part-whole situations; 5 parts; money context; part unknown**
Card 12	**Fund Raising**	**Part-whole situations; 6 parts; part unknown**
Card 13	**Cinema Outing**	**Comparison situations (additive); part-whole situations**
Card 14	**Lucy and Penny go to the Park Again**	**Change situations; addition/subtraction, multiplication/division** **See note below*
Card 15	**Shells**	**Comparison situations (additive); 3 quantities**
Card 16	**Norah's Tall Family**	**Comparison situations (additive); 3 quantities (height in cm)**
Card 17	**Three Sisters**	**Comparison situations (additive); 3 quantities (age)**

Card 18	**Wildlife Pond**	**Comparison situations (additive; multiplicative)**
Card 19	**Present for Mum**	**Comparison situations (multiplicative)**
Card 20	**Washing Up**	**Comparison situations (multiplicative); proportional reasoning**
Card 21	**Children Who Love Chocolate**	**Comparison situations (additive; multiplicative); proportional reasoning,**
Card 22	**Ice cream**	**Comparison situations (multiplicative); proportional reasoning**
Card 23	**Mandy Went Shopping**	**Part-whole situations; 3 parts; money context; part unknown**
Card 24	**Roland Likes Reading**	**Part-whole situations; multi-step; 5 parts; parts unknown**
Card 25	**Blackcurrant Drink**	**Comparison situations (multiplicative); visualising shifting content; proportional reasoning**
Card 26	**Toy Monsters**	**Comparison situations ` (multiplicative); multiple bars; proportional reasoning**
Card 27	**Population of Neverland**	**Part-whole situations; fractions; part unknown and total unknown; large numbers**
Card 28	**More Watermelons**	**Part-whole situations; divide decimal by decimal; reasoning about efficient thinking**

** There is often more than one way to solve a problem. Problems about '**change**', for example, might be solved by comparison – by considering the 2 values separately, as 2 bars, representing the 'before' on one and the 'after' on the other, and the difference between them. Alternatively, these problems might be considered as a part-whole situation, the 2 values might be represented on one bar with 2 parts, where the 'after' is the whole bar, the before is one part and the second part is therefore the difference between the before and the after. The problem itself will often suggest which of the 2 bar models is the most appropriate. If not, you will find that one is a more helpful image than the other and will learn, with experience, which is likely to be the right one to use. This class of problem will be referred to as 'Change' problems.*

Set 5

Set 5		*NB - 'additive' refers to thinking linked to addition and/or subtraction;* *'multiplicative' refers to thinking linked to multiplication and/or division*
Card 1	**Girls Saving Money**	**Comparison situations (additive); 3 quantities (money)**
Card 2	**Toy Animals**	**Comparison situations (additive); 3 quantities**
Card 3	**Cabbages and Cauliflowers**	**Comparison situations (additive; multiplicative)**
Card 4	**Four Brothers**	**Comparison situations (additive; multiplicative)**
Card 5	**Car Wash**	**Comparison situations (multiplicative-percentage)**
Card 6	**Cookies**	**Part-whole situations; fractions**
Card 7	**Selling Calendars**	**Change situations** * *see note below* **additive; multiplicative; visualising shifting content; proportional reasoning**
Card 8	**Apples and Bananas**	**Part-whole situations; fractions**
Card 9	**Bins along the Footpath**	**Part-whole situations; divide a mixed number by a fraction**
Card 10	**Extending the Footpath**	**Part-whole situations; divide a mixed number by a fraction**
Card 11	**Comparing 3 Prices**	**Comparison situations (additive; multiplicative); 3 quantities (money)**
Card 12	**Cooling Down**	**Comparison situations (additive; multiplicative); 3 quantities (money)**
Card 13	**Alton Towers 1**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning**
Card 14	**Alton Towers 2**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning**
Card 15	**Orange Juice**	**Change situations (additive; multiplicative); visualising** **shifting content; proportional reasoning**

Card 16	**Ladies Football**	**Comparison situations (multiplicative); proportional reasoning**
Card 17	**Gas Bill**	**Change situations (multiplicative- percentage)**
Card 18	**Savings Target 1**	**Change situations (multiplicative; additive - percentage)**
Card 19	**Savings Target 2**	**Change situations (multiplicative; additive - percentage)**
Card 20	**Comparing Fractions**	**Comparison situations; fractions**
Card 21	**Granny Adia**	**Part-whole situations; divide a whole number by a fraction**
Card 22	**Leftover Pizza**	**Part-whole situations; 2 steps; fractions; changing the denominator**
Card 23	**Relay Race**	**Part-whole situations; division in measure context**
Card 24	**Shoplifters Beware!**	**Part-whole situations; divide a mixed number by a fraction – time context**
Card 25	**Sunflower**	**Change situations (additive); measure context; cumulative**
Card 26	**Think it through**	**Comparison situations (additive; multiplicative)**
Card 27	**Chocolate Treats**	**Comparison situations (additive; multiplicative); 3 quantities (mass/weight)**
Card 28	**Party Rings**	**Comparison situations (multiplicative); 3 quantities; scaling**

** There is often more than one way to solve a problem. Problems about '**change**', for example, might be solved by comparison – by considering the 2 values separately, as 2 bars, representing the 'before' on one and the 'after' on the other, and the difference between them. Alternatively, these problems might be considered as a part-whole situation, the 2 values might be represented on one bar with 2 parts, where the 'after' is the whole bar, the before is one part and the second part is therefore the difference between the before and the after. The problem itself will often suggest which of the 2 bar models is the most appropriate. If not, you will find that one is a more helpful image than the other and will learn, with experience, which is likely to be the right one to use. This class of problem will be referred to as 'Change' problems.*

Set 6

Set 6		*NB- 'additive' refers to thinking linked to addition and/or subtraction;* *'multiplicative' refers to thinking linked to multiplication and/or division*
Card 1	**Alton Towers 3**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning**
Card 2	**Apple Juice**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning**
Card 3	**Ladies Football 2**	**Comparison situations (additive; multiplicative); proportional reasoning**
Card 4	**Too Much Pizza**	**Part-whole situations; 2 steps; fractions; changing the denominator**
Card 5	**Pay Rise**	**Change situations (multiplicative - percentage); cumulative**
Card 6	**Sum of Two Numbers**	**Comparison situations (multiplicative); proportional reasoning**
Card 7	**Comparing Fractions 2**	**Comparison situations; fractions**
Card 8	**Pass the Baton**	**Part-whole situations; divide a mixed number by a fraction; measure (km) context**
Card 9	**Museum Security**	**Part-whole situations; divide a mixed number by a fraction – time context**
Card 10	**Think it through 2**	**Comparison situations (additive; multiplicative); money context**
Card 11	**Chocolate Treats 2**	**Comparison situations (additive; multiplicative); 3 quantities (mass/weight)**
Card 12	**Holiday in Greece**	**Comparison situations (additive; multiplicative- percentage); money context**
Card 13	**Mae's Family Get Together**	**Comparison situations (multiplicative- percentage)**
Card 14	**Mary's Family have Cookies**	**Part-whole situations; multiple steps; fractions**
Card 15	**Shopping is Costing More**	**Change situations (multiplicative - percentage); multiple steps**

Card 16	**Heavyweight Hamsters**	**Comparison situations (multiplicative, ratio)**
Card 17	**Samantha is Cutting Back**	**Change situations (multiplicative-percentage) *[*best modelled as a part-whole situation – see note below]***
Card 18	**Mother's Day Gift**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning, ratio**
Card 19	**Grandma's House**	**Comparison situations (multiplicative- ratio)**
Card 20	**Apples and Bananas**	**Part-whole situations; fractions**
Card 21	**Lily Loves Shoes**	**Comparison situations (multiplicative- ratio)**
Card 22	**Rosy Lady**	**Change situations (additive; multiplicative); visualising shifting content; proportional reasoning, ratio - CHALLENGING**
Card 23	**Mrs Lee's School Garden**	**Part-whole situations; fractions**
Card 24	**Mr Chapman's School Garden**	**Part-whole situations; fractions; changing denominator**
Card 25	**Lisa at the Café**	**Part-whole situations; fractions of fractions**
Card 26	**Why does it work?**	**Part-whole situations; fractions of fractions**
Card 27	**Alfie's Rule**	**Part-whole situations; fractions of fractions**
Card 28	**Strawberry Lemonade**	**Change situations (additive; multiplicative, including percentage); measure context (volume) visualising shifting content; proportional reasoning, ratio**

There is often more than one way to solve a problem. Problems about 'change**', for example, might be solved by comparison – by considering the 2 values separately as 2 bars, representing the 'before' on one and the 'after' on the other and the difference between them. Alternatively, these problems might be considered as a part-whole situation, the 2 values might be represented on one bar with 2 parts, where the 'after' is the whole bar, the before is one part and the second part is therefore the difference between the before and the after. The problem itself will often suggest which of the 2 bar models is the most appropriate. If not, you will find that one is a more helpful image than the other and will learn, with experience, which is likely to be the right one to use. This class of problem will be referred to as 'Change' problems.*