

Developing Mastery in Mathematical Fluency

Name: Cathy Woodward

School: Loughton School

DEVELOPING MASTERY IN MATHEMATICAL FLUENCY THROUGH REAL-LIFE PROBLEMS IN YEAR 6

In what way were you planning to develop fluency in Mathematics?

The aim of the project was to develop fluency through real life problems. The purpose of this was to target specific skills which related to real life experiences that the children might face as they get older, both within and outside of the school environment. The premise being to fully understand the problem before breaking it down into more manageable segments in order to solve the problem. This was to help build in small sections for self-checking before reaching the final answer.

Why did you choose this area?

In October my class took the sample Year 6 Mock SATs, and as a class scored highly, but the areas that needed to be developed were based on the reasoning papers -which involved multiple step word problems. This highlighted a need for further development to secure progress as previously word problems had only consisted of no more than 2 steps. This would therefore meet the new government initiatives, where word problems now consist of more than 2 steps. I wanted to give the class the opportunity to apply their knowledge to areas of maths which 'mean' something and have a purpose, rather than just follow a process to reach an answer. Again this linked in well with the multiple step word problems, which relate well to solving real life problems. The pupils needed the opportunity to work with more challenging problems - to recognise and break them down into 'solvable' steps, solving one step at a time to reach the correct answer. They also needed to be able to justify their answers in mathematical terminology, which was also an area identified from September, where students were unable to provide reasonable and accurate explanations for their conclusions.

What did your project involve?

My project involved the planning and delivery of a series of 'real life' multi step word problems, linking to different areas of maths. We completed 3 investigations over a number of lessons with the focus for each being a different area of maths that we had covered. It was about the students linking the concepts and skills taught to real life problems. (See Appendix for investigations)

Investigation 1: The investigation focused on calculating the maximum number of chairs that could be set out in the school hall to provide seating for parents at Maths Evening. The focus was on Area, but also included the following:

- accurate measuring,
- calculate the area of the space,
- multiplying decimals,

- converting units,
- division using decimals,
- understanding of the problem,
- visualisation

Investigation 2: The investigation focused on establishing the cost for a class trip to a theme park. The focus was on Averages, but also included the following:

- accurate measuring,
- adding and subtracting decimals
- multiplying decimals,
- converting units,
- understanding of the problem,
- calculating the mean, median, mode
- reasoning

Investigation 3: This investigation focused on ordering pizza for a large party and establishing the cheapest option from a number of delivery companies. The maths involved within this was:

- multiplication
- addition
- percentages
- reasoning - Understanding the deals available
- applying the deals to the order

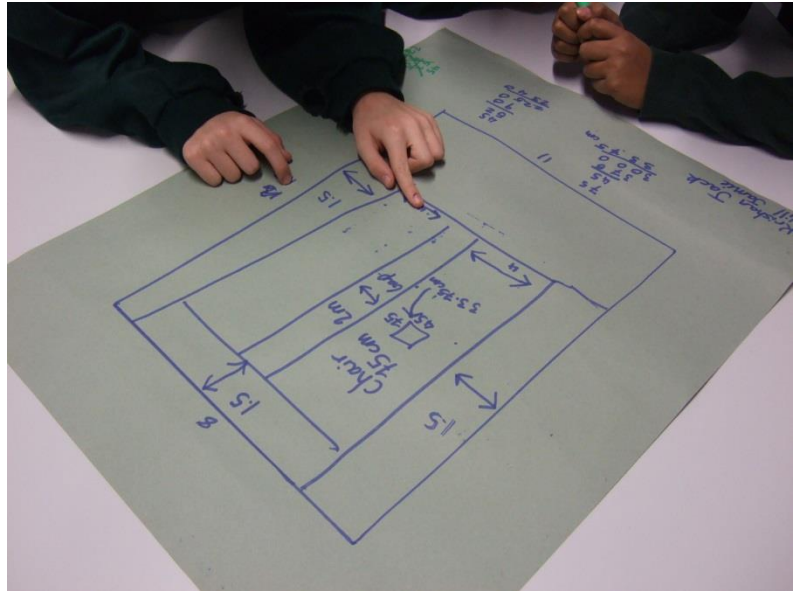
What did you find out throughout carrying out your project?

I found out that the pupils enjoyed being practical and out of their chairs! They liked being able to work within their friendship groups to solve the problems. This alone gave me a good insight into the class; that they were able to work effectively within their groups and stayed focused on the task as it was 'new' and 'fun'. As they were working within their friendship groups, they were more engaged within the activities and this led to some interesting mathematical conversations, as well as some very good cooperation and cohesion.

The pupils were not guided in how to record their findings and this prompted lots of discussion and a variety of presentation methods that best suited the individuals in that group. This allowed them to tailor their answers and understanding to their own strengths, therefore allowing me the opportunity to ask lots of 'open' questions in order to further develop their independent thinking skills. Although the answers were not always the same, the methods were broken down appropriately into the correct steps but the errors were down to accuracy and not the method. This showed that the students were able to break the multi-step word problems effectively but needed to pay more attention to the accuracy of their calculations.

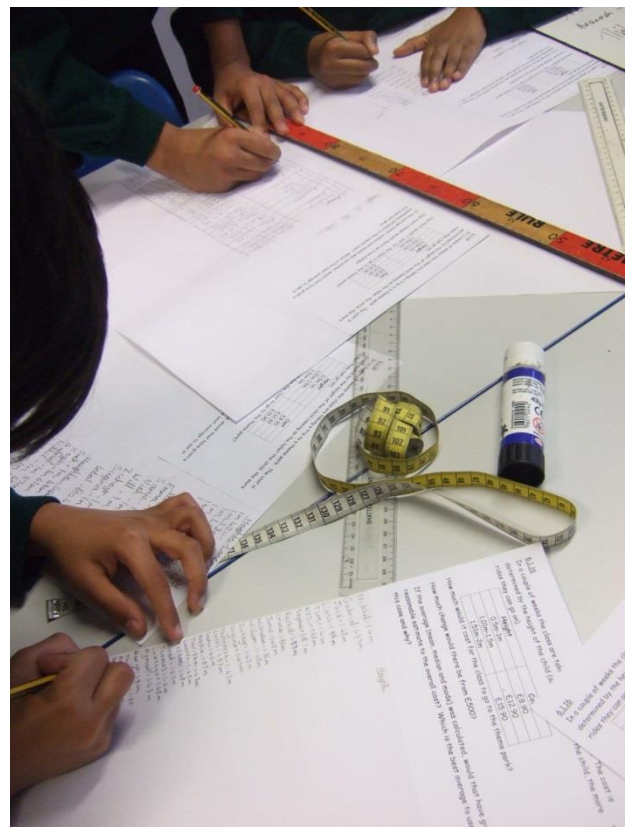
Investigation 1:

- **Choice of equipment** - Groups chose either to use a trundle wheel, metre stick or measuring tape to measure the length and width of the hall in order to calculate the area of the hall. It became clear that problems arose with the measuring - pupils using trundle wheels started with the arrow pointing at the floor and thus, were missing measurements (of the radius of the wheel) at either end of the hall. The class therefore started their calculations using a range of different measurements leading to some discrepancy. This led to lots of discussion about measurements.
- **Area of the chair** - As the seat got narrower the further it was from the floor, lots of groups had detailed discussion about what measurement to take. Many finally agreed that the measurements should be taken using where the legs of the chair met the floor (as this was the widest point).
- **Problem solving** - Groups were able to identify and break down the problems into relevant steps.
- **Common misconception** - Some groups needed redirecting to the question, regarding the amount of legroom that had to be left per chair.



Investigation 2:

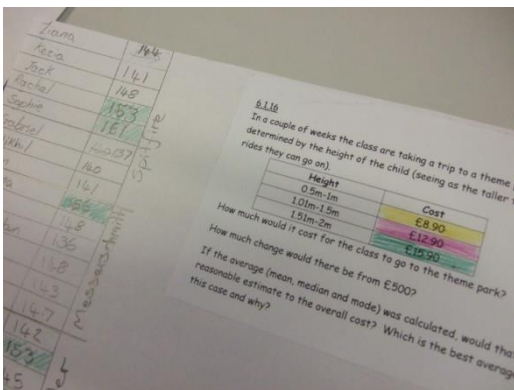
- **Class decision** - The class decided that it would be difficult for each person to measure everyone else's height so they agreed that each table group would measure their heights, record it on a whiteboard and leave it in the middle of their table for everyone else to access. This was a major decision made by the class without teacher input, to speed up the process and to ensure that they all had the same data.
- **Original data recording** - some groups decided to record both the name and height of the person as a form of checking. This was to make sure that they had all of the data for all of the people (31 pupils). They could then check and chase if they had any data missing. Others groups didn't find this as important in the process.
- **Measuring** - All groups opted to use metre sticks. However, it became apparent that they had very



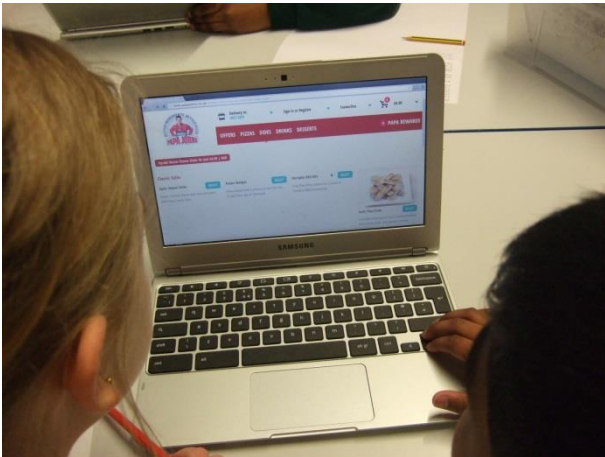
- Holding metre sticks straight - Discussions were had on how we could use the door frames to make sure that we had a straight edge to measure against.
- Children standing next to a metre stick and drawing an imaginary line across - Discussions included the importance and accuracy of standing in front of a metre stick to measure each of their heights.
- Children using a whiteboard to measure across - Many students (especially if they were measuring the height of a pupil taller than themselves) were unintentionally holding the whiteboard at an angle to help read the measurement.
- Some children took their shoes off (to obtain their actual height). However, others measured their heights whilst wearing their shoes (as, if they were to visit the theme park, they would have their shoes on) - This discrepancy led to lots of discussion. The class agreed to measure with their shoes on. This decision came about as a result of one student raising it as a concern and then stopping the class to discuss how to make the result of the investigation fair.

- Some children recorded measurements in a list, while some others recorded the data in their table groups. This was a form of self-checking for errors and was praised.
- Some children colour coded the heights for different price bands. This made it easier for them to calculate how many were to be charged at a certain price. This helped them make it a multiplication task, rather than an addition task, therefore reducing the risk of error and reducing the number of calculations needed.
- One specific child wrote a list of the 31 heights and cost and then attempted to add them together but became confused as to where the decimal point should lay.

➤ The children found it easier to calculate the median and mode rather than the mean, as this required them to reorder/list the data gathered. The mean was the more challenging calculation as there were lots of conversations about whether we were finding the mean cost or the mean height, and this generated lots of discussion about what the mean would actually tell us.



Investigation 3:



Resources

It became evident that the majority of the class had no experience of using the internet to look at websites such as these, and had very little experience of making comparisons. This needs to be a focus for the next term.

Recording data

- Many pairs of students put a lot of effort into the presentation of their work and laid their findings in a grid so that it was easy to compare not only the individual costs of the pizzas purchased in each establishment, but also the total cost for the order. However, no working was shown to demonstrate how they reached the total price. This must also be encouraged over the next term to avoid unnecessary mistakes.
- Alternatively, some students opted to lay the costs of the pizzas out in columns, so they could be easily added using column addition but 'scattered' the establishments around the page so the totals were not so easily comparable.

Investigation 3.18

I am having friends over for dinner. We have agreed that we would like to order some pizza. However, we would like:

- 3 large pepperoni pizzas
- 2 medium vegetarian pizzas
- 2 large Hawaiian pizzas (ham and pineapple) and
- 3 meat feasts

We would also like 2 slices of garlic bread and 2 slices of potato wedges

Where should I order the pizza from - Domino's, Papa John's, Pizza Hut or Pizzeria?

Think about:

- Do they have any offers on?
- Is there a delivery charge?
- How you could present this information

Quantity of the pizza + name	Dom...	Papa...	PizzaH...	Go...
3 large pepperoni pizza!	£33.98	£50.97	£52.47	£38.85
2 medium vegetarian pizza!	£14.99	£28.98	£26.98	£19.90
2 large Hawaiian pizza!	£33.98	£31.98	£30.98	£24.90
3 meat feasts!	£41.97	£37.47	£46.47	£27.85
2 pieces of garlic bread!	£7.98	£7.98	£9.98	£4.00
2 pieces of potato wedges!	£7.98	£7.98	£9.98	£6.90
Total	£115.89	£99.66	£166.80	£124.40
	£125.89	£91.66		£124.40

Investigation 3.18

I am having friends over for dinner. We have agreed that we would like to order some pizza. However, we would like:

- 3 large pepperoni pizzas
- 2 medium vegetarian pizzas
- 2 large Hawaiian pizzas (ham and pineapple) and
- 3 meat feasts

We would also like 2 slices of garlic bread and 2 slices of potato wedges

Where should I order the pizza from - Domino's, Papa John's, Pizza Hut or Pizzeria?

Think about:

- Do they have any offers on?
- Is there a delivery charge?
- How you could present this information

Establishment	3 large pepperoni pizzas	2 medium vegetarian pizzas	2 large Hawaiian pizzas	3 meat feasts	2 slices of garlic bread	2 slices of potato wedges	Total
Domino's	£33.98	£14.99	£33.98	£41.97	£7.98	£7.98	£115.89
Papa John's	£50.97	£28.98	£31.98	£37.47	£7.98	£7.98	£99.66
Pizza Hut	£52.47	£26.98	£30.98	£46.47	£9.98	£9.98	£166.80
Pizzeria	£38.85	£19.90	£24.90	£27.85	£4.00	£6.90	£124.40

There were some pupils who, when recording the cost of 3 large pepperoni pizzas, did not multiply the £16.99 by 3 but wrote it down as a long addition. As they did this for every pizza they therefore ended up adding 14 decimals. This lends itself to unnecessary mistakes.

Some students drew a table to record findings but did not use a ruler and thus the table was curved so it proved difficult to compare the different amounts.

Discussions

Some students had applied a deal that the establishment was offering on the day of the investigations, however others found it 'easier' (regardless of it being more expensive) to add the costs of individual pizzas and not take into consideration any of the available deals.

- Lots of discussion was had regarding which meat feast pizza was 'the best'. Eventually it was agreed that the cheapest meat feast from any given establishment would still achieve the criteria of the investigation.

- Many groups found the total for all four establishments, however, only a select number of groups actually answered the original question 'Where should I order my pizza from?' This must be encouraged; especially regarding the SATs.

What differences did it make to your learners?

- The children enjoyed and were engaged with the variety of different resources that were used throughout the investigations.
- The use of resources increased engagement and enthusiasm - which in turn ensured they had a better understanding of the task.
- They were more willing to ask questions, pose problems to each other and support each other in getting to the answer.
- They were more open to each other's suggestions and ideas, and were beginning to develop a 'growth mind-set'.
- They were willing to try and solve the problem in front of them as they could 'pool' ideas in order to get it right.
- The class are now confident in identifying the different steps that needed to break down a problem in order to solve it.
- They can see how the presentation of their work has an impact on how they reach the correct answer - this relates back to the Haylock and Cockburn Connective model as the images and drawing help them to visualise the work.
- Working in groups has ensured that they are more thorough in their self-checking and they are putting in check points, where they were comparing their answers amongst their group members to look for commonality to avoid errors.

What did you learn yourself?

I have identified certain gaps and misconceptions amongst the class mainly focused on the accuracy of measuring. Even though this was based on a larger scale, it is important that the students develop an attention to detail when completing this in their SATs, and making sure that they do perform self-checks that they have done, during these investigations.

Next steps:

- To refine the investigations to ensure better understanding eg, the use of averages.
- Develop more investigations throughout the year to cover a variety of areas of mathematics.
- Introduce this to Set 2 Maths, working with the class teacher to differentiate the investigations, making them more specific where possible to the needs of her class.
- Possibility to roll this out across Year 6.

Appendix:

Investigation 1

Mrs Bundy is holding a maths evening for parents. She has had an overwhelming response and must now check that the hall is large enough to hold such numbers. She has asked for our help.

These are the criteria she has given us:

- Parents will be sat on chairs.
- The chairs will be set out in horizontal rows.
- Each person will need 30cm leg room.
- There must be a 2m wide aisle down the middle.
- There must be 1.5 m border around the outside of the hall to ensure people arriving late or leaving early are able to get in or out.
- Mrs Bundy will need the front 3metres of the hall left free for her to present and display resources.

What is the maximum number of chairs that Mrs Bundy can set out?

Investigation 2

In a couple of weeks the class are taking a trip to a theme park. The cost is determined by the height of the child (seeing as the taller the child, the more rides they can go on).

Height	Cost
0.5m-1m	£8.90
1.01m-1.5m	£12.90
1.51m-2m	£15.90

How much would it cost for the class to go to the theme park?

How much change would there be from £500?

If the average (mean, median and mode) was calculated, would that have given a reasonable estimate to the overall cost? Which is the best average to use in this case and why?

Investigation 3

I am having friends over for dinner. We have agreed that we would like to order some pizza.

Between us, we would like:

3 large pepperoni pizzas

2 medium vegetarian pizzas

2 large Hawaiian pizzas (ham and pineapple) and

3 meat feasts

We would also like 2 sides of garlic bread and 2 sides of potato wedges

Where should I order the pizza from - Dominoes, Papa Johns, Pizza Hut or Pizzagogo?