11.00 – 11.45
Key Stage 3: Multiplicative Reasoning - TIME Teams

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KS3 Multiplicative Reasoning project

National Centre for Excellence in the Teaching of Mathematics

TRIBAL

Leading education and social research
Institute of Education
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MEI
Innovators in Mathematics Education

Science
National STEM Centre

myscience
Teams of Teachers improving maths education

What happens to teachers professional development and pupils learning when:

- Teachers work together on a key area of maths
- In partnership with local HE
- Using specifically developed lesson materials and professional development activities
- Work locally but coordinated centrally

TIME teams

Maths teaching in the classroom

Research into learning mathematics
The TIME team

Two professional development leads
one university researcher
Two teachers from each of 10 schools

TIME team workshops
Run by the PD leads and researcher

Teachers

• Attend the TIME workshops
• Engage with the lessons and related professional development activities developed for the project.
• Plan for their delivery in school
• Feedback on outcome of the lessons and activities carried out from the previous workshop.
This project:

• Multiplicative reasoning

• One year

• 30 intervention schools - *arranged in three TIME teams*

• External evaluation - *RCT 30 control schools*
6. Rasheed, Kerry and Anthony each buy heating oil at the same price per litre.

Rasheed bought 650 litres of oil for £143.

(a) Kerry bought 500 litres of oil. How much did she pay?

(b) Anthony paid £153. How much oil did he buy?

7. Books

A teacher asked two different classes: "What type of book is your favourite?"

Results from class A (total 30 pupils):

<table>
<thead>
<tr>
<th>Type of book</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Crime</td>
<td>3</td>
</tr>
<tr>
<td>Non-Fiction</td>
<td>12</td>
</tr>
<tr>
<td>Fantasy</td>
<td>4</td>
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</tbody>
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(a) Complete the pie chart to show this information. Show your working and draw your angles accurately.

(b) Zoe is making pink paint to make 30ml:
mix 10 ml of red paint with 20 ml of white paint.

(a) How much white paint does she need to mix with 50 ml of red paint?

(b) How much white paint does she need to make 300 ml of pink paint?
The mathematical focus for teachers and pupils will be:

- Making **connections** in mathematics where the underlining structure is **multiplicative**.

- **Deepening the understanding** of the mathematics related to solving problems where the underlining structure is multiplicative.
How are we going to do this?

*Rationale for the teaching units:*

Pupils making sense of problems

*(proportional problems)*

Supporting pupils to **represent problems** and **justify** approaches and solutions through the use of **appropriate visual images.**

In particular the use of:-

- Bar
- double number line
- ratio tables.
Bar - Double number line - Ratio table.

- 12 minutes
- 2 minutes
- 3 minutes
- 4 minutes
- 5 minutes
- 6 minutes

- 20%
- 40%
- 80%

<table>
<thead>
<tr>
<th>Miles</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
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</table>
# Units and TIME team workshops

<table>
<thead>
<tr>
<th>Unit 0</th>
<th>Formative assessment task</th>
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| **Unit 1** | Reasoning and making sense of fractions  
3 sets of 2 lessons |
| **Unit 2** | Understanding and identifying proportional contexts  
3 sets of 2 lessons |
| **Unit 3** | Application to a range of proportional problems.  
3 sets of 2 lessons |
| **Unit 4** | Review and evaluation activities |

| **Workshop 1** | 2 days |
| **Workshop 2** | 1 day |
| **Workshop 3** | 1 day |
| **Workshop 4** | 1 day |
| **Workshop 5** | 1 day |
Outcomes:

This is primarily a professional development project for teachers based around engaging with and delivering detailed lessons and paying careful attention to pupils.

**Teachers:**
- Subject knowledge
- Subject pedagogy
- Classroom practice
- Professional practice

**Pupils:**
- Understanding
- Problem solving
Professional development

Activities:

1. Active participation in TIME workshops

2. Collaboration between core colleagues and departments

3. Lessons (PD documents centred around lessons)

4. Assessment interviews (core 0 questions and videos to assess conceptual understand and progress)

5. Lesson study

6. Collaboration with university researchers

Evidence generated:

• Workshop observation of impact
• teacher focussed summary feedback forms
• unit what have I learned forms
• Portfolios of pupil work
• Videoed assessment interviews
• Completed Lesson studies forms
• Other Feedback documents
• Forum discussions and feedback on lessons on the TIME websites
Structure of the project delivery

Core development team
3 Developers and
Project Lead

National development team
Core team plus PD leads
and University Researchers

TIME team 1
10 x 2 teachers from
each school

TIME team 2
10 x 2 teachers from
each school

Time team 3
10 x 2 teachers from
each school

Develop resources, plan PD sessions for the NDT and TIME teams, attend some TIME team workshops.

Plan and lead the PD sessions with the TIME teams, liaise with the CDT regarding the effectiveness of resources.

Participate in the project, carry out the project activities in school, discuss work and feedback.
Teacher feedback on lessons and approaches in general

1. ‘Its independent learning’

2. ‘Pupils come up with the questions – they argue, its better learning coming from them’

3. ‘It sort of releases them.’

4. ‘They are more resilient (and we have to be more resilient in sticking with issues)’

5. ‘Different style of teaching - teaching is easier this way’

6. ‘You have to think more about responding to what they come up with, what responses they might make’

7. ‘I could stop the lessons not necessarily having got to the end that was ok the discussion was worthwhile.’
8. ‘Real life contexts powerful’

9. ‘Explanations is key issue - help pupils make links and deepen understanding’

10. ‘Pre- and post task was considered valuable as a formative assessment activity (good Hw task -: writing comments and questions in response to pupils answers then allowing them to return to them at the end of the unit)’

11. ‘I think the lessons are great but I need the ideas, I can’t come up with them myself’
Issues and comments by some teachers:

• Teachers felt they were *holding back* rather than intervening in lessons

• How do I help them without leading them?

• Lessons were throwing up lots of misconceptions but not dealing with them.

• a common situation was a misconception thought correct by majority and minority couldn’t persuade them it was incorrect – *Teacher: what do I do in these circumstances?*
Notes on feedback on pupils misconceptions

• 7% is whole number therefore bigger than 0.7 or 80% bigger as it’s a whole number

• 3/5 was 2 parts away from whole whereas ¾ is only one part away from whole which is why ¾ is bigger.

• Pizza circle created inaccurate representations leading to incorrect arguments

• Pupils could not link the number lines to fractions

• Many pupils didn’t use diagrams to help them but went back to ‘rules’.

• Pupils had many more misconceptions than expected – not sure why - Poor understanding of fractions?
Issues for continued development
*How can lesson design support this?*

1. Anticipating pupil responses and developing prompts and questions to move thinking on.
   - *lesson study – suggestions for focus*
   - *Identifying misconceptions and possible prompts activity (use as ongoing sheet for unit in sow)*

2. Developing key subject knowledge insights
   - Individual lesson related subject knowledge questions

3. Developing appropriate pedagogy for this subject area
   - What have I learned sheets on unit feedback
Three friends share a taxi.

The taxi driver says the total fare will be £20

- Annie is dropped off first after 6 km
- Barry next after 10 km
- then Carol after 16 km.

How much should each person pay for it to be fair?