The impact of a pre-teaching intervention in mathematics

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Background – before pre-teaching

- As a school, we did ‘re-teaching’ interventions. These were reactive, following the lesson where the child has already struggled.
- The same children took part in these interventions each day and it resulted in them missing out on other curriculum subjects.
- Children were bored and felt like they ‘couldn’t do’ maths.
- The gap was not closing and something needed to change.
- My school setting had the ‘stereotypical’ trend of boys enjoying maths and succeeding in maths more than girls.
- I was placed in a Year 6 class which had a significant proportion of middle-attaining girls who lacked confidence in maths.

Overview

- This research examined the impact of a pre-teaching intervention on middle-attaining Year 6 girls' confidence in mathematics.
- A small sample of eight Year 6 girls participated in the research.
- They took part in a pre-teaching session for around 10 minutes during registration each morning.

Pre-teaching research

- Children can feel more positive about intervention prior to the lesson and, therefore, it can boost their confidence and self-concept (Polak, 2017; Trundley, 2017; Earle and Rickard, 2017; Munk et al, 2010; Lalley and Miller, 2006).
- Pre-teaching prevents/minimises experiences of 'failure' in the lesson, where as re-teaching occurs after the difficult experience in the classroom (Lalley and Miller, 2006).
- When schools intervene after a lesson, the child has already struggled and may have negative feelings towards re-visiting work they have already found challenging (Polak, 2017).
- Pre-teaching is more effective than re-teaching as it can transform the way a child sees themselves (Minkel, 2015).

Pre-teaching research

- I ran each pre-teaching session. There is research which suggests the benefits of this:
  - Less time is required to 'hand over' the intervention to another member of staff and time for feeding back information from the intervention group is not required.
  - It enables you, as a teacher, to adapt the upcoming lesson based on children's responses during the pre-teaching session.
  - Children value having the quality time with the class teacher. It did not feel like a 'punishment'.

(Trundley et al, 2017; Watt and Therrien, 2016; Trundley et al, 2016)

Let’s think...

- Imagine something that you are terrible at...

- For a handful of children in any classroom, this can be a daily experience.
- Unlike us adults, children who feel like this don’t have the opportunity to just avoid maths!

A scenario

(Adapted from Minkel, J. 2015)

- Manuel is the only Year 1 child in the class who still doesn't know how much a pound is worth. The coins look pretty much the same to him.
- Here's what intervention looks like for Manuel:
- After the maths lesson, I meet with Manuel one-on-one for about 20 minutes to talk him through the values of each coin once again.
- Worst case: he still doesn't get it. Best case: he finally understands what the other children mastered days ago. Either way, he knows he's not very good at maths. Nothing I can say will convince him otherwise.

A scenario

(Adapted from Minkel, J. 2015)

By contrast, let's look at an example of the pre-teaching approach:

- The intervention itself looks pretty much the same. I spend 20 minutes with Manuel outside of class, walking him through the values of the coins but in this case the other children haven't had the lesson yet.
- I tell him what we'll be doing in our money lesson later that day and give him a "preview" of the lesson before any other children get to see it.
- Fast forward to the money lesson. To the surprise of his classmates and Manuel himself, he's ahead of the curve for once. He knows some of the answers before the other children do. He is one of the first students to finish the game we play with the coins. I ask him to help Will, the top maths student in the class, who is usually the one to help Manuel.

Analysis

- For the same 20-minute investment of time, we can change the way a child sees himself as a mathematician.
- We can give Manuel the rare experience of being the child who gets it first, who helps the other children figure it out, who is ready with the answer the moment he hears the question.

Data collection

1) The children completed initial questionnaires and interviews to gather their perspectives on maths.
2) The children completed an ‘initial test’ in all areas of mathematics to enable any progress to be measured.
3) Teacher case-study style initial comments were gathered.
4) The pre-teaching sessions began.
5) At the end of the term, children completed end-point questionnaires to gather data which could be compared to their initial responses.
6) The children completed an ‘end-point test’. The questions remained similar, with numbers being substituted, in order for the results to be comparable.
7) Teacher case-study style comments were gathered to reflect on children’s initial characteristics and their current characteristics in lessons.

How the staff feel

- Pre-teaching allows different children to ‘shine’ in a lesson.
- The children demonstrate a greater confidence in maths:
  - Hands up
  - Confident explanations of thinking
  - More independent work
  - Children accessing more challenging work
  - Children supporting their peers
- Children have a better chance of achieving the outcomes of the lesson.
- Misconceptions can be addressed easily.
- Questioning can be adapted.

How the children feel...

Themes identified

The data gathered from children and teachers revealed four key themes:

- Readiness for mathematics
- Self-efficacy
- Increased enjoyment
- Improved mathematical attainment, skills and understanding

Readiness for mathematics

- Participants valued having extra time to absorb information and practise skills required for the lesson that day.
  - This time is both during the pre-teaching session, but also in the time between that session and the main mathematics lesson.
  - Trundley et al (2017) presented the importance of pre-teaching occurring on the same day, but did not conclude whether this was best immediately before the lesson or with a break in between.
- When asked whether participants preferred pre-teaching at a particular time in the day, the majority replied with a comment relating to the mornings because it prepared them for the upcoming lesson.

Readiness for mathematics

- Pre-teaching enables children to have a “practice run at the skills required for the lesson”.
- Comments supported ideas that pre-teaching provides a ‘framework’ (Munk, 2010), or ‘cognitive anchors’ (Ausubel, 1960, see Lalley and Miller, 2006), which children can build knowledge upon further during the lesson.
- Some participants also placed particular value on knowing a concept before their peers.
  - There were numerous occasions where participants were introduced to a concept during pre-teaching that they had not encountered before.
  - There was a sense of excitement amongst the participants whenever they knew they were learning brand new information before their peers.
  - Participants had a sense of superiority leaving these pre-teaching sessions and entering their mathematics lessons.

Readiness for mathematics

Self-efficacy

- Children generally attempted more questions in the tests following the pre-teaching intervention which indicates an improvement in their self-efficacy.
  - These findings mirrored those of Watt and Therrien (2016).
- The participants' were asked to write a word to describe how they felt before they took the maths tests at the beginning and end of the research study.
- The qualitative comments made prior to each test indicated an overall increase in confidence, with participants' responses generally being more positive before the end-point test.

Self-efficacy

Questionnaire responses prior to initial test

Participant number	Write a word to describe how you feel about the test in front of you:
1	Nervous
2	Nervous
3	A bit worried
4	half-n-half
5	Excited
6	Unhappy
7	Unsure
8	Confident

Questionnaire responses prior to end-point test

Participant number	Write a word to describe how you feel about the test in front of you:
1	I feel confident
2	Fine
3	Less worried and a little confident!
4	Excited
5	Excited
6	Happy
7	Pretty confident
8	Ready

Self-efficacy

- At the beginning of the study, the participants demonstrated some characteristics of mathematics anxiety. The end-point data collection suggested a reduction in these negative emotions.

Self-efficacy

Questionnaire responses prior to initial test

Participant number	I feel confident about having a go at the test	I am worried I won't know how to answer some of the questions	I think that most of my answers will be right	I think I am going to get a bad score	I will try to get the test over and done with quickly
1	3	3	3	3	4
2	2	4	2	3	2
3	3	3	2	3	2
4	1	3	1	1	4
5	1	2	2	2	1
6	1	2	3	2	3
7	1	3	3	3	2
8	2	3	2	2	4
Total (highest possible = 32)	14	23	18	19	22
Average:	1.75	2.875	2.25	2.375	2.75

Questionnaire responses prior to end-point test

Participant number	I feel confident about having a go at the test	I am worried I won't know how to answer some of the questions	I think that most of my answers will be right	I think I am going to get a bad score	I will try to get the test over and done with quickly
1	1	2	2	1	3
2	1	3	2	2	2
3	2	2	2	2	2
4	1	4	1	1	3
5	1	1	2	1	1
6	1	1	2	1	3
7	1	2	2	1	1
8	1	3	2	2	3
Total (highest possible = 32)	9	18	15	11	18
Average:	1.125	2.25	1.875	1.375	2.25

Self-efficacy

- There were some responses which did not match this positive trend, however.
- There was no overall change in score when responding to the statement 'I am usually at ease during mathematics tests', with the result remaining at 18.
- This could suggest the impact of pre-teaching on children's confidence during testing situations is limited, which could link to the view of mathematical anxiety as a separate construct to other forms of anxiety, like test anxiety (Carey et al, 2017).
- It could also be because this study involved Year 6 pupils, who would sit the KS2 National Curriculum Assessments in May. Testing could therefore still be an anxious aspect of mathematics for these participants due to them being aware of being in a national testing year group.

Increased enjoyment

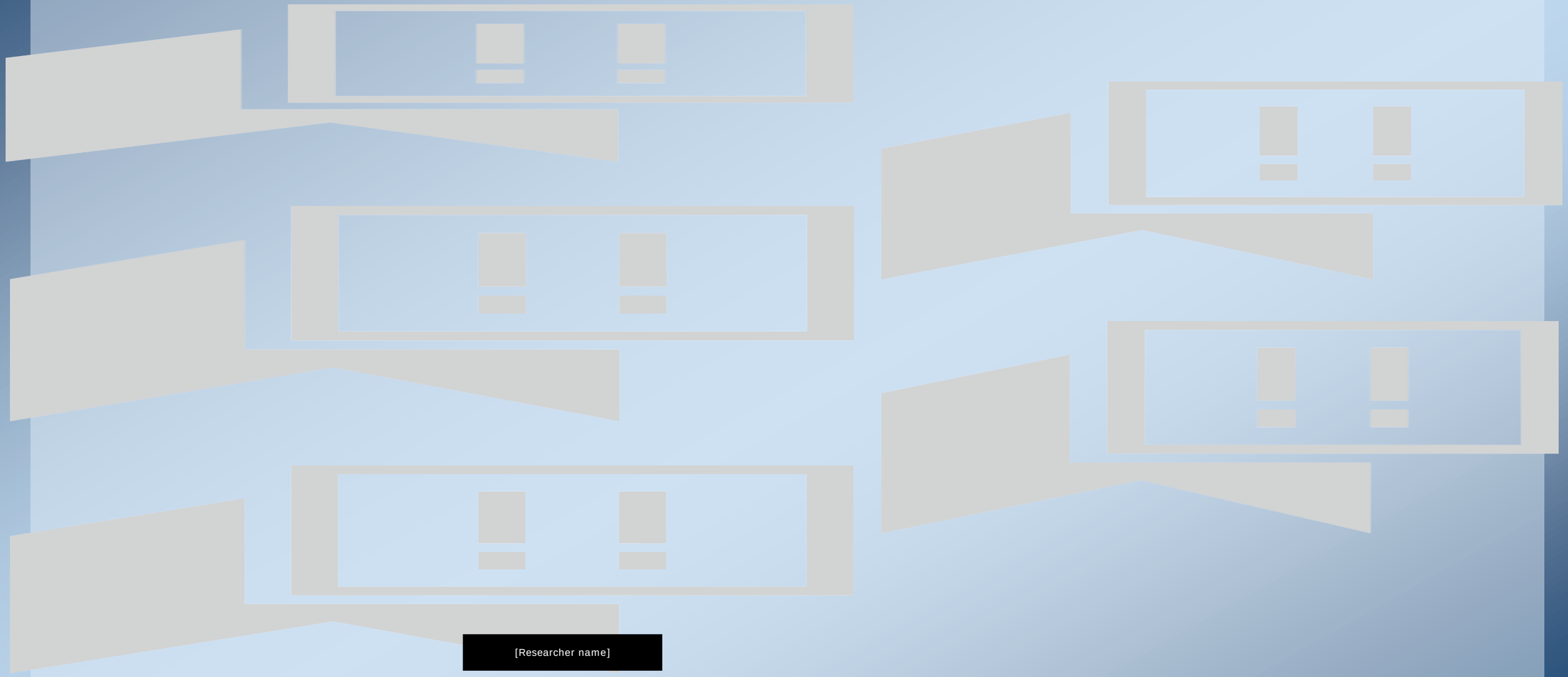
- Before the pre-teaching intervention, the anxieties some areas of mathematics presented to the children affected their confidence, reducing their viewpoint of it as a fun subject and increasing their anxieties.
- By the end of the research, a number of participants' questionnaire comments about the pre-teaching intervention related to happiness and the teachers' case study comments mirrored these responses by describing observations of the children which indicated more positive behaviour.

Increased enjoyment

Improved mathematical attainment, skills and understanding

- The participants placed great value on the pre-teaching sessions for improving their understanding and attainment in mathematics.
- When asked whether they would like to continue with pre-teaching next term, all of the participants (n=8) responded positively with ‘strongly agree’. Their explanations linked to this question frequently pointed to the impact of pre-teaching on their mathematical knowledge, skills and understanding.

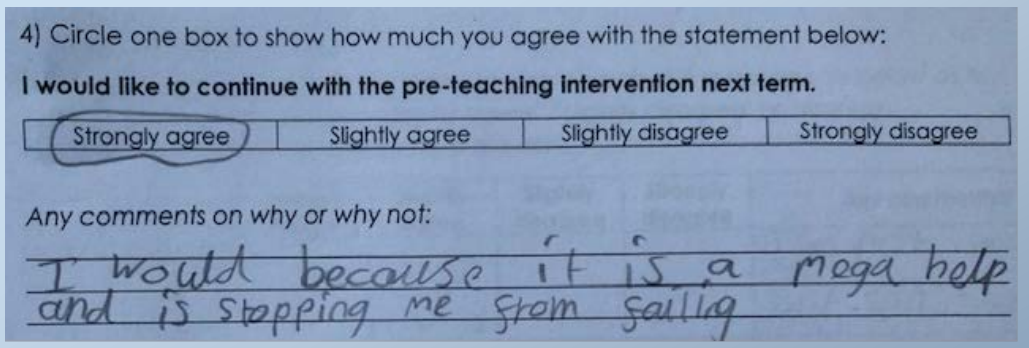
Improved mathematical attainment, skills and understanding



[Researcher name]

Improved mathematical attainment, skills and understanding

- There were a couple of comments which concerned me slightly, with participants appearing to demonstrate an over-reliance on the pre-teaching interventions.
- It is probably more beneficial to keep pre-teaching groupings flexible, so that children do not become overly dependent upon this support.
  - Flexibility with pre-teaching groups is also suggested by Munk et al (2010) and Berg and Wehby (2013).



4) Circle one box to show how much you agree with the statement below:

I would like to continue with the pre-teaching intervention next term.

Strongly agree	Slightly agree	Slightly disagree	Strongly disagree

Any comments on why or why not:

I would because it is a mega help and is stopping me from failing

Improved mathematical attainment, skills and understanding

- The participants' improved test scores also indicate improved mathematical attainment, skills and understanding.
- This academic benefit seems to run parallel with the findings of Trundley (2017) and Polak (2017) who both found that, following pre-teaching interventions, tests indicated that children's attainment had improved.

Improved mathematical attainment, skills and understanding

Number and place value initial assessment

Participant number	Total score out of 36
1	35
2	17
3	12
4	22
5	26
6	36
7	23
8	34
Average:	25.625

Addition, subtraction, multiplication and division initial assessment

Participant number	Total score out of 30
1	21
2	16
3	9
4	22
5	19
6	13
7	16
8	13
Average:	16.125

Fractions, decimals and percentages initial assessment

Participant number	Total score out of 53
1	19
2	13
3	11
4	46
5	23
6	25
7	24
8	19
Average:	22.5

Number and place value final assessment

Participant number	Total score out of 36
1	33
2	20
3	13
4	36
5	34
6	34
7	29
8	36
Average:	29.375

Addition, subtraction, multiplication and division final assessment

Participant number	Total score out of 30
1	19
2	17
3	12
4	26
5	20
6	17
7	18
8	23
Average:	19

Fractions, decimals and percentages final assessment

Participant number	Total score out of 53
1	47
2	35
3	30
4	45
5	35
6	40
7	34
8	35
Average:	37.625

Improved mathematical attainment, skills and understanding

Algebra initial assessment

Participant number	Total score out of 16
1	4
2	0
3	1
4	15
5	0
6	0
7	3
8	0
Average:	2.875

Algebra final assessment

Participant number	Total score out of 16
1	14
2	14
3	7
4	16
5	3
6	16
7	16
8	14
Average:	12.5

Statistics initial assessment

Participant number	Total score out of 7
1	2
2	2
3	0
4	0
5	0
6	0
7	3
8	0
Average:	0.875

Statistics final assessment

Participant number	Total score out of 7
1	4
2	4
3	4
4	4
5	5
6	6
7	4
8	5
Average:	4.5

Improved mathematical attainment, skills and understanding

- However, it is important to note that both pre-teaching and re-teaching strategies are effective in improving achievement (Lalley and Miller, 2006).
- Willis (2010) discusses how mathematics anxiety cuts off the working memory required for mathematics whilst the brain copes with the emotional distress mathematics causes, which can impact negatively on children's learning and performance (Ramirez, 2013).
- It therefore has to be remembered that the findings presented under this theme could be due to an increase in attainment, but they could also be due to a reduction in children's anxiety meaning more working memory is free to improve their mathematical understanding. Either way, both explanations are a positive outcome for improvement.

What next?

- Next year, pre-teaching is going to be extended to other year groups across the school, from Years 1-6.
- We are going to trial how frequently pre-teaching needs to occur.
  - Daily pre-teaching can be time-consuming and is a big expectation for all staff to follow.
- We are going to trial being more flexible with the groupings.
  - There was a concern that for a couple of the children they became a little too over-reliant upon the pre-teaching sessions, attributing their successes to the pre-teaching intervention, rather than their own abilities!

Questions?