Cultural and Demographic Factors affecting Mathematical Confidence in England

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In 2014, Nick Gibb, Education Minister for the Conservative government put forward the Mathematics Teacher Exchange Programme in attempt to tackle the gap in Mathematical attainment between pupils in the UK, and to compete with Shanghai and Singapore in international PISA league tables. The idea that mastery as a pedagogy would close this gap was absurd. This paper presents that Mathematics attainment is much more complex, by acknowledging the cultural differences in attitudes towards Mathematics in the UK and how these differences in attitudes and the demographic of pupils can influence their confidence of Mathematics, which has an effect on pupils' attainment.

Keywords: attitudes; free school meals; peers; confidence

Introduction

Educational Inequalities in Mathematics are not new (HM Government., 2022). Instead of efforts to tackle such inequalities, GCSE Mathematics was made more difficult due to the GCSE Reform in 2015 to include more demanding content (Ofqual, 2019). One of the most recent government incentives was the Mathematics Teacher Exchange (MTE) programme in 2014. The MTE programme came about due to the UK being persistently outperformed by Shanghai and Singapore in the Programme for International Student Assessment (PISA) tables and the acknowledgement of the smaller gap in attainment between pupils (OECD., 2014).

Nick Gibb, Educational minister at the time under the Conservative government, introduced the programme where 60 primary school teachers from 40 primary schools across England went to Shanghai to "learn from Shanghai practices to raise standards in Mathematics through improved pedagogy and teacher subject knowledge, a more refined and appropriately paced curriculum, and by ensuring all pupils achieve their full potential in Mathematics and are not left behind" (DfE, 2019, p.26). In 2016, this developed into the Teaching for Mastery Programme that intended to use the concepts learnt by the teacher exchange to provide professional development sessions for teachers, run through the national Maths Hubs led by the National Centre for Excellence in the Teaching of Mathematics (NCETM), and the development of textbooks.

Mastery has been adopted by many different organisations such as White Rose Maths and Ark Curriculum to provide a mastery curriculum for Key Stage 3 to follow that underpins similar pedagogy aspects such as whole class learning, using concrete, pictorial and abstract models and not progressing until the whole class achieve.

In 2019, Mark Boylan led the longitudinal Evaluation of the teacher exchange report and identified there are many other factors that contribute to pupils' Mathematical attainment, and the mastery method had not had a significant impact on increasing attainment so far (DfE, 2019). He also goes on to acknowledge that:

> "Asian mastery teaching is the product of educational and cultural norms: the expectation that all pupils will learn, pupil and teacher culture of high expectations, independent study, the belief that ability is malleable rather than fixed and the high level of involvement of both parents and grandparents in supporting their child's school learning" (DfE, 2019, p.34)

This report highlights a failure in the government in trying to address inequalities in Mathematics education, despite the evaluation report schools continue to adopt and develop this term. At the time of the Teacher Exchange Programme, this was related to wider trade negotiations between China and England (Boylan, 2021), which questions whether this exchange was for the interest in helping pupils increase their Mathematical attainment, or for economic interest of the country. This leads to the importance of this research to unveil the cultural and educational norms that operate within the UK between different groups and according to pupils' demographics to better understand inequalities within secondary Mathematics.

Attitudes Towards Mathematics

It is culturally acceptable in the UK to have negative attitudes towards Mathematics; we hear 'I can't do maths' so often, it does not sound like a strange thing to say (Kowsun, 2004). In China, education, including Mathematics education, typically draws in a high degree of parental involvement, yielding a positive attitude towards learning with a consensus that effort and due diligence will yield good results rather than ability (Lee, 1996; Wong et al., 2012). However, there are significant differences between China and the UK with regards to cultural norms and educational values (DfE, 2019).

Attitudes towards Mathematics are important as Aiken and Dreger (1961) suggest that positive attitudes lead to an increase in attainment. Research suggests Mathematical attainment has various impacts on pupils during their time in school, such as their grades, but also in their later life in relation to university entry, careers and finances (OfS, 2022; National Numeracy, 2023). Curtain-Phillips (2014) identifies that those with negative attitudes towards Mathematics are more likely to have lower Mathematical attainment, which can lead to people getting into debt.

Confidence

Confidence is one of the most influential factors affecting Mathematical achievement (Kunhertani and Santosa, 2018). Galbraith and Haines (1998) define confidence as a belief pupils obtain, where they do not worry about learning hard topics, expect to get good results and feel good about Mathematics as a subject. Pupils with low confidence expect all Mathematics to be difficult and worry about the subject more than any other.

Free School Meals (FSM)

Social class is important due to the idea that pupils are influenced from their primary socialisation by the family, nested within social class, on their attitudes towards school (Popa., 2021). In educational research, FSM eligibility is commonly used as a proxy for social class (Hobbs and Vignoles, 2013). Despite confidence being identified as a key influential factor on attainment, little research has been done into the effects of FSM on Mathematical confidence. There is much research out there about the inequality of achievement levels between those who are on FSM and those who are not (HM Government, 2022; DfE 2015). Government statistics show that

47% of pupils eligible for FSM achieve a standard pass in GCSE Maths and English compared with 75% of those not eligible for FSM (HoC, 2023).

Gender

There has been much research into gender and confidence in Mathematics, especially due to the underrepresentation of females in STEM subjects. Ghasemi and Burley (2019) found that males and females' confidence in Mathematics was similar. However, Cho (2017) argues that it is the over-confidence between genders that differs. Males tend to be overconfident despite their ability, which lends itself to the stereotypical idea that more males go into STEM subjects than females as it is a more male dominated area (Sarabi and Smith, 2023).

Peer Influence

Wilkins and Ma (2003) identify that parents and peers positive support can help develop positive attitudes about the social importance of Mathematics, with Coleman (1966) suggesting that peers are the most significant determinant of pupil's attainment. North and Ryan (2017) argue that peers' opinions and expectations about each other's Mathematical attainment matters for their own Mathematical attainment, suggesting that peer attitudes will also be important in influencing pupils' Mathematical confidence.

Data and Methods

The empirical analysis presented in this research is from primary data collected from 10 Secondary schools in the North West of England. The sample consists of 1698 Year 9 pupils and includes demographic factors such as gender, FSM eligibility and attitudinal statements relating to their peers.

Confidence was measured using the Key Stage 3 National Curriculum Programme of Study (DfE, 2013). This indicates the Mathematical content pupils should know by the end of Year 9. I selected two items from each topic in the Mathematics curriculum and asked pupils on a scale of 1 – 5 (1 = Not at all confident, 5 = very confident) how confident they felt with the topics below such as 'use and interpret algebraic notion 3y in place of y+y+y'.

Attitudes towards Mathematics were measured using 12 statements on a 5-point Likert scale (strongly agree – strongly disagree) taken inspiration from Hunt et al's (2011) math anxiety scale, but also included attitudinal statements regarding the pupil's perception on the value and relevance of Mathematics.

Descriptive and Inferential data analysis has been carried out to explore the effects of FSM eligibility, gender and peer attitudes towards pupils' Mathematical confidence. FSM eligibility was measured by asking pupils whether they were eligible for FSM, with an option of yes or no. Gender was measured by asking what gender the pupils identified as out of female, male or other. Peer attitudes towards Mathematics were measured by asking pupils whether they thought their friend's liked maths, thought it was important, did maths at home or thought maths was boring.

Results

Confidence

Mean	Median	Mode	Minimum	Maximum	Range
33.07	35	40	1	50	49

Table 1 – Descriptive statistics for pupils' confidence of Mathematics

	Confidence Score	Significance
Free School Meals and Confidence		
Free School Meals	31.84	<.001
Non Free School Meals	34.64	
Gender and Confidence		
Male	35.08	<.001
Female	31.77	
Other	32.90	
Peer Influence and Confidence		
My friends like maths		
Strongly Agree	38.37	<.001
Strongly Disagree	30.65	
My friends think maths is important		
Strongly Agree	36.85	<.001
Strongly Disagree	30.92	

Table 2 – Inferential statistics for pupils' confidence of Mathematics depending on their free school meal status (t-Test), gender (ANOVA), and peer influence (ANOVA).

Discussion

Results found that FSM eligibility, gender and peers' attitudes towards Mathematics has an effect on pupils' Mathematical confidence ($p<.001$) . Those who were eligible for FSM scored significantly lower (31.84) than average (33) compared to those who were not eligible for FSM (34.64). This indicates that those who are eligible for FSM are less confident than those who are not, suggesting why only 47% of pupils achieve a pass in Mathematics (HoC, 2023).

Those who identified as male scored significantly above average (35.08) than those that identified as female (31.77) and other (32.90). This suggests that males are more confident in Mathematics than females and other, however as Cho (2017) points out, males are more over-confident than females which may not necessarily translate to better attainment. Instead, this could be a reason why more males choose to study STEM subjects and go onto STEM careers as they are more confident that they can do well and apply for those courses and job roles.

Those who strongly agreed that their friends liked maths scored significantly higher (38.37) compared to those who strongly disagreed (30.65). Those that strongly agreed that they thought their friend's thought maths was important scored significantly higher (36.85) compared to those that strongly disagreed (30.92). This highlights that peers' attitudes towards Mathematics influences individual pupils' confidence. This is supported by North and Ryan (2017) that peer opinions and expectations about each other matters for their own Mathematical attainment.

In conclusion, peers' attitudes towards Mathematics had the most impact on pupils' confidence, with those who believed their friends liked maths had more confidence in Mathematics than any other variable. This research also highlights the importance of attitudes towards Mathematics on affecting pupils' confidence, supporting DfE (2019) that cultural and educational norms are more important than the method used to teach Mathematics. Additionally, there are differences in confidence between those eligible and not eligible for FSM and gender. As confidence is a main influence on attainment, this research highlights the cultural and

demographic factors that affect confidence that need to be considered when looking for solutions to improve Mathematics attainment in the UK.

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