Department for Education

PISA in Practice: Additional Analysis of PISA 2012 in England

Research brief

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Contents

Background

The evidence that is generated every three years through the Organisation for Economic Cooperation and Development (OECD) Programme for International Student Assessment (PISA) is used by governments around the world to compare the performance of their pupils, and hence the outputs of their education systems, with pupils at the same age in other participating countries. The results offer a valuable perspective for governments to benchmark their performance and inform their education policy. Following the publication of the PISA 2012 results in December 2013, the Department for Education commissioned three further analysis reports, which aim to inform practitioners and school leaders of the PISA 2012 results, and showcase some key findings from PISA 2012, which teachers can use in the classroom.

This Research Brief provides an overview of the key findings from each of the three reports:

1. **Cognitive Activation in Mathematics** – outlines what is meant by the teaching of 'cognitive activation' and how this is related to achievement;
2. **Tackling Low Performance in Mathematics** – explores the links between pupil attitudes and behaviours, and low performance in mathematics.
3. **What can we Learn from England's High Performance in Science and Problem Solving** – explores the engagement strategies that teachers can use to maximise pupil performance in science and problem solving.

The full reports are available to download from the NfER's website at these links:

1. PISA in Practice: Cognitive Activation in Maths – www.nfer.ac.uk/publications/PQUK04
2. PISA in Practice: Tackling Low Performance in Maths – www.nfer.ac.uk/publications/PQUK05
3. PISA in Practice: Tackling What can we Learn from England's High Performance in Science and Problem-solving – www.nfer.ac.uk/publications/PQUK06

Key findings

Cognitive Activation in Mathematics

The PISA 2012 study asked pupils to report the frequency with which their mathematics teachers use a number of teaching practices, such as encouraging them to reflect on problems, asking them to solve complex problems using their own procedures, or applying knowledge to new contexts. A number of these teaching practices have been identified in recent literature[1] as 'cognitive action' strategies, meaning that these practices involve teaching pupils strategies, which they can call upon when solving mathematics problems, rather than teaching pupils the answers to individual problems.

In England, pupils report that their mathematics teacher asks them to use cognitive activation strategies to solve problems more often than is seen on average internationally. However, high ability pupils report being given cognitively activating tasks in their mathematics lessons significantly more often than the medium and low ability pupils. Additionally, an analysis of the association between pupil mathematics performance and frequency of teachers' use of cognitive activation strategies identifies that:

- Pupils from low- and medium-level socio-economic backgrounds profit most from teachers' use of cognitive action strategies in their mathematics lessons;
- Pupils whose teachers more frequently use cognitive activation in their mathematics lessons report higher levels of *intrinsic* (interest and enjoyment) and *instrumental* (understanding the value of learning mathematics) motivation.
- Pupils whose teachers more frequency use cognitive activation in their mathematics lessons report higher levels of self-efficacy and self-concept, and lower levels of anxiety.

Tackling Low Performance in Mathematics

The performance of our 15-year-olds in the PISA 2012 mathematics assessment was at the international average. However, the gap between the achievement of the most and least able 15-year-olds is relatively wide (22 per cent of English pupils only manage to achieve low PISA maths performance (14 per cent achieve Level 1 and a further eight per cent fail to achieve Level 1). This is a much higher proportion of low performers than in the highest performing countries where, in general, only ten per cent of pupils would be defined as low performers.

[1] For example, in Klieme, E., Pauli, C. and Reusser, K. (2009). 'The Pythagoras Study: investigating effects of teaching and learning in Swiss and German classrooms.' In: Janik, T. and Seidel, T.(Eds) The Power of Video Studies in Investigating Teaching and Learning in the Classroom. Munster:Waxmann Verlag.

In England, the characteristics of pupils that are low-performing in the PISA mathematics assessment indicate that the following pupil groups struggle the most with this subject: girls; pupils from more disadvantaged backgrounds; pupils with SEN; pupils from black ethnic groups; and those attending schools with higher proportions of pupils eligible for free school meals. With the exception of gender, these findings mirror what is seen in terms of the attainment gaps in the national Key Stage 4 results.

Additionally, absenteeism and poor punctuality are associated with a higher likelihood of being a low performer in the PISA maths assessment in England, as in the majority of other countries. Although pupils in England report a relatively positive attitude towards mathematics compared to pupils internationally, those pupils in England who report a less positive attitude, poor disciplinary climate in their lessons, and lower levels of perseverance are more likely to be low-performers.

The final sections of the report provide evidence-based strategies for teachers and schools to tackle low performance in mathematics through increased pupil engagement in their mathematics lessons and the school learning environment.

What can we learn from England's high performance in science and problem-solving?

England's average performance in the PISA 2012 science and problem-solving assessments was significantly better than the international average. Only ten countries outperformed England in the PISA science assessment and only seven in problem-solving. In both subjects the countries that outperformed England included the high performing East and South East Asian countries. Pupils in England performed significantly better in problem-solving, on average, than pupils in countries that had a similar performance in reading mathematics and science.

Further analysis of the factors associated with high performance in these subjects highlights pupils' attitudes and engagement as having a significant impact on performance. In general, pupils in England report a relatively positive attitude towards school compared to their peers internationally, and those that report what they learn at school as interesting and relevant perform at higher levels than their peers in science and problem-solving.

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