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Evidence for Excellence in Education

PISA in Practice:
Tackling Low Performance in Maths
Additional Analysis of PISA 2012 in England

Foreword

The OECD Programme for International Student Assessment – or PISA – is used by governments around the world to compare results of differing education policies and provides a wealth of information which informs educational policy.

Yet this evidence is not the sole preserve of policy makers. In-depth analysis of the PISA data can help inform practitioners and school leaders about factors relating to pupil achievement. Such analysis can, for example, provide robust useful evidence about specific pupil characteristics, attitudes and behaviours which are related to low achievement in maths.

It is not enough, though, to simply identify where such relationships exist – it is important to reflect on how practitioners can adapt their practice to overcome these issues.

In this series, commissioned by the Department for Education (DfE), we showcase some findings from PISA which teachers can use in the classroom.

This report focuses on England's performance in PISA 2012. It explores the characteristics of those pupils who were low performers in maths in PISA, and identifies strategies for overcoming some of the characteristics, behaviours and attitudes associated with low performance.

PISA 2012 in England was conducted by NFER on behalf of the DfE. The national report for England can be accessed at: https://www.gov.uk/government/publications/programme-for-international-student-assessment-pisa-2012-national-report-for-england and the international reports at: http://www.OECD.org/PISA

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Overview

What can PISA tell us?

PISA is the world's biggest international pupil assessment, involving 15-year-old students in over 60 countries – it assesses maths, reading and science. PISA is a key source of performance data for individual countries. It is an internationally comparable measure, providing information above and beyond the data collected at a national level, for example GCSE or key stage results. The findings from PISA allow us to:

- compare achievement in England with other countries, including both high- and low-achieving countries

- explore our performance across the ability range and compare this with other countries

- identify our low performers and compare them to their peers internationally

- combine information about achievement with information about pupil characteristics and attitudes

- identify some of the background characteristics associated with low performance, for example levels of engagement, attitudes to maths and perseverance.

How did pupils in England perform in the PISA 2012 maths assessment?

The average maths performance of a 15 year old in England in 2012 was at the same level as an average 15 year old across all OECD countries[1]. The maths performance of our 15 year olds has remained stable since PISA 2006. Of the 65 countries that participated in PISA 2012, 19 countries significantly outperformed England in maths, the seven highest achieving countries were in East and South East Asia.

It is also important for the purposes of teaching and learning to examine the spread in performance between the most and least able pupils. A country with a wide spread of achievement will have large numbers of pupils who are underachieving as well as pupils performing at the highest levels. If we look at the distribution of maths performance of pupils in England, we can see a relatively wide spread of achievement when compared to some of the high-performing countries that participated in PISA 2012. However, some of the highest performing East Asia countries have a wider distribution, for example Chinese Taipei and Singapore. The figure below shows the spread of achievement between the highest and lowest achievers in England and in the 19 countries that outperformed England in the PISA maths assessment.

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1 There are 34 OECD countries, a full list of which can be found here: http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm

Spread of performance in England and the high-performing countries

389	Estonia	657
376	Finland	657
371	Viet Nam	654
370	Canada	663
373	Poland	669
367	Netherlands	665
353	Austria	654
379	Macao-China	685
374	Switzerland	681
377	Japan	686
370	Liechtenstein	680
353	Germany	667
335	England	650
348	Australia	663
391	Hong Kong-China	709
386	Korea	710
435	Shanghai-China	765
342	Belgium	677
393	Singapore	737
363	Chinese Taipei	738

How do we define low performers on the PISA maths assessment?

In this report, pupils are categorised as low performers if they failed to achieve PISA Level 2. This includes pupils who achieved PISA Level 1 (the lowest PISA proficiency level, 14 per cent of pupils in England) or failed to achieve PISA Level 1 (eight per cent of pupils in England).

What pupils can typically do at PISA Level 1	What pupils can typically do at PISA Level 2
Answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined.	Interpret and recognise situations in contexts that require no more than direct inference.
Identify information and carry out routine procedures according to direct instructions in explicit situations.	Extract relevant information from a single source and make use of a single representational mode.
Perform actions that are almost always obvious and follow immediately from the given stimuli.	Employ basic algorithms, formulae, procedures or conventions to solve problems involving whole numbers and make literal interpretations of the results.

Source: OECD (2014a)

The figure below shows the percentage of pupils at each of the six PISA proficiency levels in England and the seven highest achieving countries. We can see that, compared with these high-achieving countries, England has a much higher percentage of pupils at Level 1 and below Level 1 and a much lower percentage of pupils at the higher proficiency levels.

Just over ten per cent of pupils in England are only able to answer PISA questions that focus on simple tasks and involve familiar contexts where all relevant information is present. (A further eight per cent are not able to access even these simple questions.) In Shanghai, by comparison, nearly a third of pupils perform at PISA Level 6, meaning they are able to answer questions which require them to develop and work with models for complex situations, identify constraints and specify assumptions.

Percentage of pupils at each of the PISA proficiency levels
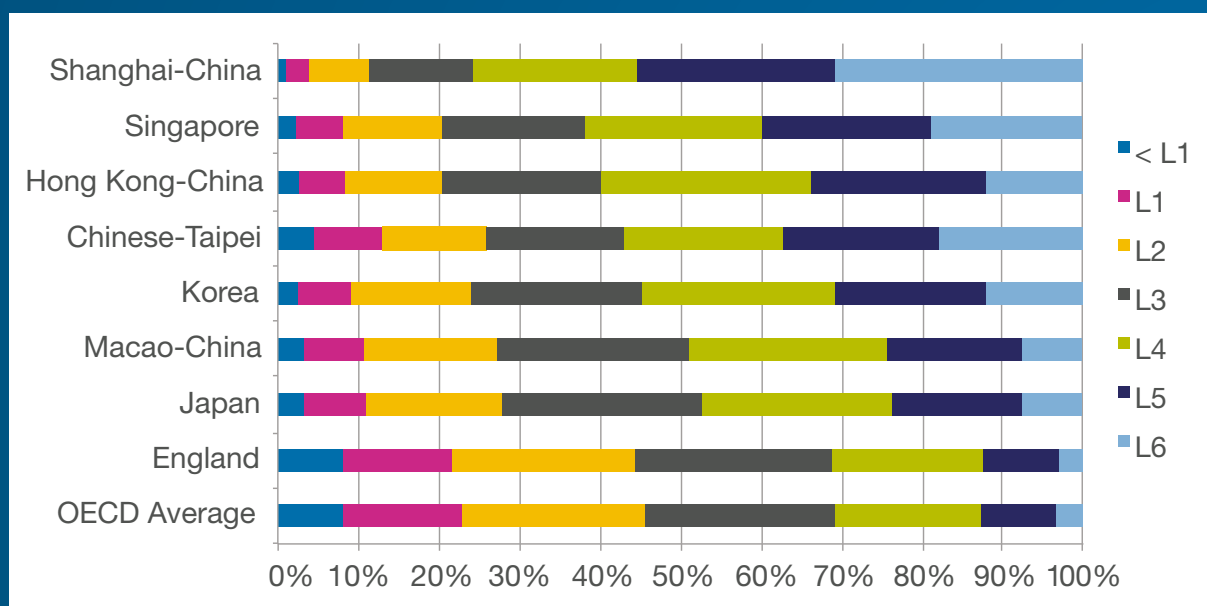
Who are the low performers in England?

A number of background characteristics are related to the likelihood of a pupil being a low performer in the PISA maths assessment in England. In general, the findings from PISA mirror what is seen nationally[2], and, pupils with the following background characteristics are **more likely to be low performers** in the PISA maths assessment:

- girls (conversely, nationally, girls continue to outperform boys in maths at GCSE)

- pupils from more disadvantaged backgrounds

- pupils with special educational needs (SEN) (nationally, at GCSE, pupils known to have SEN perform less well)

- pupils from a black background (nationally, at GCSE, pupils from a black background remain the lowest performing group)

- pupils attending schools with higher proportions of pupils eligible for free school meals (nationally, at GCSE, pupils known to be eligible for free school meals (FSM) perform less well).

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2 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/280689/SFR05_2014_Text_FINAL.pdf

PISA provides us with a valuable source of information about our low performers, over and above our existing national data. The PISA Student Questionnaire, for example, collects information on pupil attitudes and behaviours, such as engagement in school and attitudes to maths. As this type of information is not collected alongside national achievement data, PISA offers us additional insights into those aspects of pupil character which might be associated with low performance. Combined with the results from the PISA maths assessment, this questionnaire data tells us more about the engagement and attitudes of pupils who perform at the lowest levels in maths, including that:

- pupils who report arriving late to school or skipping whole classes or days perform worse, on average, than their peers

- pupils with more positive attitudes towards their school, and higher work ethics in maths, are less likely to be low performers in maths in PISA 2012

- pupils with higher intrinsic motivation to learn maths and higher levels of perseverance are less likely to be low performers in maths in PISA 2012

- pupils reporting lower levels of discipline in their maths classroom are also more likely to be low performers.

How can I engage and motivate low performers?

The characteristics highlighted above, for example absenteeism, low work ethic and lower levels of perseverance, indicate a lack of pupil engagement. The evidence from PISA shows a positive relationship between performance in maths and pupil engagement. Increasing pupil engagement is consequently likely to reduce these negative behaviours and attitudes and may well help to improve performance.

The OECD found that the strategies and practices teachers use in the classroom have an important role to play in promoting engagement with school and learning (OECD, 2013b). We examined this finding further through consultation with a number of independent consultants, members of the Association for Achievement and Improvement through Assessment (AAIA), school improvement partners and former local authority advisors in England, who offered some key ideas from a range of their action research projects. We have used these to develop a programme of ten key strategies that you can adopt to maximise and enhance pupil involvement in their learning and provide the best possible opportunities for successful, active learning. These strategies are based on practices that have been found by practitioners, when used in classrooms, to enhance pupil engagement in learning maths. They are not aimed at tackling the negative behaviours and attitudes outlined above directly, instead they provide useful suggestions – for teachers and school leaders – as to what you might do to engage learners and reduce low performance generally in your classes and schools.

Ten key engagement strategies

✔ Make the learning meaningful to your pupils so that they can see why they are learning something and how that might relate to their lives.

✔ Invest time planning how to introduce a topic to your class; try starting a new topic with exploratory discussions with your pupils.

✔ Design tasks to encourage discussions and reflection and invite pupils to exchange speculative or reflective thoughts.

✔ Ensure there are opportunities for pupils to discuss, explain and reflect on their learning and to share their ideas with peers.

✔ Make time for de-briefing sessions to establish how your pupils' learning has moved forward.

✔ Ensure pupil engagement has a prominent focus in school; include it as a standing agenda item in whole-staff and Department/Faculty meetings and appoint 'learner engagement' champions.

✔ Consider the pupil characteristics associated with low performance and think about how the relevant pupils can be best supported through both whole-school policy and classroom practices.

✔ Establish teacher learning communities or lesson study groups within school so that teachers can observe their peers and share effective practice.

✔ Identify a range of engagement strategies, based on research and staff experience, and encourage all teachers to select one or two strategies to try out with their classes.

✔ Provide opportunities for teachers to feed back on the engagement strategies they have tried and exchange ideas on alternative strategies.

1 Introduction: England's maths performance in PISA 2012

The PISA 2012 study allows us to compare the maths ability, engagement and teaching of 15 year olds in England with that in other countries around the world. This report focuses particularly on what the PISA results say about the links between pupil attitudes and behaviours, such as motivation and perseverance, and low attainment in maths.

What is PISA?

The Programme for International Student Assessment (PISA) is the world's biggest international pupil assessment, involving schools and pupils in over 60 countries.

It assesses the knowledge and skills of 15 year olds in science, reading and maths and was developed jointly by member countries of the Organisation for Economic Co-operation and Development (OECD).

Maths was the main subject in PISA 2012 and so was assessed in greater depth compared with the other two subject areas. (A description of the levels of maths ability assessed by PISA is provided below.)

In addition to the assessments, pupils and schools complete questionnaires to provide information about pupil background and attitudes, and aspects of school management and school climate.

Over 60 countries participated in PISA 2012 and England's average performance in maths was not significantly different from the OECD average[3]. Nineteen countries outperformed England. These include countries in East and South East Asia, English-speaking countries and countries in Europe. Although England was not among the highest achieving group of countries internationally, average performance in maths in England compares well with a number of other EU and OECD countries. However, in England the gap between the achievement of the most able pupils and the least able pupils is relatively large. Only in ten countries is the difference between the highest and lowest performers greater than it is in England.

How do the OECD define and measure 'maths ability'?

…an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens.
(OECD, 2013a)

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3 This is the mean of the data values for all OECD countries for which data is available or can be estimated. The OECD average can be used to see how a country compares on a given indicator with a typical OECD country (OECD, 2005).

1.1 The difference between the highest and the lowest performers

In addition to knowing how well pupils in England perform, *on average*, it is also important for the purposes of teaching and learning to examine the *spread* in performance between the most and least able pupils. A country with a wide spread of attainment will have large numbers of pupils who are underachieving as well as pupils performing at the highest levels. Figure 1 shows that England has a relatively wide spread of achievement when compared with the 19 countries that outperformed England in PISA 2012. In only seven countries is there a bigger difference between the highest and lowest performers (this includes the top five perfomers in maths in PISA 2012).

Figure 1 Spread of attainment

Low	Country	High
389	Estonia	657
376	Finland	657
371	Viet Nam	654
370	Canada	663
373	Poland	669
367	Netherlands	665
353	Austria	654
379	Macao-China	685
374	Switzerland	681
377	Japan	686
370	Liechtenstein	680
353	Germany	667
335	England	650
348	Australia	663
391	Hong Kong-China	709
386	Korea	710
435	Shanghai-China	765
342	Belgium	677
393	Singapore	737
363	Chinese Taipei	738

England's average score masks the fact that just over ten per cent of pupils are performing relatively well and that a larger proportion (over 20 per cent) have relatively low performance.

The PISA performance scale is split into a number of proficiency levels. This allows us to look at the proportion of pupils in England whose performance according to PISA can be described by the types of skills pupils are likely to demonstrate and the tasks that they are able to complete given their test performance (OECD, 2014a). Test questions that focus on simple tasks and involve familiar contexts where all relevant information is present are categorised at lower levels. Questions that are more demanding, which require pupils to develop and work with models for complex situations, identifying constraints and specifying assumptions, are categorised at higher levels. The six PISA proficiency levels are outlined in Figure 2. This also shows the cumulative percentages of pupils who achieve each level in England (as well as the OECD average[4]).

Figure 2 PISA maths proficiency levels

| Levels	% at this level		What pupils can typically do at each level
	England	**OECD average**	
6	3.1% perform tasks at Level 6	3.3% perform tasks at Level 6	• Can conceptualise, generalise and use information based on their investigations and modelling of complex problem situations, and can use their knowledge in relatively non-standard contexts. • Can link different information sources and representations and move flexibly among them. • Are capable of advanced mathematical thinking and reasoning and can apply this insight and understanding to develop new approaches and strategies for addressing novel situations. • Can reflect on their actions, and can formulate and precisely communicate their actions and reflections.
5	12.4% perform tasks at least at Level 5	12.6% perform tasks at least at Level 5	• Can develop and work with models for complex situations, identifying constraints and specifying assumptions. • Can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems. • Can work strategically using broad, well-developed thinking and reasoning skills. • Can reflect on their work and can formulate and communicate their interpretations and reasoning.

4 This is the mean of the data values for all OECD countries for which data is available or can be estimated. The OECD average can be used to see how a country compares on a given indicator with a typical OECD country (OECD, 2005).

Levels	% at this level		What pupils can typically do at each level
	England	**OECD average**	
4	31.0% perform tasks at least at Level 4	30.8% perform tasks at least at Level 4	• Can work effectively with explicit models on complex, concrete situations that may involve constraints or call for making assumptions. • Can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. • Can use their limited range of skills and can reason with some insight, in straightforward contexts. • Can construct and communicate explanations and arguments based on their interpretations, reasoning and actions.
3	55.6% perform tasks at least at Level 3	54.5% perform tasks at least at Level 3	• Can execute clearly described procedures, including those that require sequential decisions. • Can make interpretations that can form the basis for building a simple model or for selecting and applying simple problem-solving strategies. • Can interpret and use representations based on different information sources and reason directly from them. • Show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships.
2	78.4% perform tasks at least at Level 2	77.0% perform tasks at least at Level 2	• Can interpret and recognise situations in contexts that require no more than direct inference. • Can extract relevant information from a single source and make use of a single representational mode. • Can employ basic algorithms, formulae, procedures or conventions to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
1	92.0% perform tasks at least at Level 1	92.0% perform tasks at least at Level 1	• Can answer questions that involve familiar contexts where all relevant information is present and the questions are clearly defined. • Can identify information and carry out routine procedures according to direct instructions in explicit situations. • Can perform actions that are almost always obvious and follow immediately from the given stimuli.

Source: OECD (2014a)

Based on these proficiency levels, pupils have been categorised as **low performers** if they achieved PISA Level 1 (the lowest PISA proficiency level) or failed to achieve PISA Level 1. In England, nearly 14 per cent of pupils achieved Level 1 and a further eight per cent of pupils failed to achieve Level 1. This means that 21.6 per cent of pupils are categorised as low performers in maths (Wheater *et al.*, 2013). Compared with the highest achieving East and South East Asian countries, England has a much higher percentage of pupils at Level 1 and below Level 1. Figure 3 shows the percentage of pupils at each of the proficiency levels in England and the seven highest achieving countries.

Figure 3 Percentage of pupils at each of the PISA proficiency levels
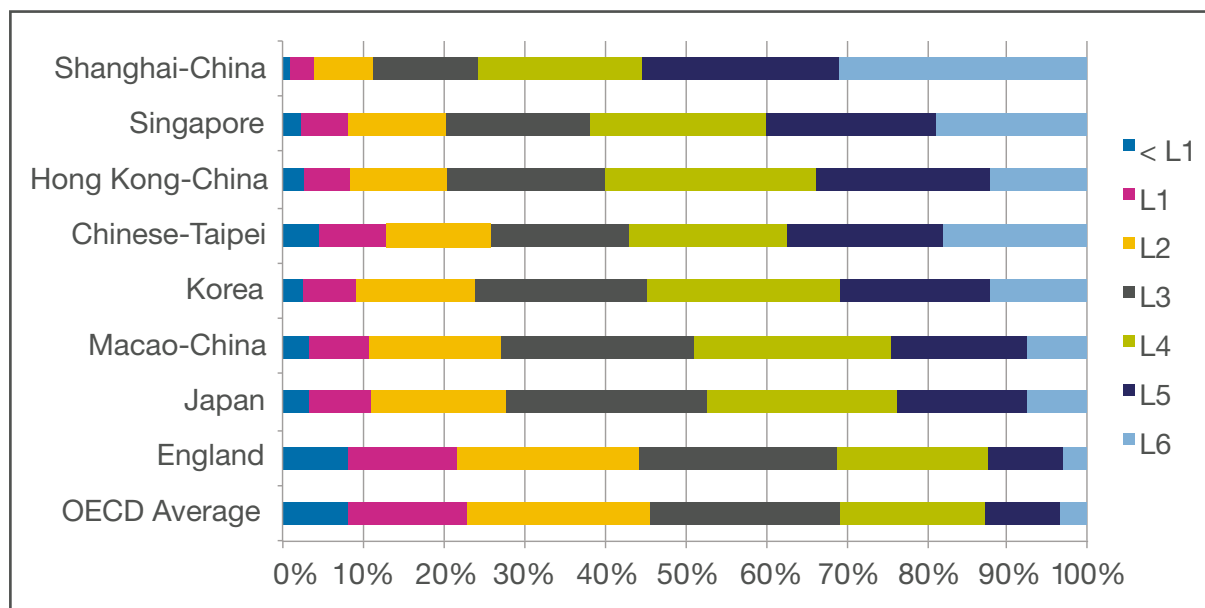
Below is an example of a Level 2 PISA maths item which low performers would be unable to answer. Just over a fifth of pupils in England would find this question too challenging. This is a relatively high proportion compared to the highest achieving countries where approximately 90 per cent of pupils would be able to answer this question. For example, in Shanghai, 97 per cent of pupils would be likely to answer this question correctly.

Helen has just got a new bike. It has a speedometer which sits on the handlebars. The speedometer can tell Helen the distance she travels and her average speed for a trip.

Question:

On one trip, Helen rode 4 km in the first 10 minutes and then 2 km in the next 5 minutes.

Which one of the following statements is correct?

A Helen's average speed was greater in the first 10 minutes than in the next 5 minutes.

B Helen's average speed was the same in the first 10 minutes and in the next 5 minutes.

C Helen's average speed was less in the first 10 minutes than in the next 5 minutes.

D It is not possible to tell anything about Helen's average speed from the information given.

Source: OECD (2014a)

Why is it important to find out more about the low performing pupils in England?

Research has shown that gaining good basic maths skills can have an impact on young people's longer term education and employment prospects.

Proficiency in mathematics is a strong predictor of positive outcomes for young adults, influencing their ability to participate in post-secondary education and their expected future earnings. (OECD, 2014a).

By finding out more about those pupils who struggle with the PISA maths assessment, teachers can use this information to plan teaching strategies and interventions that could help to address factors related to lower performance. In addition, given that we know that the results from national maths assessments (Key Stage 1, Key Stage 2 and GCSEs) are good predictors of achievement in PISA, tackling low performance is likely to have an impact on pupils' achievement in both national and international assessments and will ultimately improve their life chances.

2 Attitudes and behaviours and low performance in maths

Identifying the characteristics of low performers

Using the PISA maths scores, information from the National Pupil Database (NPD) and the PISA Student Questionnaire we identified some of the pupil characteristics that are related to low performance. However, this analysis does not identify whether a specific pupil characteristic causes low performance.

For example, we do not know whether it is because pupils are low performers that they have particular attitudes or demonstrate particular behaviours or whether the opposite is true. That is, they are low performers because they have particular attitudes or demonstrate particular behaviours.

The PISA 2012 results can help teachers and school leaders tackle low performance, by highlighting those groups of pupils most likely to perform at lower levels in maths and so enabling practitioners to develop targeted interventions to raise the achievement of these specific groups. A number of background characteristics are associated with the likelihood of a pupil being a low performer in the PISA maths assessment. Pupils with the following characteristics are significantly **more likely to be low performers** in maths:

- girls
- pupils with special educational needs (SEN)
- pupils from a black background
- pupils in schools with higher proportions of pupils eligible for free school meals (FSM).

The findings for SEN, ethnicity and FSM mirror what is seen in the national Key Stage 4 attainment data for the same cohort[5]. That is, there is a gap in attainment between the pupils in these specific groups and their peers.

However, notably, there is a difference between the PISA findings and national data in terms of gender and attainment. The national picture (at Key Stage 4) does not seem to be as clear cut as PISA in relation to maths performance and gender – the analysis of the PISA maths attainment data found that girls were more likely than boys to be low performers. When we look at the percentage of pupils achieving five or more GCSEs grades A* to C (including maths) this shows that girls outperform boys and that the gender gap has widened. However, when we look specifically at the higher grades at maths GCSE, we find very little gender difference, with 14.5 per cent of boys and 13.8 per cent of girls achieving an A* or grade A[6]. The findings from these two national measures and PISA 2012 do not tell the same story about gender differences. Further analysis of the PISA data and the assessments themselves would be needed to explain these differences.

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5 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/280689/SFR05_2014_Text_FINAL.pdf
6 www.jcq.org.uk

2.1 Engagement and attitudes to school

PISA allows us to explore aspects of pupil character which, in addition to certain pupil background characteristics, are related to the likelihood of a pupil being a low performer in the PISA maths assessment.

> Pupils responded to questions in PISA Student Questionnaire on the following topics:
>
> - punctuality
> - absenteeism
> - attitudes towards school
> - motivation to learn maths
> - maths work ethic
> - perseverance

Research highlights that pupils need to be engaged and motivated in order to learn (OECD, 2013b) and, as expected, **responses from low-performing pupils in England to questions on the above topics, suggest that their level of engagement with and attitudes towards school are less positive than their higher-performing peers.**

- Low performers were, for example, more likely to report having arrived late for school more in the two weeks prior to the PISA assessment than their higher-performing peers.

- The proportion of low performers in England who skipped whole lessons or school days in the two weeks prior to the PISA assessment is higher than the international average for all pupils.

- Over a third of low performers have skipped whole lessons or school days in the two weeks prior to the assessment (compared with 21 per cent of higher-performing pupils).

- Nearly half of low performers feel that school has done little to prepare them for adult life when they leave school (compared with 22 per cent of higher-performing pupils).

- Over a tenth of low performers feel that school is a waste of time (compared with less than five per cent of higher-performing pupils).

Higher levels of absenteeism and more frequent lateness are related to low performance in England.

This is true regardless of a pupil's background characteristics (including gender, ethnicity and socio-economic status[7]). These findings mirror what is seen internationally. In the vast majority of countries participating in PISA 2012, pupils who reported having arrived late for school, and those pupils who had been absent, in the two weeks before the assessment had lower test scores than those who had not. In the case of absenteeism, the difference in test scores between those pupils who reported skipping school in the fortnight prior to the assessment and those who did not is equivalent to almost one full year of formal schooling (OECD, 2014b). These findings are perhaps unsurprising as we know that these pupils are missing out on learning opportunities.

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7 Socio-economic status is measured using eligibility for FSM and the PISA Index of Economic, Social and Cultural Status. The PISA measure of Economic Social and Cultural Status combines a variety of family background characteristics (OECD, 2014a). It is based on pupils' responses to questions about their parents' background and education and possessions in their homes.

Attitudes towards school are related to achievement.
Pupils who have a less positive attitude towards
school are more likely to be low performers.

As is the case for absenteeism and lateness, this is true regardless of a pupil's social background. On average, low performers have a less positive attitude towards school than their peers. These pupils more often agree or strongly agree with statements such as *School has done little to prepare me for adult life when I leave school*. In England, there is generally a more positive attitude towards school than that seen, on average, internationally and this is also the case for low performers. That said, despite above average levels of positivity towards school, compared with the highest performing countries, a relatively large proportion of pupils in England are low performers in maths.

2.2 Attitudes to maths and school work

In addition to looking at general engagement in school and attitudes towards school, PISA also explores whether attitudes towards maths and attitudes to school work (including maths work ethic and perseverance) are related to performance. The survey finds that **low performing pupils in England have less positive attitudes towards maths and towards school work than their higher performing peers.**

- Compared to pupils internationally, low performers in England report a relatively positive attitude to their maths lessons. However, those who report a positive attitude towards their lessons are still in the minority amongst low performers in this country.

- In general, low performers have a more negative attitude towards maths. Nearly 70 per cent of low performers disagree or strongly disagree that they do maths because they enjoy it (compared to less than 60 per cent of higher performing pupils).

- Compared to higher performing pupils, in England, a smaller percentage of low performers report that they finish their maths homework in time for their maths lesson.

- Nearly a third of low performers are not prepared for their maths exams (compared with 18 per cent of higher performing pupils).

- Compared to higher performing pupils, in England, a much higher percentage of low performers identify that they will not persevere until they have solved a problem. Nearly a third of low performers feel that they resemble someone who would give up easily when confronted with a problem, compared with only 11 per cent of higher performing pupils.

- The proportion of low performers in England who would put off tackling a difficult problem is similar to the international average. They are neither more nor less likely to report putting off a difficult problem than pupils across the other participating countries.

Pupils with a lower intrinsic motivation in maths, a lower work ethic in maths, and lower levels of perseverance are more likely to be low performers in the PISA maths assessment in England.

This is true regardless of a pupil's socio-economic status. These pupils more often disagree or strongly disagree with statements such as *I look forward to my mathematics lesson or I am interested in the things I learn in mathematics*. Compared to the higher performing pupils, in England, low performers did not demonstrate such a strong maths work ethic. A smaller percentage of the low performers also agreed or strongly agreed with statements such as *I finish my homework in time for mathematics class* or *I pay attention in mathematics class*. The low performers also reported less perseverance when tackling problems. They more often saw themselves reflected in statements such as *When confronted with a problem, I give up easily* and less often in statements such as *I remain interested in the tasks that I start* than the higher performing pupils.

3 The learning environment and low performance in maths

In addition to exploring links between pupil attitudes and behaviours, and performance, PISA also explores the relationship between aspects of the learning environment and low performance. In particular it explores the disciplinary climate in maths lessons and the support pupils receive from their teacher in their maths lessons. Internationally, there is a positive association between disciplinary climate and maths performance. Disciplinary climate is also positively associated with pupil engagement. However, research suggests that the association between teacher support and performance is complicated by the fact that extra support is often given to weaker students (OECD, 2010).

Pupils responded to questions in the PISA Student Questionnaire on the following topics:

- disciplinary climate in the classroom
- mathematics teacher support.

This survey finds that low performing pupils in England, experience a poorer disciplinary climate in their maths lessons than their higher performing peers. (Table 1 shows the differences between the two ability groups).

- Compared with pupils internationally, low performers in England report a poorer disciplinary climate in their maths lessons.

- Over 40 per cent of low performers report that in most or every maths lesson pupils do not listen to what the teacher says (compared with less than 30 per cent of higher performing pupils).

- Over 40 per cent of low performers report that there is noise and disorder in most or every maths lesson (compared with less than 30 per cent of higher performing pupils).

- Over a third of low performing pupils report that their maths teacher has to wait a long time for pupils to settle down (compared with less than a quarter of higher performing pupils). In addition, compared to higher performing pupils, a much larger percentage of low performers report that pupils do not start working for a long time after the lesson begins (15 per cent and 32 per cent respectively).

Pupils who perceive that there is a poor disciplinary climate in the classroom are more likely to be low performers in the PISA maths assessment – this is the case regardless of pupil background characteristics.

Table 1 Disciplinary climate in the classroom

How often do these things happen in your mathematics lessons?	Every lesson or most lessons		
	Low performers (England)	Non-low performers (England)	OECD average
Students don't listen to what the teacher says.	42%	27%	32%
There is noise and disorder.	41%	28%	32%
The teacher has to wait a long time for students to settle down.	38%	22%	27%
Students cannot work well.	27%	12%	22%
Students don't start working for a long time after the lesson begins.	32%	15%	27%

Supportive teacher-pupil interactions are a key element of a positive classroom climate and an important dimension of instructional quality (OECD, 2013a). In order to explore the issue of teacher support, PISA includes a number of questions on pupils' perceptions of the teacher who takes their maths lesson, including items on teacher interest in pupils, whether the teacher helps pupils with learning and allows pupils to express opinions. In England, the support offered by teachers during maths lessons was not related to the likelihood of being a low performer in the PISA maths assessment. It is possible that the lack of a relationship between teacher support and performance in England could be linked to the fact that low performers and higher-performing pupils report receiving similar levels of support from their maths teachers.

8 This is the mean of the data values for all OECD countries for which data is available or can be estimated. The OECD average can be used to see how a country compares on a given indicator with a typical OECD country (OECD, 2005).

4 Summary

England's average performance in the PISA 2012 maths assessment was not significantly different from the international average. However, the gap between the achievement of the most and least able pupils in England is relatively wide. When we look at the PISA proficiency levels, 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.

In England, girls, pupils from more disadvantaged backgrounds, pupils with SEN, black pupils and those attending schools with higher proportions of pupils eligible for FSM are more likely to be low performers in the PISA maths assessment. With the exception of gender, these findings mirror what is seen in terms of the attainment gaps in the national Key Stage 4 results.

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. It is important to recognise that attendance alone may not guarantee that a pupil is engaged in learning processes. However, if interventions to improve attendance are coupled with interventions aimed at increasing pupils' participation in maths classes, this could help to improve the achievement of low performers.

In general, pupils in England report a relatively positive attitude towards maths compared to pupils internationally. However, those pupils in England who report a less positive attitude towards school and maths are more likely to be low performers in the PISA maths assessment.

In addition, **lower levels of perseverance are associated with a higher likelihood of being a low performer in maths**. For example, pupils who are put off by difficult problems are more likely to be low performers in maths. This mirrors what is seen internationally where, in the majority of countries, the relationship between perseverance and performance is relatively strong. Equipping pupils with strategies to help them tackle difficult tasks may increase levels of perseverance and decrease their likelihood of being low performers in maths. Teacher-directed instruction, formative assessment and cognitive activation[9] may all encourage perseverance and, so, contribute here (OECD, 2013b).

Pupils who perceive their classrooms to have a poor disciplinary climate are also more likely to be low performers in maths. PISA highlights the importance of teachers and schools implementing strategies that create classrooms which are well structured and focused on learning. This supports earlier research which showed that learning is supported by a classroom climate that is 'positive and respectful…relatively free of disruption and focused on student performance' (OECD, 2013a , p.180).

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9 *Cognitive Activation* involves teaching students strategies, such as summarising, questioning and predicting, which they can call upon when solving problems. These strategies encourage students to think more deeply in order to find solutions and to focus on the method they use to reach the answer rather than simply focusing on the answer itself.

5 What does this mean for me?

The evidence from PISA shows there is a positive relationship between performance in maths and pupil engagement. Some of the evidence relates to issues of attendance and discipline, and schools may wish to review their policies in these areas. The OECD (2013b) also found that the strategies and practices teachers use in the classroom have an important role to play in promoting engagement with school and learning. Regardless, therefore, of whether low achievement influences pupil engagement or vice versa, teachers may wish to try alternative pedagogical approaches that maximise and enhance pupil involvement in their learning and thereby provide the best possible opportunities for successful, active learning to take place.

In order to establish a range of strategies and practices that may be successful in engaging low performers we have worked with a number of independent consultants who are members of the Association for Achievement and Improvement through Assessment (AAIA), including Jenny Short, a School Professional Partner (Assessment and Leadership), Liz Thomas, a teaching and learning advisor for numeracy and Jan Evans, an independent educational consultant. We have used the key ideas from a number of their action research projects, combined with the lessons learned through PISA, to identify a range of strategies that may help you to maximise and enhance pupil engagement.

What can I do to improve the attitudes and behaviour of low-performing pupils in my maths class?

To maximise pupil engagement, you could explore ways in which pupils can be helped to link what they are learning to real-world situations. You could develop some open questions designed to make pupils 'think and do', rather than to simply elicit correct answers. Pupils tend to become more involved when they have been supported to guide their own learning, rather than when expectations are determined solely by the teacher. As a teacher, this means continuously looking for specific ways to involve pupils in effective dialogue and to support them in this way in investing in owning and developing their own learning.

The strategies outlined below have been found by the practitioners that have used them to enhance pupil engagement in learning. These strategies are not specifically aimed at tackling the particular negative behaviours and attitudes identified through the results of PISA 2012, instead they provide useful suggestions as to what you might do to engage learners generally and so reduce low performance in your classes and schools.

What could I do in my own practice?

- **Think** of the best ways to make learning relevant to your pupils. Learning in maths becomes particularly meaningful when pupils are able to see why they are learning it and understand how it might relate to their own lives.

- **Explore** the resources available at https://www.ncetm.org.uk/ (for example *Mastery approaches to mathematics and the new National Curriculum*) or similar sites.

- **Invest time** planning how to introduce a topic and consider starting a new topic area with some exploratory discussion with your pupils.

- **Listen** to your pupils. Find out/explore what they know already and, through this discussion, invite your pupils to ask questions that might be addressed in future lessons on the topic.

- **Avoid direct question and answer sessions** at the start and end of lessons. This can discourage lower achievers and promote disengagement. It also limits the number of pupils directly involved.

- **Plan tasks** so that:
  - they have a real context or purpose where possible
  - pupils will need to use what they have just learned to complete the task
  - differentiated tasks and activities are available to support all learners and these are supported by a series of 'challenge' cards/resources and interactive displays
  - they incorporate higher-level thinking[10], asking pupils, for example, to sequence, classify, compare and contrast, explain cause and effect, analyse, organise, relate, and apply
  - they include more demanding elements that will require that they generalise, predict, evaluate, reflect, hypothesise, create, prove, plan, justify, argue, prioritise, and design or construct.

- Design tasks to **encourage exchange of speculative or reflective thought** and discussions.

- **Use pupils as learning resources for each other**. Cooperative learning can improve understanding and motivation and gives pupils ownership of their learning.

- **Provide opportunities** for pupils to discuss, explain and reflect on their learning and to share their perceptions and insights with others.

- **Make time for de-briefing sessions** to establish how your pupils' learning has moved forward.

- **Consider the use of exit cards** or post-its where pupils can identify tricky aspects or points now understood. This will allow you to plan most appropriately for subsequent lessons.

- **Explore the research** literature on student engagement and select and try out strategies you feel might make a difference in your classroom.

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10 As in Blooms Taxonomy or SOLO Taxonomy

What can we do as a school?

Developing student engagement can, and should, have a whole-school focus. Ensuring opportunities for teachers to explore and share their experience of good practice will enhance their professional development and understanding. In this way, it can also improve pupils' engagement in their learning.

- **Include pupil engagement as a standing item on the agenda of whole-staff and Departmental/Faculty meetings**. Giving pupil engagement a prominent focus will keep it in the forefront of teachers' minds.

- **Consider the background features associated with low performance on PISA**. As a staff member, be aware of the groupings, attitudes and behaviours associated with lower performance and reflect on how the relevant pupils in your school might best be supported through school policy and through pedagogy.

- **Appoint 'learner engagement' champions**. It is often helpful to appoint two or more members of staff with responsibility for co-ordinating the exploration and sharing of good practice in relation to pupil engagement strategies within the school.

- **Establish teacher learning communities or lesson study groups within the school**. These can be within Departments/Faculties or across Departments depending on current pedagogical development in your school. It is important that opportunities for professional discussion are maintained, so that teachers continue to actively observe, develop and share effective practice. You may also wish to consider establishing similar groups with colleagues from other schools or local authorities. **Identify a range of engagement strategies, based on research and staff experience**. First invite staff to research and share strategies such as starter activities, or ways of closing lessons effectively. After sharing with the wider group, ask each to select one or two approaches to try out with their classes over a given period (say a month or half term), and then feedback to the group on their success, or otherwise.

- **Provide opportunities for feedback and exchange**. It is important that teachers have the opportunity to reflect on and consolidate their learning. Teachers often report that their most effective continuing professional development (CPD) has emerged from professional dialogue with colleagues.

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