



NFER Education Briefings

Key insights for England from PIRLS, TIMSS and PISA

Each country's education system is intricate and unique, underpinned with different policies and priorities. International Large Scale Assessments (ILSAs) provide valuable insights into how a country's education system is performing. These studies gather in-depth contextual information about systems, schools, teachers and students; and explore the relationships between background characteristics and achievement. This information can help countries make evidence-informed

decisions on aspects of their own education policy and classroom practice that they might review and adapt to improve learning.

This briefing provides an overview of England's performance in three of the most recent studies to report their findings, considers the experiences of other participating countries, and seeks to draw lessons for future education policy in England.

England's participation in ILSAs

England's participation in ILSAs has been long-standing. Three of the most well-known are:

The **Progress in International Reading Literacy Study (PIRLS)**: a study of reading at ages 9-10 with a five year cycle. England participated in the first cycle in 2001.

The **Trends in International Mathematics and Science Study (TIMSS)**: a study of maths and science at ages 9-10 and 13-14 with a four year cycle. The first cycle was in 1995, which included the participation of England.

The **Programme for International Student Assessment (PISA)**: a study of reading, science and maths at ages 15-16 with a three year cycle. The first cycle was in 2000. England have participated since 2000 but their results are only available from 2006.

How do the ILSAs differ?

PIRLS and TIMSS are run by the IEA¹ and aim to evaluate students' mastery of the curriculum, i.e. an in-depth understanding of the curriculum and how well students are able to apply their learning and skills to increasingly more complex situations. PIRLS and TIMSS are therefore based on curriculum content in the participating countries. The samples are grade-based (PIRLS year 5, mostly age 10; TIMSS years 5 & 9, mostly age 10 and 14).

PISA is run by the OECD² and aims to evaluate the education system, with a strong emphasis on socio-economic factors and equity issues. The assessment aims to measure the application of knowledge to real-life situations, and the preparedness of young people for society, further study and the workplace. Although reading, science and maths are always included, each cycle has one subject as a major focus. The main focus of PISA 2015 was science, and in 2018 it will be reading. The sample is age-based (15-16 year-olds, mostly in year 11).

How did England perform in the most recent ILSAs?



1 International Association for the Evaluation of Educational Achievement

2 Organisation for Economic Co-operation and Development

* This is not exactly the same sample as in 2015, but students from this age group have been sampled in PIRLS 2011, TIMSS 2011 and TIMSS 2015.



Average scores for science have increased at year 5 but not at year 9.



The average scores of students in England for maths have shown steady improvement since 1995 at both year 5 and year 9.

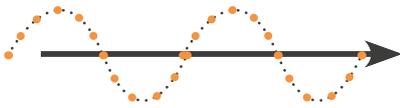


England's year 5 and year 9 average maths scores were higher than the international mean and the majority of other participating countries.

England's average science scores were significantly higher than most other countries, with only five countries significantly outperforming England at year 9.



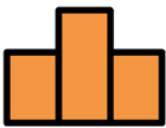
Singapore, Hong Kong, South Korea, Taiwan, Japan and the Russian Federation performed well across both subjects and both year groups.



Average science, maths and reading scores have not significantly changed in England since PISA 2006.



England is above the OECD average in science and at the OECD average for maths.



The top performers in science were Singapore, Japan, Estonia, Taiwan, Finland, Macao, Canada, Vietnam and Hong Kong.



For the first time, England was significantly above the OECD average in reading, mainly because of decreases in other OECD countries.

England performed significantly better in science than many of the Scandinavian countries (Norway, Sweden, Denmark), and several other industrialised countries (eg France, Spain, USA).



2001-2002
Born (Y9)

2005-2006
Born (Y5)

2006
Started
Reception (Y9)

2010
Started
Reception (Y5)

2011
TIMSS and PIRLS
cycle (Y9)*

2015
Participated in
TIMSS (Y5 and Y9)

TIMSS 2015

1999-2000
Born

2004-2005
Started
Reception

2015
Participated
in PISA

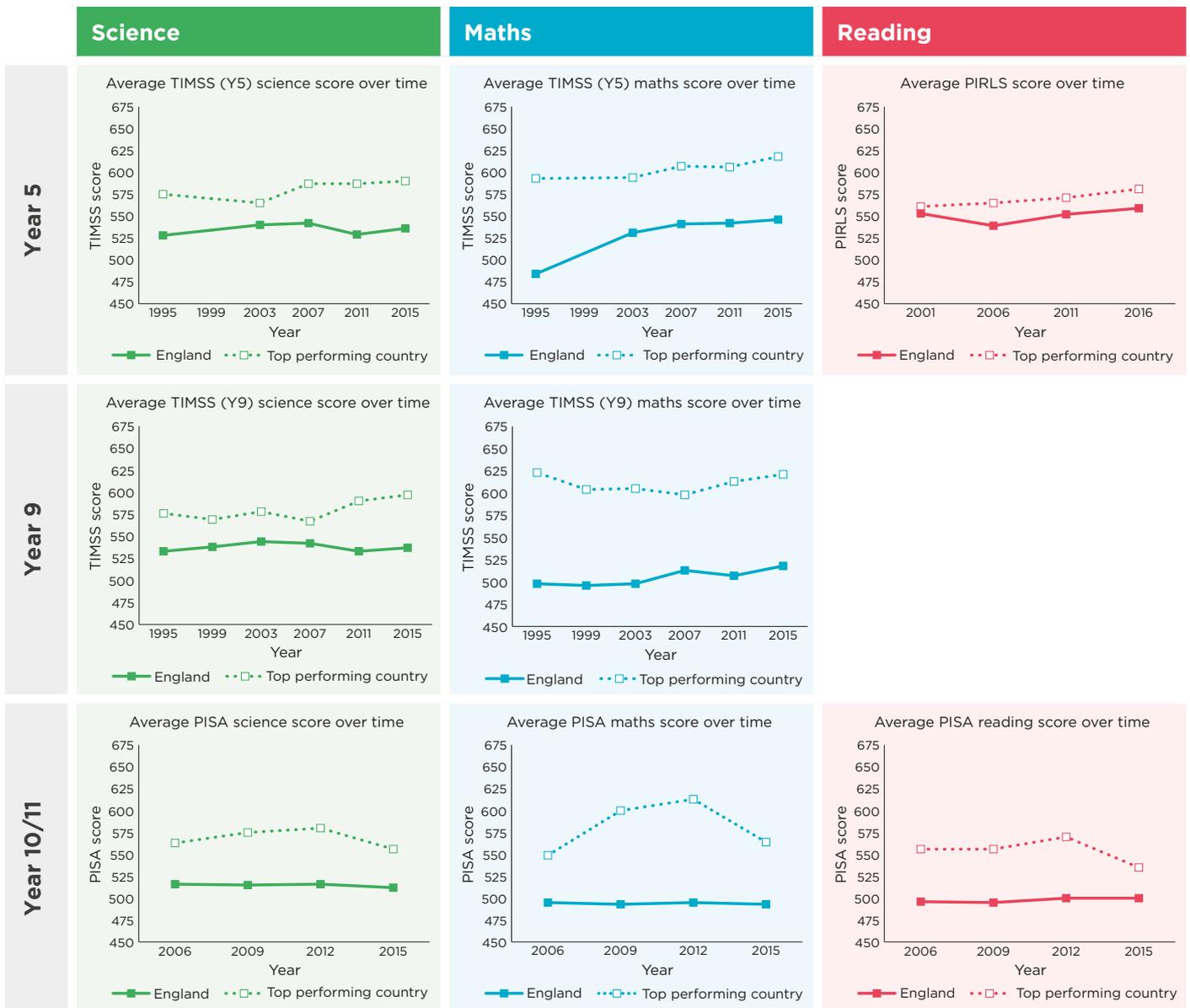
PISA 2015

England has participated in other ILSAs, such as OECD's Survey of Adult skills (PIAAC) in 2011 and 2012, as well as IEA's International Civic and Citizenship Education Study (ICCS) in 2009. This document focuses on the most recent ILSAs: PIRLS 2016, TIMSS 2015 and PISA 2015 and considers them alongside some key policy areas in England.

How is England performing over time?

There are encouraging improvements in achievement at primary level, but less so among secondary students where performance has not changed significantly.

England performed well internationally in science and reading at primary level. Performance is weaker in maths, with a larger gap between achievement of top performing countries and England, however TIMSS does show gradual improvements.



Please note: The top-performing country varies between studies and across cycles, but includes Chinese Taipei, Finland, Hong Kong, Korea, Russian Federation, Singapore, Shanghai China and Sweden.

The PIRLS, TIMSS and PISA achievement scales are defined with a centrepoint set at 500 and a standard deviation of 100. However, each study's scale is determined independently during its inception, or in PISA's case, the first time that subject was a major focus. Direct comparison of average scores across studies and across subjects within studies should therefore not be made.

Across all studies the 'Asian tigers' dominate as top-performing. The educational success of these East Asian countries is ascribed by some to *the high value placed on education and a belief that effort rather than innate ability is the key to educational achievement* (Boylan, 2016). While undoubtedly a factor, these cultural attitudes alone cannot explain the rapid development in education made by these countries, since these traditional values are not of recent origin. Another thing they have in common is reforms in

recent decades based on theories of learning and competency-based education, as typified by the Singapore slogan *Teach less, learn more* (Cheng, 2017). They also share high status of teachers and opportunities for continued professional development. However, there should be some caution in seeking lessons from these countries since they are beginning to have concerns about levels of stress and unhappiness among their children and young people caused by pressure for academic success.

Examining England's performance in at least four cycles of each ILSA provides a useful overview of education in England. The studies are particularly valuable when they are used to investigate specific policy issues, such as gender differences, attainment in Science, Technology, Engineering and Maths (STEM) subjects, the impact of socio-economic status and school climate.

Boys in England outperform girls in maths

ILSA findings in England reflect international patterns in relation to gender differences in maths. The average maths score for boys was higher than that of girls in both TIMSS Year 5 and PISA. This difference was also found in 2017 GCSE maths results, where 16.5 per cent of boys were awarded at least an A or a 7 grade, compared with 14.7 per cent of girls.

Around half of countries had a gender gap in favour of boys in TIMSS (Y5). In PISA the male advantage in England was larger than the OECD average, although in general boys outperformed girls internationally.

This gender gap was not present in science performance in PISA or in either of the year groups in TIMSS. This is an encouraging sign since boys have outperformed girls in earlier PISA studies and a gender gap is found in many other countries.

In reading, in common with the great majority of other countries, girls outperformed boys in both PIRLS and PISA. The gender gap was similar to international averages in both studies. The gap has narrowed in PIRLS, due to boys improving their average performance.



Policy focus on maths education in England

Maths education has been a major policy focus in recent years, with new policies and funding in place to support students and teachers to improve maths performance for all – particularly girls and those from disadvantaged backgrounds. Initiatives and announcements include:

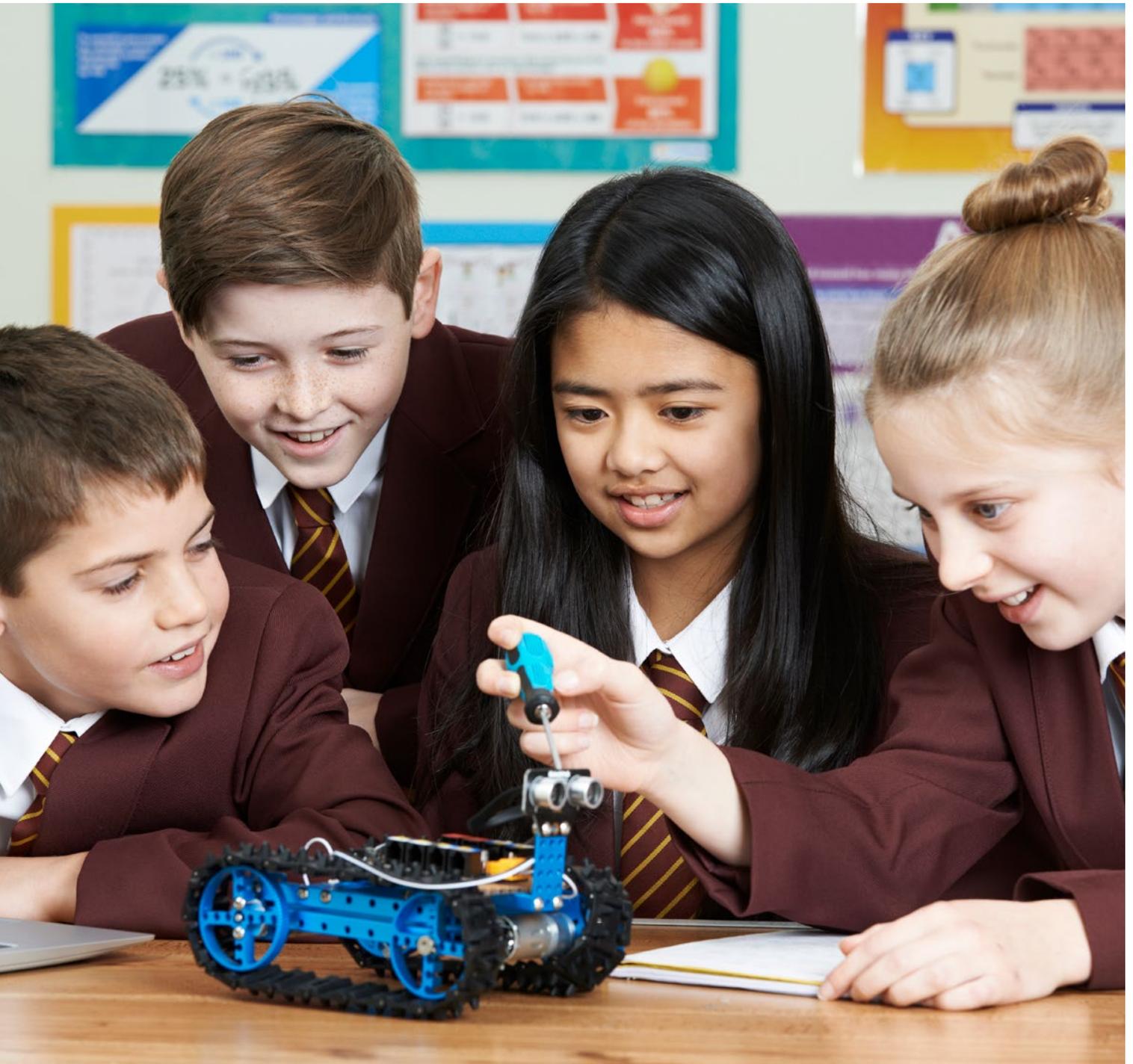
- From 2020 year 4 students will sit a mandatory multiplications tables check.
- The Advanced Maths Premium, announced in February 2018, is a new fund to help schools and colleges increase the number of students studying maths after GCSE. Further support is offered to institutions to increase the number of girls and those from disadvantaged backgrounds taking advanced maths qualifications.
- The Government's Industrial Strategy promises to invest an additional £406m in maths, digital and technical education.
- Announced in 2016, with the help of up to £41 million of funding, more than 8,000 primary schools - half of the total number in England - will receive support to adopt the 'maths mastery' approach, which is used by some of the leading performers in maths in the world, including Shanghai, Singapore and Hong Kong.
- Continuation of Maths hubs to bring England in line with top-performing countries. A further £6 million was invested in 2017 to expand these hubs to more challenging areas.
- Since August 2014 students on 16-19 programmes who do not hold a GCSE grade 9 to 4, A* to C (a standard pass grade) or equivalent qualification in maths must study maths as part of their programme.
- From September 2019, a reformed functional skills qualification in maths will be available in teaching.
- Bursaries have been introduced to encourage good graduates to train as maths teachers.

Girls lack confidence and self-belief

“... the strong relationship among self-beliefs, gender and performance in mathematics and science hints that countries may be unable to develop a sufficient number of individuals with strong mathematics and science skills partly because of girls’ lack of confidence in their abilities.”

OECD (2015)

“ England performed well internationally in science and reading at primary level



England's young people have the potential to compete internationally in science-related fields

As the government seeks to enhance the nation's competitiveness on the world stage it will be increasingly important to ensure all our young people are equipped with STEM skills and make the most of their talents. With two of the ILSAs collecting information on maths and science, England's participation can provide some insight into the state-of-play so far.

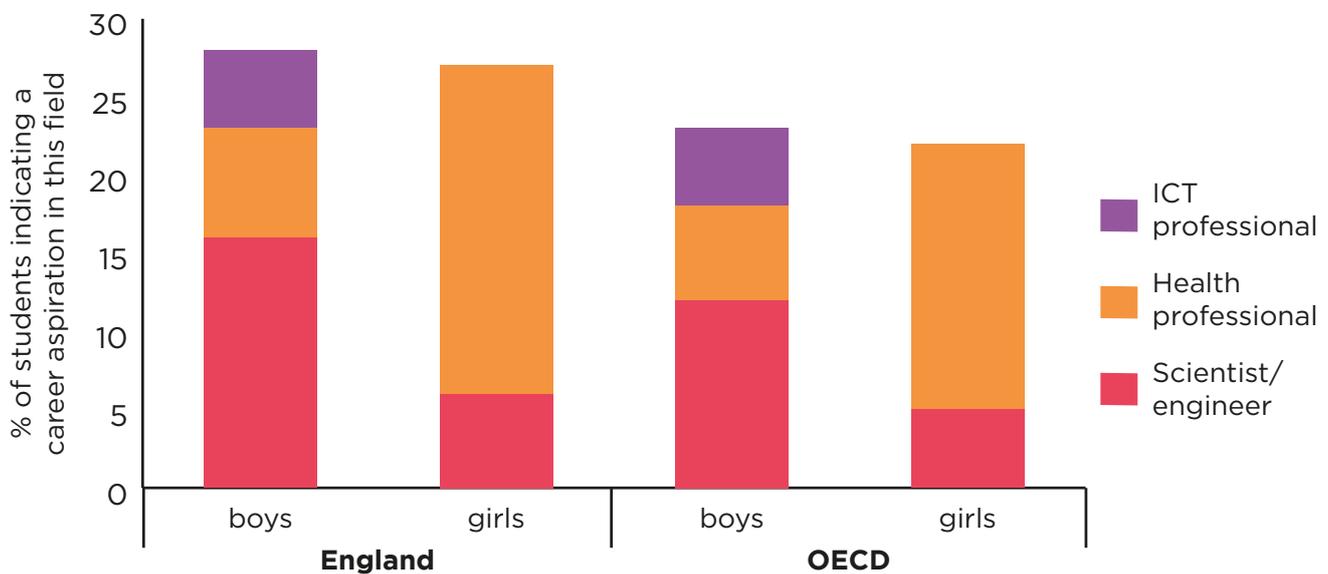
- TIMSS and PISA results show that England is in a good position to compete internationally in science-related fields, but lags behind in maths.

- The majority of students in PISA view school science as relevant to their future and 28 per cent aspire to a career in a STEM field, higher than the OECD average of 24 per cent. This has increased from PISA 2006 when only 16 per cent aspired to a STEM-related career.
- The most popular STEM-related aspirations were 'engineer' (six per cent) and 'medical doctor' (five per cent).

"Weaknesses in the UK's skills base have contributed to its long-standing productivity gap with France, Germany and the United States. It performs poorly on intermediate professional and technical skills, and is forecast to fall from 22nd to 28th out of 33 Organization for Economic Co-operation and Development (OECD) countries for intermediate skills by 2020."

GB. Parliament. HoC (2016)

Boys and girls have different career aspirations



One-in-five girls (21 per cent) in England are interested in a career as a health professional, compared to seven per cent of boys (Jerrim and Shure, 2016). Conversely, boys in England are more likely to aspire to become a scientist/engineer than girls (16 and 6 per cent respectively).

This gender difference is not unique to England. Internationally, boys are more than

twice as likely as girls to expect to work as engineers, scientists or architects (OECD, 2017a). Additionally, nearly five per cent of boys expect to work as ICT professionals, on average, across OECD countries. However, less than one per cent of girls expected the same. Girls are almost three times more likely than boys to expect to work as doctors, veterinarians, nurses or other health professionals.

The socio-economic gap is relatively high in England, but many students also overcome disadvantage

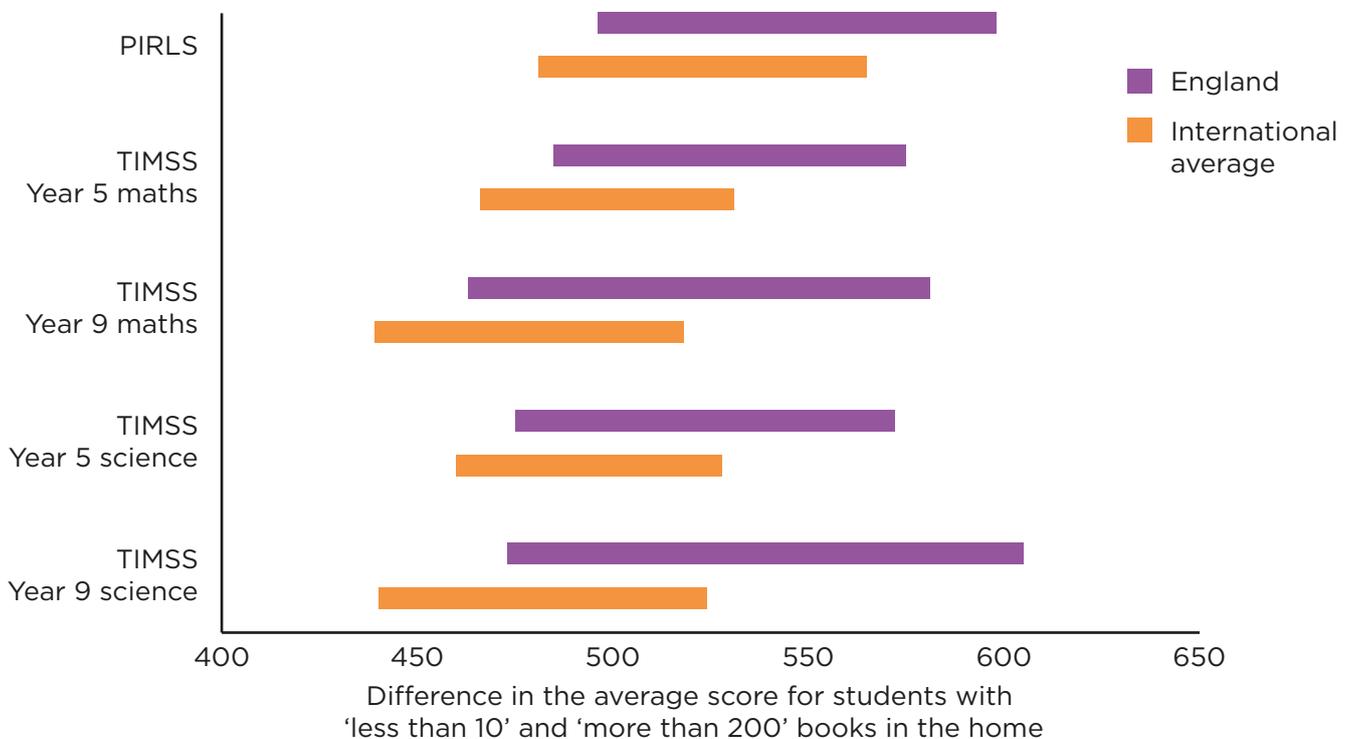
Social mobility is a key priority for the Government, which has an ambition to close the attainment gap. ILSAs can help point out in more detail the extent to which England provides opportunities for young people from all socio-economic groups.

“... disadvantaged children remain – on average – four months behind at the end of reception year, 11 months behind at the end of primary school and 19 months behind at key stage 4”

GB. Parliament. HoC. (2017)

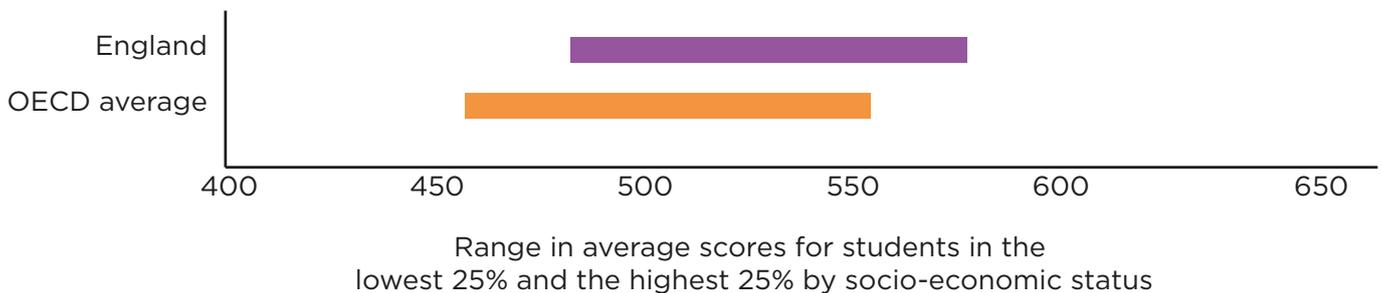
- In PIRLS and TIMSS, the number of books in the home is used as a measure of socio-economic status³. In PIRLS, there is a difference of more than 100 points between students reporting having the most and least books at home. In TIMSS 2015, at both year 5 and year 9, there are similarly large differences.
- In PISA, the main measure of socio-economic status is the Economic, Social and Cultural Status (ESCS) index. This is based on parental occupation and home possessions. The impact of socio-economic background in PISA 2015 is similar to that of many other countries.
- In England, the relationship between ESCS and average maths score has not improved since 2006, with the difference between the most and least disadvantaged students being equivalent to over three years of schooling (Wheater *et al.*, 2016).

The socio-economic gap in PIRLS and TIMSS



³ See NFER’s research for a more sophisticated socio-economic measure, based on PISA’s index of ESCS, which was used to analyse Northern Ireland’s TIMSS data (Bradshaw *et al.*, 2018). This is not currently replicable with England data, as England does not administer a parent questionnaire.

The socio-economic gap in PISA science is similar to other OECD countries



Resilience in PISA⁴

As well as the *size* of the effect of socio-economic status on attainment (i.e. the difference in attainment between a typical high and low socio-economic status student), the strength of the effect is also important (i.e. how much variation there is, and hence the likelihood that some students ‘buck the trend’). One way to consider the strength of the effect is by examining the concept of resilience.

The term ‘resilience’ refers to the positive adjustment that enables individuals to overcome adversity; and academic resilience can be used to characterise students who succeed in school despite coming from a socio-economically disadvantaged background (Agasisti, 2018).

Factors which are associated with resilience:

- a positive classroom disciplinary climate
- availability of extra-curricular activities
- low turnover of teachers.

Encouragingly, around a third of students in England are classed as ‘resilient’, overcoming a disadvantaged socio-economic background to achieve top scores, compared with an OECD average of 29 per cent.

⁴ See NFER’s research (Wheater *et al.*, 2016) for further findings on resilience in PISA

Germany is reducing the socio-economic gap

In PISA 2000, Germany had one of the lowest levels of social equity amongst all of the OECD countries, which caused major shock to the education system. This swiftly led to the implementation of large-scale reforms including:

- The 2004 development of a ‘common standard’ within subjects across Germany’s 16 states.
- The 2006 adoption of a comprehensive strategy for educational monitoring, including a cross-state comparative study (Vergleichsarbeiten) for third and eighth grade students. Results of which are used for monitoring instead of accountability; teachers can see the strengths and weakness of their students, allowing them to target their most disadvantaged students.
- A reduction in the amount of selectivity within the education system.
- An increased investment in comprehensive schools where children of all abilities are taught together.

The recent PISA results suggest Germany has managed to improve in all three subjects whilst decreasing inequality in its school system. The proportion of resilient students has also risen from 25 per cent in 2006 to 32 per cent in 2015.

Teachers and headteachers in England are more positive about school climate than their students

PIRLS, TIMSS and PISA include questionnaires completed by the headteachers and teachers of the sampled students, as well as the students themselves. Headteacher and teacher questionnaires contain questions addressing the school climate, formulating scales such as schools' emphasis on academic success, teachers' job satisfaction, and problems facing teachers. These questionnaires also address school safety by looking at discipline problems, bullying, and how safe and orderly schools are. These findings provide contextual information, giving insight into what is actually happening in schools.



“The key task for a school leader is to create a culture - usefully defined as ‘the way we do things around here’- that is understood and subscribed to by the whole school community.”

Bennett (2017)

- In PIRLS, teachers report that their schools are safe and orderly and headteachers report that issues with discipline are rare more, on average, than in other countries. However, the percentage of students reporting bullying is higher than in many other countries.
- In TIMSS, headteachers and teachers report fewer problems with school climate than in other countries while students report bullying at a similar rate to students in other countries.
- In PISA, 93 per cent of headteachers report that they pay attention to disruptive behaviour, compared to an OECD average of 82 per cent. However, there is more frequent student-reported disruption in science classrooms in England than in the average high-performing country - especially compared with East Asia - although this is similar to many other industrialised countries.

South Korea: the trade-off between high achievement and student wellbeing

South Korea is one of the highest-performing countries in the world. Well-disciplined classrooms and long hours of studying are commonly considered to be contributory factors in this success. However, it has also consistently scored lowest in various studies when it comes to student wellbeing, happiness at school and the general quality of life of young people. In PISA 2015, for example, only 53 per cent of students reported that they are satisfied or very satisfied with life, compared with an OECD average of 71 per cent. In response to the alarming rate of unhappiness and high suicide rates among young people, several reforms have been introduced, including:

- The 2015 Revised National Curriculum which aims to nurture creative and integrative learners.
- The ‘Free Semester’ system in middle schools that aims to enhance the happiness and wellbeing of students by giving them opportunities to explore non-academic dreams and aptitudes.
- A ‘character education plan’ which encourages schools to implement experience and project-based activities, including sports activities and music.

England has a high level of teacher shortages compared with other countries⁵

“A variety of factors have contributed to the growing sense of crisis for schools in England struggling to retain and develop their teachers. Particularly worrying is that the number of secondary school teachers has been falling since 2010 and more teachers have been leaving the profession for reasons other than retirement since 2012.”

GB. Parliament. HoC. Committee of Public Accounts (2018)

- In TIMSS, headteachers reported more teacher recruitment problems than many other countries. Around half of year 9 students were in schools with shortages in both subjects; 67 per cent of headteachers find year 9 science vacancies hard to fill.
- In PISA, the number of headteachers reporting teacher shortages was high compared with other countries (England 45 per cent, international average 30 per cent). Only two high-performing countries complained of more teacher shortages than England (Japan 55 per cent, China 64 per cent).

5 For more research into teacher recruitment and retention in England visit www.nfer.ac.uk/research/school-workforce

How high-performing countries develop and support teachers

“In countries that performed above the OECD average in science, at least 80 per cent of the students are in schools that invite specialists to conduct teacher training or organise in-service workshops for teachers or where teachers cooperate with each other. This is higher, on average, than what is observed among other countries.”

OECD (2017b)

Key considerations when looking at ILSAs

The anticipation that surrounds these ILSAs, especially on the day the findings are released, creates an opportunity for misrepresentation of the data. Here are some important notes regarding interpretations of findings:

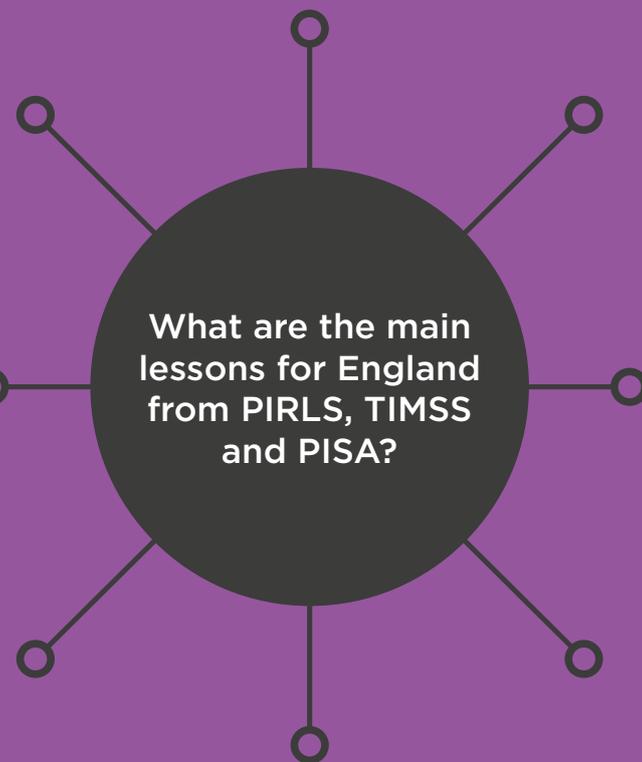
1. Simply looking at whether a score is higher or lower than in previous study cycles does not tell us accurately whether achievement has improved, is stable or is in decline. It is crucial to consider whether a score is *statistically significantly* different – in other words, the differences have not arisen solely by chance.
2. It is tempting to focus on ‘rankings’ when comparing achievement between countries. However, ‘rankings’ can be misleading because small difference in scores may not be statistically significant.
3. ‘Rankings’ can also be volatile, varying according to the number and mix of countries participating in any given cycle. One country’s position relative to other countries is not just based on its own performance. It’s also influenced by how many countries participate, as well as which countries they are and whether their performance has changed since the last round of the study.
4. No ILSA covers all subjects. Single assessments cannot measure everything, so it is important to remember that there are other areas children and young people need to learn, and avoid narrowing their curricula.
5. The data from these ILSAs alone do not provide a magic formula for policy changes that will improve achievement. It is therefore important to consider these studies alongside other sources of evidence.

England is strongest in science and primary reading. The weakest subject is maths but TIMSS shows some encouraging improvements at primary level.

An encouragingly high number of 15-year-olds have ambitions to work in STEM-related fields, although there are gender differences in the type of career they aspire to.

Teacher shortages, especially at secondary level, are more of a problem in England than in many other countries.

Some countries, such as Canada, have high scores and narrow gender and socio-economic gaps. Improvement in England's average score as well as a reduction in the size of the gaps is possible.



The 'Asian tiger' countries dominate in all subjects and all age groups. These countries highly value their education system and their teachers. They collectively place emphasis on effort rather than innate ability and have adopted a learning and competency-based education. However, there are concerns about the impact this ethos may have on their children and young people.

Achievement is improving at primary level, but not at secondary. Attention is needed to the transition to secondary level to ensure that the progress made at primary level is maintained.

Teachers and headteachers are, on the whole, more positive about school climate than their students.

The effects of socio-economic status are relatively high, although some high-performing countries have an even larger gap than England. Nevertheless there is still a long tail of underachievement in England which needs to be addressed.

Agasisti, T., Avvisati, F., Borgonovi, F. and Longobardi, S. (2018). 'Academic resilience: What schools and countries do to help disadvantaged students succeed in PISA', *OECD Education Working Papers*, No. 167, OECD Publishing, Paris [online]. Available: <http://dx.doi.org/10.1787/e22490ac-en> [30 April, 2018].

Great Britain. Parliament. House of Commons (2016). *Post-16 Skills Plan*, (Cm. 9280). London: TSO [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/536043/Post-16_Skills_Plan.pdf [30 April, 2018].

Boylan, M. (2016). 'PISA results: four reasons why East Asia continues to top the leaderboard' *The Conversation*, 6 December [online]. Available: <https://theconversation.com/pisa-results-four-reasons-why-east-asia-continues-to-top-the-leaderboard-69951> [30 April, 2018].

Bradshaw, J., De Lazzari, G. and Andrade, J. (2018). Performance in TIMSS 2015 of Disadvantaged Pupils in Northern Ireland. Slough: NFER [online]. Available: <https://www.education-ni.gov.uk/sites/default/files/publications/education/Performance-in-TIMSS-2015-of-disadvantaged-pupils-in-Northern-Ireland.pdf> [30 April, 2018].

Cheng, K. (2017). Advancing 21st Century Competencies in East Asian Education Systems [online]. Available: <http://asiasociety.org/sites/default/files/21st-century-competencies-east-asian-education-systems.pdf> [30 April, 2018].

Great Britain. Parliament. House of Commons (2017). *Unlocking Talent, Fulfilling Potential*. (Cm. 9541). London: TSO [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/667690/Social_Mobility_Action_Plan_-_for_printing.pdf [30 April, 2018].

Bennett, T. (2017). *Creating a Culture: How School Leaders Can Optimise Behaviour* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/602487/Tom_Bennett_Independent_Review_of_Behaviour_in_Schools.pdf [30 April, 2018].

Jerrim, J and Shure, N. (2016). *Achievement of 15-Year-Olds in England: PISA 2015 National Report* [online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/574925/PISA-2015_England_Report.pdf [30 April, 2018].

OECD (2015). *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*. PISA, OECD Publishing: Paris [online]. Available: <http://dx.doi.org/10.1787/9789264229945-en> [30 April, 2018].

OECD (2017a). 'What kind of careers in science do 15-year-old boys and girls expect for themselves?' *PISA in Focus*, No. 6, 27 February [online]. Available: https://www.oecd-ilibrary.org/education/what-kind-of-careers-in-science-do-15-year-old-boys-and-girls-expect-for-themselves_76e7442c-en [30 April, 2018].

OECD (2017b). 'What do we know about teachers' selection and professional development in high-performing countries?' *PISA in Focus*, No. 70, 21 March [online]. Available: <http://www.oecd-ilibrary.org/docserver/download/87acdc87-en.pdf> [30 April, 2018].

Great Britain. Parliament. House of Commons. Committee of Public Accounts (2018). *Retaining and Developing the Teaching Workforce* (HC 460). London: TSO [online]. Available: <https://publications.parliament.uk/pa/cm201719/cmselect/cmpubacc/460/460.pdf> [30 April, 2018].

Wheater, R., Durbin, B., McNamara, S. and Classick, R. (2016). *Is Mathematics Education in England Working for Everyone? NFER Analysis of the PISA Performance of Disadvantaged Pupils*. Slough: NFER [online]. Available: <https://www.nfer.ac.uk/publications/PIAN01/PIAN01.pdf>

Sources: The ILSA study data presented in this briefing comes from international reports available online at:

TIMSS 2015
<http://timss2015.org/timss-2015/mathematics/student-achievement/>
<http://timss2015.org/timss-2015/science/student-achievement/>

PIRLS 2016
<http://timssandpirls.bc.edu/pirls2016/international-results/>

PISA 2015
<http://www.oecd.org/pisa/>

