

Programme for International Student Assessment (PISA) 2012

December 2013

Introduction

This Research Note gives an overview of Wales' results in the 2012 cycle of the Programme for International Student Assessment (PISA), which were published on 3 December 2013. PISA is a survey of the educational achievements of 15 year olds in 65 countries around the world. It is organised by the Organisation for Economic Co-operation and Development (OECD) and takes place every three years.¹

Key points

- Wales' score has fallen in Mathematics and Science since 2009, whilst it has risen in Reading. Its score has decreased overall since 2006 in all three domains.
- Wales' ranking has fallen in all three domains since 2009.
- Wales has the lowest score and ranking in each of the three PISA domains of any of the four UK nations.
- In all three domains, Wales' score is lower than both the UK and OECD averages. With the exception of Northern Ireland's performance in Mathematics, no other UK nation has a score lower than the OECD average in any domain.

¹ For further introductory information on the programme, see the Research Service's Quick Guide, '*Programme for International Student Assessment (PISA)*', November 2013.

- In Reading and Mathematics, more countries have a significantly higher score than Wales than significantly lower.
- Wales' scores in each domain are significantly lower than more countries in the 2012 cycle compared to 2009.
- The scale of progress that will be required for Wales to be a top 20 PISA nation in 2015 is between 24 and 33 points and between 16 and 23 ranking places across the three domains.

Sampling arrangements

PISA tests are taken by a sample of 15 year olds in Wales, with age, rather than year group, being the decisive factor. However, there is a small amount of flexibility and, in reality, the PISA 2012 sample in Wales (as well as England and Northern Ireland) consisted of pupils aged from 15 years and two months to 16 years and two months. The tests were sat by pupils in Wales in November 2012.

Participating countries must follow specified international sampling procedures to ensure their samples are comparable. Certain variables are factored into the sampling process from the outset, including school type, region, gender, school band, and local authority to seek to ensure a fair and representative sample.

The Welsh Government provides a list of eligible schools and pupils to the PISA consortium which selects an original main sample. In PISA 2012, this was 153 schools. It is not compulsory for schools selected to agree to participate, and those who decline are replaced by schools from a back-up sample. However, according to PISA sampling rules, 85 per cent of the original main sample of schools must take part for the country's results to be valid.

30 pupils are selected at random from each school in the sample. Another sampling requirement is that at least 50 per cent of pupils selected must participate for a school to be counted as a participating school.

In total, 3,305 pupils from 137 schools in Wales took part in PISA 2012.²

Schools and pupils had the choice between taking the tests in either English or Welsh, although all tests taken by an individual pupil had to be in the same language. Tests were taken in Welsh in 22 of the 137 schools, with all pupils doing the Welsh tests in 14 of these, and some pupils in the remaining 8 schools doing all the tests in Welsh and other pupils undertaking them all in English. **In total, 381 pupils undertook the Welsh language version of the tests.**

Testing arrangements

The tests were designed by an international consortium led by the Australian Council for Educational Research on behalf of the OECD. They were administered by the National Foundation for Educational Research (NFER) across the four UK nations.

Mathematics was the lead domain in PISA 2012 and, as such, there were a number of different Mathematical areas assessed. These consisted of four content areas and three process categories, enabling the results to be analysed to see how well pupils fared in these different areas of Mathematics.

Of the 13 test booklets, half of these assessed Mathematics while the remainder were split between Reading and Science. **All pupils took the tests in Mathematics while random sub-samples of approximately 70 per cent of pupils were assessed in the other two domains.** The results in Reading and Science were used to estimate scores for the whole sample.

² Further details of the sampling process are contained on pages 100-103 of Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013). *Achievement of 15-year-olds in Wales: PISA 2012 National Report*. Slough: NFER.

Wales' scores relevant to previous cycles

Wales' scores in 2012 represent the following changes from 2009:

- A decrease of 4 points in Mathematics
- A rise in 4 points in Reading
- A decrease of 5 points in Science

The overall changes since 2006 when Wales first participated in PISA are as follows:

- A 16 point fall in Mathematics
- A 1 point fall in Reading
- A 14 point fall in Science.

Table 1: Wales' mean scores in the PISA 2006, 2009 and 2012 cycles

Domain	Wales' mean score		
	2006	2009	2012
Mathematics	484	472	468
Reading	481	476	480
Science	505	496	491

Source: Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013), *Achievement of 15-year-olds in Wales: PISA 2012 National Report*, Appendix B21, p124; Appendix C6, p136; Appendix D6, p142.
Notes:

- a) The lead domain in 2006 was Science, in 2009 it was Reading, and in 2012 it was Mathematics.

There is a question over to what extent valid comparisons can be made between a country's scores over different PISA cycles. The Welsh Government's Cabinet Statement on **7 December 2010**, following the publication of the 2009 results, stated that it was not statistically valid to compare the 2006 and 2009 results, despite publishing them in a table in the statement for the purposes of public interest. The statement on **3 December 2013** regarding the 2012 results contained no such caveat.

In its chapter on the lead domain for 2012, Mathematics, the NFER's report on Wales states that it is not possible to compare data between cycles when a subject was a lead domain in one of these and a minor domain in another. However, the report's tables at

Appendices B21, C6 and D6, which compare scores over the different cycles, make no note of this.

This notwithstanding, PISA uses a test of statistical significance to ascertain whether differences between a country's scores over time, or indeed between different countries' scores in the same cycle, can be explained merely by potential sampling or measurement errors. If a difference cannot be explained by these factors, then it is considered to be 'statistically significant'.

- The differences between Wales' scores in any of the three domains between 2009 and 2012 are not statistically significant.
- The reductions in Wales' Mathematics and Science scores between 2006 and 2012 are statistically significant.
- There is no statistically significant difference in Wales' scores in Reading between 2006 and 2012.

Wales' international ranking has fallen in each of the three domains from 2009.

- In Mathematics, its ranking has fallen from 40th in 2009 to 43rd in 2012.
- Its ranking in Reading has dropped from 38th in 2009 to 41st in 2012.
- In Science, its ranking has fallen from 30th in 2009 to 36th in 2012.

The PISA rankings in the Wales specific report are based on a group of 68 nations; the 64 nations which participated in PISA (excluding the UK) and the four home nations.

Comparisons with other UK nations

Whilst the PISA 2012 study published by the OECD lists the UK's scores overall, as a single participating country, the survey is undertaken in a way that allows disaggregation of the scores for the four home nations. This means that, in addition to making comparisons with countries around the world, the performances of the samples of 15 year olds participating in PISA can be compared between Wales, England, Scotland and Northern Ireland.

Table 2 below shows the scores of the four UK nations in each of the three domains, alongside the UK's overall score and the OECD average.

Table 2: PISA 2012 scores for different parts of the UK

	<i>mean score</i>		
	Mathematics	Reading	Science
Wales	468	480	491
England	495	500	516
Scotland	498	506	513
Northern Ireland	487	498	507
UK	494	499	514
OECD	494	496	501

Source: Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013). *Achievement of 15-year-olds in Wales: PISA 2012 National Report*, Appendix B1, p104; Appendix C1, p131; Appendix D1, p137.

In the OECD's rankings, the UK is placed 26th in Mathematics, 23rd in Reading and 22nd in Science. In addition, the individual UK nations are ranked within each domain in the NFER report on Wales.

Table 3: PISA 2012 rankings for different parts of the UK

	<i>ranking</i>		
	Mathematics	Reading	Science
Wales	43	41	36
England	26	24	18
Scotland	25	21	22
Northern Ireland	32	25	24

Source: Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013). *Achievement of 15-year-olds in Wales: PISA 2012 National Report*, Appendix B1, p104; Appendix C1, p131; Appendix D1, p137.

Notes:

- a) These rankings are based on excluding the UK as a whole and including the four UK nations. This has the effect of ranking the four UK nations within a group of 68 nations (the other 64 besides the UK plus the four of them). In practice, some of the scores for the 68 are omitted from the rankings as they have very low scores (below 430). All of these are ranked below all of the four UK nations.

The following significant points emerge from the data:

- Wales' scores (and therefore its rankings) in each of the three domains are lower than those for England, Scotland and Northern Ireland in all cases. In each of the domains, the difference is statistically significant.
- Wales' score in Mathematics is 4 points lower than in 2009, whereas the overall UK score has risen by 2 points.
- In Reading, Wales' score is up by 4 points from 2009, whilst the score for the UK has risen by 5 points.
- Wales' score in Science has fallen by 5 points since 2009, whereas for the UK as a whole it has remained the same.
- Other than Northern Ireland in the case of Mathematics, no other UK nation has a score lower than the OECD average. Wales' score is below the OECD average in all three domains.

How Wales compares to other countries in PISA 2012

Wales' scores are significantly lower than the OECD average in all three domains. The numbers, and lists, of countries with significantly higher and significantly lower scores than Wales in PISA 2012, as well as those with scores of no significant difference, are given below.³ (based on the 64 countries except the UK)

In Maths:

38 countries had significantly higher scores:

Shanghai-China, Singapore, Hong Kong-China, Chinese Taipei, Korea, Macao-China, Japan, Liechtenstein, Switzerland, Netherlands, Estonia*, Finland*, Canada, Poland*, Belgium*, Germany*, Vietnam, Austria*, Australia, Republic of Ireland*, Slovenia, Denmark*,*

³ OECD countries not italicised, non-OECD countries italicised, EU countries marked with an asterisk*. Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013) *Achievement of 15-year-olds in Wales: PISA 2012 National Report*, Appendix B1, p104; Appendix C1, p131; Appendix D1, p137.

New Zealand, Czech Republic, France*, Iceland, Latvia*, Luxembourg*, Norway, Portugal*, Italy*, Spain*, Russian Federation, Slovak Republic*, United States, Lithuania*, Sweden*, Hungary*.*

2 countries' scores were not significantly different:

Croatia, Israel.*

24 countries had significantly lower scores:

Greece, Serbia, Turkey, Romania*, Cyprus*, Bulgaria*, United Arab Emirates, Kazakhstan, Chile, Mexico, plus 14 other countries whose scores were omitted from the rankings list.*

In Reading:

31 countries had significantly higher scores:

Shanghai-China, Hong Kong-China, Singapore, Japan, Korea, Finland, Republic of Ireland*, Canada, Chinese Taipei, Poland*, Estonia*, Liechtenstein, New Zealand, Australia, Netherlands*, Belgium*, Switzerland, Macao-China, Vietnam, Germany*, France*, Norway, United States, Denmark*, Czech Republic*, Italy*, Austria*, Latvia*, Hungary*, Spain*, Luxembourg**

10 countries' scores were not significantly different:

Portugal, Israel, Croatia*, Sweden*, Iceland, Slovenia*, Lithuania*, Greece*, Turkey, Russian Federation.*

23 countries had significantly lower scores:

Slovak Republic, Cyprus*, Serbia, United Arab Emirates, Chile, Thailand, Costa Rica, Romania*, Bulgaria*, Mexico, plus 13 other countries whose scores were omitted from the rankings list.*

In Science:

25 countries had significantly higher scores:

Shanghai-China, Hong Kong-China, Singapore, Japan, Finland, Estonia*, Korea, Vietnam, Poland*, Canada, Liechtenstein, Germany*, Chinese-Taipei, Netherlands*, Republic of Ireland*, Australia, Macao-China, New Zealand, Switzerland, Slovenia*, Czech Republic*, Austria*, Belgium*, Latvia*, France.*

12 countries' scores were not significantly different:

Denmark*, United States, Spain*, Lithuania*, Norway, Hungary*, Italy*, Croatia*, Luxembourg*, Portugal*, Russian Federation, Sweden*.

27 countries had significantly lower scores:

Iceland, Slovak Republic*, Israel, Greece*, Turkey, United Arab Emirates, Bulgaria*, Chile, Serbia, Thailand, Romania*, Cyprus*, Mexico, plus 14 other countries whose scores were omitted from the ranking list.

International comparisons relative to 2009

This Research Note has already highlighted that the PISA 2012 results show Wales' score fell in Mathematics and Science, whilst it rose in Reading, compared to 2009. The results also show that in each of three domains Wales' score and ranking is below both the UK and OECD averages.

In Mathematics and Reading, more countries have significantly higher than significantly lower scores, compared to Wales, whilst in Science there are two more countries with significantly lower scores than significantly higher.

It is also of note, however, to compare this relationship with other countries in terms of statistically significant differences across the 2009 and 2012 cycles.

Table 4: Wales' significant differences with other countries in PISA 2009 and 2012

	number of countries	
	2009	2012
Mathematics		
Significantly higher than Wales	35	38
No significant difference	3	2
Significantly lower than Wales	26	24
Reading		
Significantly higher than Wales	29	31
No significant difference	10	10
Significantly lower than Wales	25	23
Science		
Significantly higher than Wales	20	25
No significant difference	15	12
Significantly lower than Wales	29	27

Source: Wheeler, R., Ager, R., Burge, B. and Sizmur, J. (2013).

Achievement of 15-year-olds in Wales: PISA 2012 National Report, Appendix B1, p104; Appendix C1, p131; Appendix D1, p137, and Bradshaw, J., Ager, R., Burge, B. and Wheeler, R. (2013). *PISA 2009: Achievements of 15-year-olds in Wales*, Appendix A1, p59; Appendix B1, p74; Appendix C1, p79.

Notes:

- a) In both cycles, the number of participating countries was 65, meaning that once the UK's overall figure is removed, there are 64 countries with which to compare Wales' score in both 2009 and 2012.

From Table 4, it can be seen that the number of countries with significantly higher scores than Wales has risen since 2009 in all three domains.

How important is PISA?

PISA is generally regarded as a valuable and useful tool of comparing different countries' education systems and allowing countries to assess their position relative to their international counterparts, although there are some critics of the programme as well. It is important to stress that the PISA study in its entirety is about more than just rankings as it provides a deeper analysis of the characteristics of high performing countries that others may seek to emulate.

However, the overall scores and rankings of different nations inevitably become the main focus of attention with the publication of each cycle of results. Arguably, this is particularly so when a nation-state's results are broken down into regions or nations, as in the case of the UK. Furthermore, rankings are likely to receive additional profile where there are significant education policy diversions, again as with the UK home nations.

What does PISA measure?

PISA tests 15 year old pupils, as they near the end of their compulsory education, on their ability to apply their knowledge and skills to address real life challenges, as set out in the tests. This sets PISA apart from other forms of pupils' assessment, such as GCSEs 'which measure their mastery of the school curriculum', and PISA instead measures their 'literacy' in these areas.⁴

The OECD has said that PISA questions require pupils to go beyond simply reproducing what they are taught and to extrapolate and apply this to unfamiliar settings.⁵ Sample PISA questions are available on the 'Try the test' section of the OECD website.

Gareth Pierce, the Chief Executive of the WJEC, has offered one possible distinction which is that PISA is primarily for states to evaluate and compare how effective their education systems are, whilst GCSEs enable students to demonstrate their suitability for further and higher education as well as for the employment market.⁶

This distinction may be significant as, unlike GCSEs, which pupils recognise are important in enabling them to progress to employment or further education or training, PISA tests arguably do not provide the same level of personal incentive to pupils.

⁴ Wheater, R., Ager, R., Burge, B. and Sizmur, J. (2013). *Achievement of 15-year-olds in Wales: PISA 2012 National Report*, p11.

⁵ OECD (2013), *PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science (Volume I)*, PISA, OECD Publishing, p24

⁶ Gareth Pierce, "PISA versus GCSE: where does attainment most matter?", Presentation to the *Institute of Welsh Affairs conference "The second wave in Welsh school improvement"*, 8 March 2013 [accessed 6 December 2013]

Debate and criticism over PISA methodology

PISA has not been immune to criticism of its methodology and validity. Amongst the most prominent of these critics is Professor Svend Kreiner of the University of Copenhagen, Denmark who in 2011 wrote an article criticising the scaling model used by PISA and therefore the foundations of the programme.⁷ During the same year, the OECD responded to Kreiner's critique, defending its methodology.⁸

Whilst there is on-going debate about the usefulness and applicability of PISA⁹, it is important to recognise that governments around the world take its findings seriously and it clearly has a considerable influence on policy. As Sir Michael Barber, chief education strategist with Pearson and former adviser to the UK Government, commented:

'The arrival of new PISA results every three years focuses minds in education ministries around the world like nothing else. The objective data encourages ministers to take a fair view of their system's performance, and review which education reforms are having the greatest impact. (...) The result is that education ministers and officials around the world now engage in continuous dialogue about education reform. None can afford to ignore the mounting evidence of what works and what doesn't.'¹⁰

Influence on Welsh Government policy

The importance and relevance with which PISA is regarded is evident from the influence the 2009 results have had on Welsh Government policy. In a high profile **speech on 2 February 2011**, Wales' PISA 2009 results were described as a 'wake up call to a complacent system' by the then Minister for Children, Education and Lifelong Learning, Leighton Andrews. Policy responses to PISA therefore formed a significant part

⁷ Kreiner, S. (2011) *Is the Foundation Under PISA Solid?: A Critical Look at the Scaling Model Underlying International Comparisons of Student Attainment*, Department of Biostatistics, University of Copenhagen

⁸ Adams, R (2011) *Comments on Kreiner 2011: Is the foundation under PISA solid? A critical look at the scaling model underlying international comparisons of student attainment*, OECD

⁹ See also TES, *Is PISA fundamentally flawed?* 26 July 2013 [accessed 5 December 2013]

¹⁰ The Pearson Blog, *Sir Michael Barber reflects on more PISA shock*, 3 December 2013 [accessed 5 December 2013]

of the '20 point action plan' outlined by the Welsh Government in Cabinet Statements, firstly on **2 February 2011** and expanded upon on **7 February 2012**.

Former Minister Leighton Andrews said at the time of the publication of the 2009 results:

'PISA is a highly respected and robust measure of the relative performance of education systems. These results cannot be argued away or excused.'¹¹

The **Cabinet Statement** of 3 December 2013 from the current Minister for Education and Skills, Huw Lewis, reiterated that '[the Welsh Government] do not underestimate the gravity of these [the 2012] results.'

Comparing GCSE results

In light of the distinction drawn between PISA and other forms of assessment at age 15 to 16 such as GCSEs, it is perhaps useful to look at differences in these results between Wales and England to see if they present a similar impression.

Table 5 provides GCSE results for both Wales and England in English Language and Mathematics. As with the Reading and Mathematics domains in PISA, Wales' results for grades A*-C are lower than England's. It is, however, noteworthy, that the proportion of pupils achieving grades A*-C in GCSE Welsh Language was in fact higher than for GCSE English Language in both Wales and England, over the whole of the five year period covered.

¹¹ Welsh Government, Leighton Andrews (Minister for Children, Education and Lifelong Learning), *Statement on the Programme for International Student Assessment (PISA) 2009 Results*, Cabinet Written Statement, 7 December 2010

Table 5: GCSE results in Wales and England

	percentage of entries			
	English Language		Mathematics	
	A*-C	A*-G	A*-C	A*-G
2012/13				
Wales	62	99	59	97
England (p)	70	99	73	98
2011/12				
Wales	62	99	57	97
England	69	99	71	98
2010/11				
Wales	63	99	60	97
England	72	99	67	98
2009/10				
Wales	63	99	59	97
England	70	99	65	98
2008/09				
Wales	62	99	57	96
England	66	99	61	98

Source: Extracted from a number of statistical releases by Welsh Government, **Statistics for Wales**, and Department for Education (England), GOV.UK, **Publications**

Notes:

- a) Percentages are a proportion of entries
- b) (p): 2012/13 figures for England are provisional
- c) The figures in England for English Language for 2012/13 and 2011/12 are actually denoted as 'English' in the relevant statistical releases. However, this relates to English Language as distinct from English Literature.

Other information provided by PISA

PISA's coverage extends considerably further than the three domain's overall mean scores and subsequent rankings. In particular, there is more detailed analysis of performance within the lead domain of Mathematics. This focuses on the four content areas of *quantity; uncertainty and data; change and relationships; and space and shape*, and the three process categories of *formulating* situations mathematically; *employing* concepts, facts, procedures and reasoning; and *interpreting, applying and evaluating* mathematical outcomes.

Other areas of coverage under PISA 2012 include:

- Gender differences in performance
- Spread of performance: differences between highest and lowest attainers
- Pupil questionnaires to ascertain interest and attitudes towards different elements of learning.

- School questionnaires regarding the school system and learning environment.
- Relationship between performance and equity in educational opportunities
- Relationship between performance and resources
- Relationship between performance and socio-economic conditions, and the level of 'resilience' of pupils (high performance despite low socio-economic conditions)

Not all of the above elements of PISA are covered within this Research Note, although the information in full is located on the PISA 2012 results section of the OECD website. [Note: some of this data may only be available at a UK level.]

Implications for the top 20 target

Following the 2009 results, the Welsh Government set an aim that Wales would be in the top 20 of the PISA 2015 rankings. Both the former Minister, Leighton Andrews, and current Minister, Huw Lewis stressed on a number of occasions that many of the reforms that were being put in place would take several years to take effect and that they did not expect to see large improvement in the 2012 results.

However, given that Wales' ranking has gone down in all three domains and its points score has fallen in two of them, the rate of improvement by 2015 will need to be considerable. This is particularly evident in light of the gap between Wales' 2012 results and the top 20:

- In Mathematics, Wales would have to improve by 33 points and 23 ranking places to be in the top 20 in 2015.
- In Science, Wales would have to improve by 24 points and 16 places to be in the top 20 in 2015.
- In Reading, Wales would have to improve by 28 points and 21 places to be in the top 20 in 2015.

If the aim is still going to be met, the improvement will now need to be achieved over one PISA cycle of three years, although it should be remembered that many of the reforms the Welsh Government intends will have an impact have already started. Michael Davidson, Principal Analyst at the OECD, who is responsible for overseeing PISA, said in 2012:

'A 20-point increase in the space of **six years** would be a challenge. It's not impossible, but it would be at the upper end of what other countries have achieved.'¹² [my emphasis]

Professor David Reynolds also remarked in between the 2009 and 2012 results that a rise of up to twenty places and a 30-40 point increase in Mathematics has only been achieved by Chile, and that this took ten years rather than six (or three).¹³

When questioned about the aim in Plenary on 4 December 2013, the Minister for Education and Skills, Huw Lewis, said:

'We have a stated aim that Wales should be a top 20 PISA country. I am not going to lower expectations or the challenge that is in front of our educational system and our schools and our professionals in Wales. Those aspirations remain undimmed and unchanged.'¹⁴

OECD Review of Education in Wales

The same organisation which runs PISA, the OECD, is currently undertaking a separate review of education in Wales at the request of the Welsh Government. The decision to commission the OECD to carry out the review, which is focusing on 3 to 16 education and transition to and from this stage, was taken by the former Minister for Children, Education and Lifelong Learning, Leighton Andrews, on 4 December 2012.

¹² TES, *We'll reach Pisa goals but perhaps not this year*, Friday July 2012 [accessed 5 December 2013]

¹³ David Reynolds, 'How can Wales perform better in PISA 2015/16?', presentation to the *Institute of Welsh Affairs conference "The second wave in Welsh school improvement"*, 8 March 2013 [accessed 5 December 2013]

¹⁴ National Assembly for Wales, Plenary, *RoP[14.04]*, 4 December 2013

The key objectives set by the Welsh Government for the review are:

- To provide an external assessment of the quality and equity of education outcomes in Wales.
- To draw upon lessons from PISA and other benchmarking countries/ regions with an expert analysis of key aspects of education policy in Wales.
- To invite the OECD, on the basis of their analysis, to highlight areas of policy and its implementation which might add further value to the Welsh Government's education reforms.

The OECD is due to report on its review in March 2014.

Further information

For further information about **PISA**, please contact **Michael Dauncey** (michael.dauncey@Wales.gov.uk), Research Service.

See also:

- National Foundation for Educational Research, **Achievement of 15-year-olds in Wales: PISA 2012 National Report**, December 2013
- OECD, **PISA 2012 Results: What Students Know and Can do : Student Performance in Mathematics, Reading and Science (Volume I)**, December 2013
- Research Service Quick Guide, **PISA**, November 2013
- Welsh Government, Huw Lewis (Minister for Education and Skills), **PISA 2012**, Cabinet Written Statement, 3 December 2013

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