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Programme for International Student Assessment (PISA) 2015: Highlights from Scotland's Results: Collaborative Problem Solving



CHILDREN, EDUCATION AND SKILLS



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Main Messages

Key points

- Scotland performed above the OECD average in the Programme for International Student Assessment (PISA) of collaborative problem solving in 2015
- The proportions of Scottish pupils performing at the highest level of achievement (“Level 4”) were above the OECD average and those performing at the lowest levels (“below Level 2”) were below the OECD average
- The gradient of relationship between performance and social background was similar to the OECD average. However, the strength of the relationship was lower than the OECD average. The performance of students from immigrant and non-immigrant backgrounds was similar and the gap between them was smaller than the OECD average

Scotland’s performance in collaborative problem solving

- In collaborative problem solving, **Scotland’s performance in 2015 was higher than the OECD average** with a mean score of 513 points.

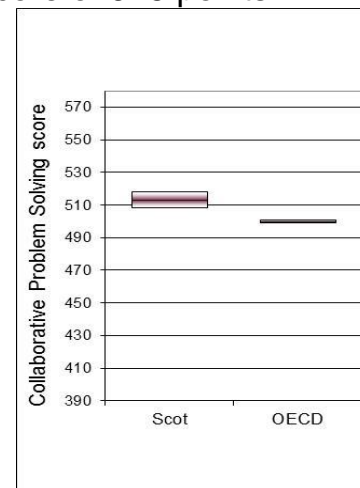
- With respect to Scotland’s relative position (compared to OECD countries and UK administrations) Scotland was outperformed by nine countries, was similar to six, and performed higher than 19.

- The **proportion of low performers (below Level 2) was 23.8 per cent and was lower than the OECD average (28.1 per cent).**

- The proportion of high performers (at Level 4) was 9.8 per cent, and was higher than the OECD average of 7.9 per cent.

- The **strength of relationship between social disadvantage and a pupil’s score in Scotland was lower than the OECD average.** About six per cent of the variation in Scotland could be explained by socio-economic factors.

- The **extent to which disadvantage was related to performance (or “gradient”) in Scotland was similar** to the average across OECD countries and amounts to around 28 points.



1. Introduction and Methodology

What is PISA?

1. The Programme for International Student Assessment (PISA) is an assessment of 15 year-olds' skills carried out under the auspices of the Organisation for Economic Co-operation and Development (OECD). The programme runs every three years across all OECD members and a variety of partner countries. Scotland has participated in all six surveys since the first wave of testing in 2000.
2. Each survey cycle focusses on one of three domains: reading, mathematics and science. In 2015 the main domain was science, with maths and reading as subsidiary domains. Data on these domains was published in 2016. In 2015, for the first time, Scotland participated in the "innovative" domain - collaborative problem solving - and this report represents the results of that assessment.

Methodology

3. The survey was carried out in Scotland between 3 and 28 March 2015 in 109 secondary schools. The 3,123 students tested are generally described as "15 year-olds" although the actual age range was 15 years and 2 months to 16 years and 2 months as of 1 March 2015. Students were mostly (87.5 per cent) in the S4 year group.
4. The assessment items were in six clusters so that approximately half were science, the main domain, with the remainder split between reading, maths and collaborative problem solving.
5. The assessments are also supplemented by background questionnaires. Pupils are asked about their motivations for study, attitudes to school, views on science and studying, and their socio-economic background. Headteachers are asked about the challenges facing their schools, organisation and factors that they believe affect their students' performance. In 2015, we also participated in the Parents Questionnaire, sent to the parents of all student participants.
6. Further information on PISA worldwide, and how it was administered in Scotland, can be found in our [2016 report](#).
7. We have included some details on how collaborative problem solving was assessed in Chapter 2. Further details of how each domain was assessed can be found in the OECD volumes published on the PISA website, www.oecd.org/pisa.

Interpreting the results

8. It should be understood that PISA is a sample survey. Like all surveys of this type, it is subject to sampling error. The necessity of surveying only a sample of students, even when chosen at random, runs the risk that such a group will not necessarily reflect the larger population of students. We must therefore be

cautious in assuming that the values found in the survey would be the same as those in the population.

9. This means that being confident that there is a difference between Scotland and the OECD average, or between groups and countries, will depend on both the size of the observed difference and the standard error associated with the sample sizes used. Significance tests are used to assess the statistical validity of comparisons made.

10. Therefore, it is not possible to produce individual country rankings based on the absolute (mean) score. Accordingly this report shows results divided into those countries whose scores are statistically significantly higher than, similar to or lower than Scotland. By “significant” we mean that we are 95 per cent certain that there is a difference (or similarity). Where this report states that two figures are different, this has been established to be statistically significant. Where the report states that figures are similar, any differences were found to be statistically insignificant.

2. Collaborative Problem Solving and how it is assessed

11. PISA is designed to measure what students know, but also the application of knowledge in real-life situations. Below, we summarise key features of the OECD's framework for collaborative problem solving literacy.

The PISA framework for collaborative problem solving

12. The OECD define collaborative problem solving as:

the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills and efforts to reach that solution.

13. There are a number of concepts that underlie this definition. Some of these draw on problem-solving as a discipline in itself. PISA has its own definition of problem solving, developed for the Creative Problem Solving innovative domain administered in the 2012 cycle¹, as follows.

- **exploring and understanding:** exploring the problem situation by observing it, interacting with it, searching for information and finding limitations or obstacles; and demonstrating understanding of the information given and the information discovered while interacting with the problem situation
- **representing and formulating:** using tables, graphs, symbols or words to represent aspects of the problem situation; and formulating hypotheses about the relevant factors in a problem and the relationships between them to build a coherent mental representation of the problem situation
- **planning and executing:** devising a plan or strategy to solve the problem; executing the strategy; and perhaps clarifying the overall goal and setting sub-goals
- **monitoring and reflecting:** monitoring progress, reacting to feedback, and reflecting on the solution, the information provided with the problem, or the strategy adopted.

14. To develop the framework for collaborative problem solving, a further element of collaboration is added with the following aspects:

¹ Scotland did not participate in the innovative domain in 2012.

- **establishing and maintaining shared understanding:** identifying the knowledge and perspectives that other group members hold and establishing a shared vision of the problem states and activities
- **taking appropriate action to solve the problem:** identifying the type of collaborative problem solving-related activities that are needed to solve the problem and carrying out these activities to achieve the solution
- **establishing and maintaining team organisation:** understanding one's own role and the roles of other agents, following the rules of engagement for one's role, monitoring group organisation, and facilitating the changes required to optimise performance or to handle a breakdown in communication or other obstacles to solving the problem.

15. This creates an overall framework with 12 components, set out in Table 2.1 below

Table 2.1: Skills evaluated in the PISA 2015 collaborative problem solving assessment

		Collaborative problem-solving competencies		
		(1) Establishing and maintaining shared understanding	(2) Taking appropriate action to solve the problem	(3) Establishing and maintaining team organisation
Problem-solving processes	(A) Exploring and understanding	(A1) Discovering perspectives and abilities of team members	(A2) Discovering the type of collaborative interaction to solve the problem, along with goals	(A3) Understanding roles to solve the problem
	(B) Representing and formulating	(B1) Building a shared representation and negotiating the meaning of the problem (common ground)	(B2) Identifying and describing tasks to be completed	(B3) Describing roles and team organisation (communication protocol/rules of engagement)
	(C) Planning and executing	(C1) Communicating with team members about the actions to be/being performed	(C2) Enacting plans	(C3) Following rules of engagement (e.g. prompting other team members to perform their tasks)
	(D) Monitoring and reflecting	(D1) Monitoring and repairing the shared understanding	(D2) Monitoring results of actions and evaluating success in solving the problem	(D3) Monitoring, providing feedback and adapting the team organisation and roles

Source: OECD

The assessment

16. Participants undertake tasks, with the computer providing a number of simulated partners who take on various roles, such as a holder of information, or leading on a sub-task necessary to solve the problem. The student interacts with

their virtual partners by selecting the next step from a range of options presented. Box 2.1 gives a flavour of the type of task involved.

Box 2.1: Types of collaborative problem-solving tasks

Jigsaw or hidden-profile tasks, where each group member is given different information or skills. Groups need to pool each member's information and skills together in order to solve the problem and hence collaboration among group members is required. Moreover, group members are dependent on one another to arrive at the solution: no single member can achieve the solution on his or her own, and a group member who chooses not to participate can jeopardise the achievement of the group's goal

Consensus-building tasks, where a group must agree on a decision after considering the views, opinions and arguments of all group members. A successful solution will involve all group members contributing their ideas and the careful yet efficient consideration of all such ideas. However, some group members may dominate the conversation and not allow for all ideas to be aired, while other group members may not be willing to disagree with what has already been said, potentially leading to "group think"

Negotiation tasks, where not all group members share the same individual goals. They must negotiate in order to achieve, in the best-case scenario, a win-win situation that satisfies both their individual goals and overall group goals.

Source: OECD

It should be noted, that task can cover more than one of these categories, for example, beginning as a jig-saw task, and ending up with a need to build a consensus, or negotiate a final outcome

17. The role of the computer in taking the place of a human has been examined and validated by a study undertaken by the University of Luxembourg. This study, plus the full framework for collaborative problem solving and a description of the typical question items, is available on the OECD website at www.oecd.org/pisa.

18. Questions are constructed drawing upon the framework above, and at varying levels of difficulty, in order to identify a student's ability. Their score corresponds to proficiency levels, which are summarised in Table 2.2 below.

Table 2.2: Proficiency levels in collaborative problem solving, and what they mean

Level	Score range	What students can typically do
4	Equal to or higher than 640 score points	At Level 4, students can successfully carry out complicated problem-solving tasks with high collaboration complexity. They can solve complex problems with multiple constraints, keeping relevant background information in mind. These students maintain an awareness of group dynamics and take actions to ensure that team members act in accordance with their agreed-upon roles. At the same time, they can monitor progress towards a solution and identify obstacles to overcome or gaps to be bridged. Level 4 students take initiative and perform actions or make requests to overcome obstacles and to resolve disagreements and conflicts. They can balance the collaboration and problem-solving aspects of a presented task, identify efficient pathways to a solution, and take actions to solve the given problem.
3	540 to less than 640 score points	At Level 3, students can complete tasks with either complex problem-solving requirements or complex collaboration demands. These students can perform multi-step tasks that require integrating multiple pieces of information, often in complex and dynamic problems. They orchestrate roles within the team and identify information needed by particular team members to solve the problem. Level 3 students can recognise the information needed to solve a problem, request it from the appropriate team member, and identify when the provided information is incorrect. When conflicts arise, they can help team members negotiate a solution.
2	440 to less than 540 score points	At Level 2, students can contribute to a collaborative effort to solve a problem of medium difficulty. They can help solve a problem by communicating with team members about the actions to be performed. They can volunteer information not specifically requested by another team member. Level 2 students understand that not all team members have the same information and can consider differing perspectives in their interactions. They can help the team establish a shared understanding of the steps required to solve a problem. These students can request additional information required to solve a problem and solicit agreement or confirmation from team members about the approach to be taken. Students near the top of Level 2 can take the initiative to suggest a logical next step, or propose a new approach, to solve a problem.
1	340 to less than 440 score points	At Level 1, students can complete tasks with low problem complexity and limited collaboration complexity. They can provide requested information and take actions to enact plans when prompted. Level 1 students can confirm actions or proposals made by others. They tend to focus on their individual role within the group. With support from team members, and when working on a simple problem, these students can help find a solution to the given problem.

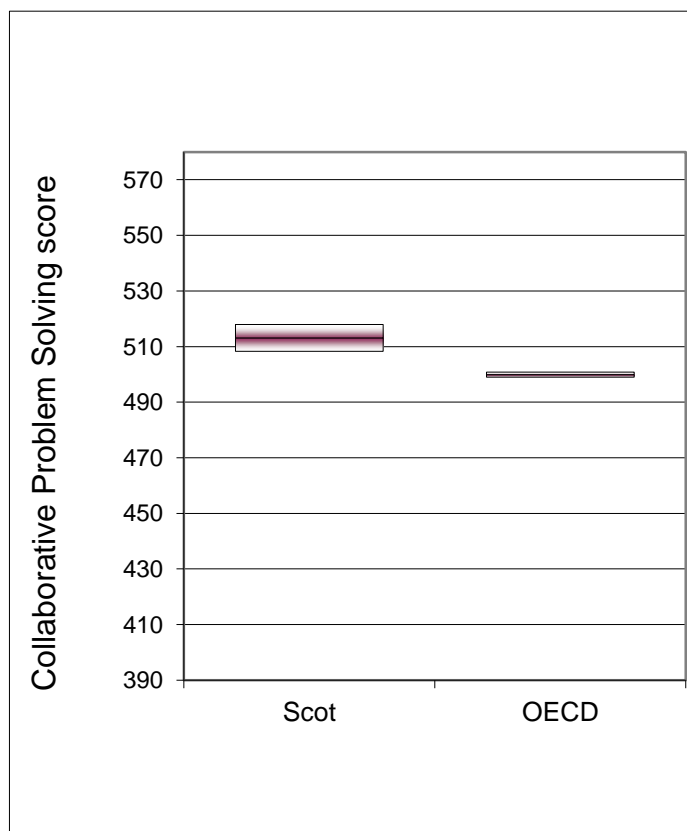
Source: OECD

3. Performance in Collaborative Problem Solving

Average scores

19. In collaborative problem solving, Scotland scored **513** in PISA 2015. Chart 3.1 illustrates Scotland's score with 95-per-cent confidence intervals² next to the scores for the OECD average. Note that Scotland, with a smaller sample, has larger confidence intervals than does the OECD average, where the combined sample makes for more certainty.

Chart 3.1: Comparison of Scotland and OECD collaborative problem solving scores



20. Scotland's score was above the OECD average in 2015. The OECD average is set at 500, reflecting that collaborative solving is a new domain.

²These are confidence intervals where we can be 95 per cent certain the "true" value lies. Where the intervals around two values overlap, we cannot be sure that the true values are different.

Comparisons with other countries

21. Compared to the 31 OECD countries³ who participated, plus the three other UK administrations, Scotland performed similarly to six countries, including Northern Ireland and the United States, and above 19 countries including Wales, France, Norway and Italy. Nine countries performed above Scotland, including Canada, Germany, Korea and England. Table 3.1 below shows which countries were statistically significantly above, similar to and below Scotland in 2015. Table A.1a, located in the annex, shows each country's score.

Table 3.1: OECD countries and UK administrations, higher than, similar to and lower than Scotland in collaborative problem solving

Higher score than Scotland	Similar score to Scotland	Lower score than Scotland
Australia	Austria	Belgium
Canada	Denmark	Chile
England	Netherlands	Czech Republic
Estonia	Northern Ireland	France
Finland	Sweden	Greece
Germany	United Kingdom ⁴	Hungary
Japan	United States	Iceland
Korea		Israel
New Zealand		Italy
		Latvia
		Luxembourg
		Mexico
		Norway
		OECD average
		Portugal
		Slovak Republic
		Slovenia
		Spain
		Turkey
		Wales

22. Among the participating non-OECD countries and economies, Singapore (the highest scoring participant), Hong Kong-China, Chinese Taipei and Macao-China performed significantly higher than Scotland. No country was similar to Scotland. Sixteen countries and economies performed significantly below

³ Those OECD member states other than Ireland, Poland and Switzerland, for which there is no data, and the United Kingdom itself.

⁴ All references to the "United Kingdom" include Scotland

Scotland, including Brazil, the Russian Federation and the four provinces participating from the Peoples' Republic of China ("B-S-J-G"⁵).

23. Table A.1b (annex) records the mean scores for the non-OECD member states. The OECD reports published at the same time as this report have full details on all countries' scores, and also where data has been collected on a "regional" basis (including Scotland).

Distribution of scores

24. As well as comparison between countries' mean scores, it is important to look at how these are distributed within a country. It is likely that there is much more variation within than between countries. Scotland's spread of performance in collaborative problem solving, as measured by standard deviation of the scores (99 points), was larger than the OECD average (95 points). Seventeen countries had a narrower distribution, eleven similar and six greater.

High and low achievers

Low performance (below Level 2)

25. As set out in Chapter 2, the OECD categorise students into levels according to their ability to undertake certain tasks. However, the group below Level 2 merits particular attention, as the OECD consider that Level 2 is the baseline of ability to participate effectively in society. 23.8 per cent of 15 year-olds in Scotland performed below Level 2 in 2015 – lower than the OECD average of 28.1 per cent.

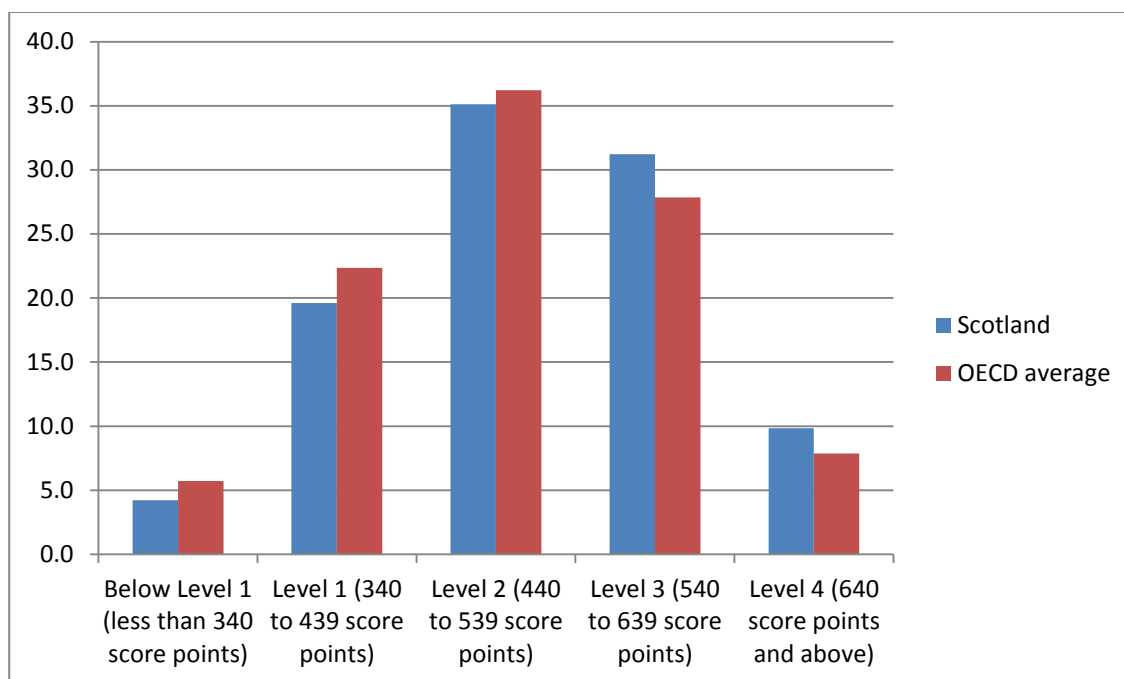
High performance (Level 4)

26. At the other end of the distribution, the proportion of students who were "higher" achievers (Level 4) was 9.8 per cent, greater than the OECD average of 7.9 per cent.

27. Chart 3.2 below shows the distribution of scores in Scotland compared to the OECD average. Table A.2 (annex) shows each OECD country and UK administration's distribution of scores by proficiency level.

⁵ Beijing, Shanghai, Jiangsu and Guangdong

Chart 3.2: Percentage of Scottish students by proficiency level in collaborative problem solving (per cent)



Gender

Mean score

28. Girls in Scotland performed better than boys. The average score in collaborative problem solving was 530 for female students, and 497 for male students. The gap (33 points) was similar to the OECD average (29 points).

High and low achievers

29. In terms of the gender share of higher and lower achievers, girls were more likely to record high performance (Level 4) than boys (12.4 per cent of girls and 7.3 per cent of boys). 29.0 per cent of boys and 18.5 per cent of girls were below Level 2 (a significant difference between boys and girls at Level 1, but not Below Level 1).

30. Girls recorded a higher share of Level 4 performers than the OECD average. Boys' share was similar to the OECD average. Boys recorded a lower share of low performers than the OECD average for Below Level 1 only. Girls recorded a lower share of low performers for Level 1 only.

Social background

31. The OECD measure social background using their own Index of Economic, Social & Cultural Status (ESCS) calculated from data given by students in the background questionnaire. A number of indicators are used to explain how much performance is related to student background. Further information is provided in the Scottish Government's previous PISA report, and the OECD volumes.

32. The **share of variation**⁶ in test scores for collaborative problem solving that was explained by students' background was 5.6 per cent. This was lower than the OECD average (7.9 per cent) This means that Scotland's pupils were more likely to break away from the pattern of background affecting performance. Although there was still a clear link between background and performance, there are other things that affect performance, and many pupils do not follow the pattern.

33. The **gradient** in Scotland, i.e. how much the mean performance score in collaborative problem solving changes with social background, was 28 points. This was statistically similar to the OECD average of 30 points and was greater than in five countries, similar to 21 and less than eight others.

34. The difference between the 5th and 95th percentiles by ESCS was 2.63 points. Combined with a 28-point gradient, this implies that the average scores in collaborative problem solving between the most disadvantaged and least disadvantaged students are apart by nearly 74 points. If, as the OECD surmises with maths, reading and science, a year's schooling is equivalent to about 30 points, that would imply a difference of nearly two and half years' education.

35. Table A.3 (annex) has each OECD country and UK administration's scores on the gradient and strength of relationship.

Students and immigration background

36. The survey also asks about students' background in terms of whether they or their parents were born outside the country of the test (for these purposes, the UK). In 2015, students without an immigrant-background performed similarly to those with an immigrant-background (defined as both parents being born outside the UK). This contrasted with the OECD average, where Scotland's (statistically non-significant) gap of 4 points in favour of immigrant students, compares with a statistically significant gap of 36 points in favour of non-immigrant-background students. This gap in turn was significantly different to Scotland's. This indicator is also reported in Table A.3 (annex) for each OECD country and UK administration.

⁶ Statistically this is the R-squared measure multiplied by 100.

4. Student Questionnaire Responses

Students' views on collaborative behaviour

37. Scottish students were significantly more likely than the OECD average to “agree” or “strongly agree” to the statements that “I enjoy seeing my classmates be successful” (89.6 per cent vs. 87.8 per cent), “I take into account what others are interested in” (90.2 per cent vs. 86.4 per cent), “I prefer working as part of a team than working alone” (71.4 per cent vs. 66.9 per cent) and “I find that teamwork raises my own efficiency” (71.6 per cent vs. 69.7 per cent).

38. Scotland scored similar to the OECD average on the overall “Index of Valuing Relationships”, however, within Scotland, there was a difference between the top and bottom quartiles by social background (measured by ESCS) with more advantaged students more likely to value relationships. In contrast however, students from less advantaged backgrounds were more likely to value teamwork than their more advantaged peers.

39. Girls scored higher than boys on valuing relationships overall, and were more likely than boys to say “I am good listener” (91.5 per cent vs. 84.3 per cent), “I enjoy seeing my classmates be successful” (92.9 per cent vs. 86.2 per cent), “I take into account what others are interested in” (92.9 per cent vs. 87.6 per cent) and “I enjoy considering different perspectives” (89.8 per cent vs. 84.4 per cent).

40. Boys were more likely than girls to value teamwork overall, being more likely to say “I prefer working as part of a team than working alone” (74.0 per cent vs. 69.8 per cent), “I find that teams make better decisions than individuals” (75.4 per cent vs. 71.5 per cent), and “I enjoy co-operating with peers” (89.0 per cent vs. 86.6 per cent).

41. Further questionnaire data was published in the Scottish Government’s previous PISA report, as well the OECD volumes.

Annex: Detailed results

Collaborative Problem Solving

Note for all tables

1. “s.e.” = “standard error”, “s.d.” = standard deviation
2. For all references to Malaysia, the OECD consider that the coverage is too small to ensure comparability. See Annex A4 of Volume I of the OECD report for further details.

Table A.1a: Mean scores in collaborative problem solving, by gender, and comparison with Scotland: OECD and UK administrations

	Overall				Scores by gender			
	Mean score		S.D.		Male		Female	
	mean	s.e.	s.d.	s.e.	mean	s.e.	mean	s.e.
Significantly above Scotland								
Australia	531	(1.9)	107	(1.3)	511	(2.5)	552	(2.5)
Canada	535	(2.3)	104	(1.0)	516	(2.8)	555	(2.4)
England	521	(3.1)	104	(1.3)	504	(3.7)	539	(3.8)
Estonia	535	(2.5)	90	(1.3)	522	(2.9)	549	(2.7)
Finland	534	(2.6)	101	(1.5)	511	(3.2)	559	(3.0)
Germany	525	(2.8)	101	(1.5)	510	(3.4)	540	(3.0)
Japan	552	(2.7)	85	(1.8)	539	(3.6)	565	(2.6)
Korea	538	(2.5)	84	(1.5)	522	(3.5)	556	(3.3)
New Zealand	533	(2.4)	106	(1.7)	513	(3.2)	553	(3.0)
Similar to Scotland								
Austria	509	(2.6)	98	(1.5)	498	(3.4)	521	(3.4)
Denmark	520	(2.5)	90	(1.2)	509	(2.9)	530	(3.3)
Netherlands	518	(2.4)	97	(1.5)	504	(3.0)	531	(2.8)
Northern Ireland	514	(3.7)	88	(1.9)	500	(4.2)	528	(4.8)
Scotland	513	(2.5)	99	(1.7)	497	(3.4)	530	(3.0)
Sweden	510	(3.4)	98	(1.8)	489	(4.0)	531	(3.8)
United Kingdom	519	(2.7)	103	(1.1)	503	(3.1)	536	(3.3)
United States	520	(3.6)	108	(1.7)	507	(4.4)	533	(4.0)
Significantly below Scotland								
Belgium	501	(2.4)	99	(1.4)	489	(3.0)	514	(2.9)
Chile	457	(2.7)	84	(1.3)	450	(3.1)	464	(3.1)
Czech Republic	499	(2.2)	91	(1.4)	486	(2.9)	512	(2.7)
France	494	(2.4)	100	(1.5)	480	(3.4)	508	(2.8)
Greece	459	(3.6)	92	(1.6)	444	(4.2)	475	(3.7)
Hungary	472	(2.4)	95	(1.6)	459	(3.3)	485	(2.8)
Iceland	499	(2.3)	94	(1.9)	485	(3.0)	512	(2.6)
Israel	469	(3.6)	105	(1.8)	459	(4.3)	481	(4.7)
Italy	478	(2.5)	96	(1.6)	466	(3.4)	489	(3.4)
Latvia	485	(2.3)	90	(1.3)	465	(2.6)	505	(2.9)
Luxembourg	491	(1.5)	100	(1.0)	478	(2.5)	504	(1.9)
Mexico	433	(2.5)	79	(1.5)	426	(2.9)	440	(2.7)
Norway	502	(2.5)	94	(1.6)	487	(3.0)	518	(3.2)
OECD average	500	(0.5)	95	(0.3)	486	(0.6)	515	(0.5)
Portugal	498	(2.6)	91	(1.3)	489	(3.2)	507	(2.7)
Slovak Republic	463	(2.4)	93	(1.5)	448	(2.8)	478	(3.4)
Slovenia	502	(1.8)	93	(1.3)	484	(2.2)	521	(2.2)
Spain	496	(2.1)	88	(1.1)	485	(2.7)	508	(2.6)
Turkey	422	(3.4)	78	(1.6)	411	(4.0)	434	(4.1)
Wales	496	(3.5)	89	(1.5)	485	(3.8)	508	(4.0)

Note

Countries are grouped by their position relative to Scotland when comparing the overall mean score

Table A.1b: Mean scores in collaborative problem solving, by gender, and comparison with Scotland: non-OECD countries and economies

	Overall				Scores by gender			
	Mean score		S.D.		Male		Female	
	mean	s.e.	s.d.	s.e.	mean	s.e.	mean	s.e.
	Significantly above Scotland							
Chinese Taipei	527	(2.5)	90	(1.5)	513	(3.4)	541	(3.4)
Hong Kong (China)	541	(2.9)	90	(1.6)	523	(3.7)	559	(3.4)
Macao (China)	534	(1.2)	90	(1.1)	515	(1.9)	553	(2.0)
Singapore	561	(1.2)	97	(1.2)	552	(1.7)	572	(2.1)
	Significantly below Scotland							
Brazil	412	(2.3)	87	(1.3)	402	(2.5)	421	(2.6)
B-S-J-G (China)	496	(4.0)	97	(2.1)	486	(3.9)	508	(4.6)
Bulgaria	444	(3.9)	98	(1.7)	429	(4.6)	461	(3.9)
Colombia	429	(2.3)	83	(1.4)	425	(2.9)	433	(2.7)
Costa Rica	441	(2.4)	78	(1.3)	437	(2.8)	445	(2.7)
Croatia	473	(2.5)	87	(1.5)	459	(3.3)	486	(2.6)
Cyprus	444	(1.7)	91	(1.3)	424	(2.0)	464	(2.2)
Lithuania	467	(2.5)	91	(1.4)	453	(2.9)	482	(2.8)
Malaysia	440	(3.3)	80	(1.7)	429	(3.6)	450	(3.4)
Montenegro	416	(1.3)	79	(1.2)	403	(1.8)	429	(2.0)
Peru	418	(2.5)	83	(1.6)	414	(2.8)	421	(3.0)
Russian Federation	473	(3.4)	92	(1.4)	460	(3.8)	486	(3.9)
Thailand	436	(3.5)	83	(1.7)	416	(4.1)	451	(3.6)
Tunisia	382	(1.9)	59	(1.4)	375	(2.3)	387	(2.3)
United Arab Emirates	435	(2.4)	95	(1.0)	416	(2.9)	454	(3.1)
Uruguay	443	(2.3)	91	(1.3)	434	(3.3)	451	(2.7)

Note

Countries are grouped by their position relative to Scotland when comparing the overall mean score

Table A.2: Estimates of proportion at each proficiency level (per cent), collaborative problem solving: OECD and UK administrations (Below Level 1 to Level 4)

	Below Level 1		Level 1		Level 2		Level 3		Level 4	
	%	s.e.	%	s.e.	%	s.e.	%	s.e.	%	s.e.
Australia	4.3	(0.3)	15.6	(0.6)	31.2	(0.6)	33.6	(0.8)	15.3	(0.7)
Austria	4.5	(0.4)	20.2	(0.9)	35.8	(1.0)	30.4	(1.0)	9.1	(0.7)
Belgium	5.7	(0.5)	21.1	(0.8)	36.7	(0.7)	29.3	(0.8)	7.1	(0.6)
Canada	3.4	(0.3)	15.0	(0.7)	32.0	(0.8)	33.8	(0.9)	15.7	(0.7)
Chile	8.4	(0.7)	33.9	(1.2)	40.5	(1.0)	16.0	(1.0)	1.2	(0.2)
Czech Republic	4.6	(0.5)	21.6	(0.8)	39.6	(1.0)	28.8	(1.0)	5.4	(0.4)
Denmark	2.7	(0.3)	16.3	(0.8)	38.8	(0.9)	33.4	(0.9)	8.9	(0.7)
Estonia	1.8	(0.3)	13.5	(0.7)	35.4	(1.1)	37.2	(1.0)	12.2	(0.8)
Finland	3.4	(0.4)	14.7	(0.8)	32.2	(1.0)	35.2	(1.0)	14.4	(0.8)
France	7.0	(0.5)	22.6	(0.7)	36.2	(0.9)	27.6	(1.0)	6.6	(0.5)
Germany	3.6	(0.4)	16.9	(0.8)	34.3	(0.9)	32.4	(0.8)	12.7	(0.7)
Greece	10.4	(1.0)	31.6	(1.2)	37.9	(1.1)	18.1	(1.0)	2.0	(0.3)
Hungary	8.7	(0.6)	28.6	(1.0)	37.4	(0.9)	22.0	(0.9)	3.3	(0.4)
Iceland	4.6	(0.5)	22.5	(1.0)	38.1	(1.2)	28.2	(1.0)	6.5	(0.6)
Israel	11.5	(0.9)	30.2	(1.1)	30.7	(1.2)	22.1	(1.0)	5.4	(0.5)
Italy	7.8	(0.6)	26.9	(1.0)	38.5	(1.0)	22.6	(0.9)	4.2	(0.5)
Japan	1.2	(0.2)	8.9	(0.7)	31.4	(1.0)	44.4	(1.1)	14.0	(0.8)
Korea	1.5	(0.3)	11.4	(0.7)	35.1	(0.9)	41.6	(1.0)	10.4	(0.8)
Latvia	5.6	(0.5)	25.4	(0.9)	41.3	(0.9)	23.8	(1.0)	3.9	(0.5)
Luxembourg	6.5	(0.5)	24.8	(0.7)	36.3	(0.7)	25.5	(0.7)	6.8	(0.4)
Mexico	12.2	(0.9)	41.2	(1.4)	37.4	(1.2)	8.8	(0.6)	0.4	(0.1)
Netherlands	3.4	(0.4)	18.6	(0.9)	35.7	(0.9)	32.3	(1.0)	10.0	(0.7)
New Zealand	3.8	(0.4)	15.9	(0.7)	31.3	(0.9)	33.2	(1.0)	15.8	(0.9)
Norway	4.4	(0.5)	21.0	(0.8)	39.5	(1.1)	28.3	(1.0)	6.8	(0.6)
Portugal	4.6	(0.4)	21.5	(0.9)	40.2	(0.8)	28.4	(1.0)	5.2	(0.5)
Slovak Republic	9.5	(0.7)	31.1	(1.0)	38.4	(1.1)	18.4	(0.9)	2.6	(0.4)
Slovenia	4.4	(0.4)	21.2	(0.8)	38.6	(1.2)	29.3	(0.9)	6.4	(0.7)
Spain	4.4	(0.4)	21.4	(0.9)	41.6	(0.8)	28.3	(0.8)	4.3	(0.4)
Sweden	4.5	(0.5)	20.1	(1.0)	35.9	(1.1)	30.3	(1.1)	9.1	(0.9)
Turkey	14.9	(1.1)	44.5	(1.4)	33.6	(1.5)	6.9	(0.8)	0.2	(0.1)
United Kingdom	4.2	(0.4)	18.3	(0.8)	34.6	(0.8)	30.9	(0.9)	12.0	(0.7)
United States	4.9	(0.5)	18.9	(1.0)	32.7	(0.8)	29.7	(1.0)	13.8	(1.0)
England	4.3	(0.5)	17.8	(1.0)	34.0	(0.9)	31.0	(1.0)	12.9	(0.9)
Northern Ireland	2.6	(0.5)	18.5	(1.4)	39.1	(1.6)	32.8	(1.4)	7.0	(0.8)
Scotland	4.2	(0.5)	19.6	(0.8)	35.1	(1.0)	31.2	(1.0)	9.8	(0.7)
Wales	3.9	(0.5)	23.0	(1.3)	41.0	(1.3)	27.2	(1.5)	4.9	(0.5)
OECD average	5.7	(0.1)	22.4	(0.2)	36.2	(0.2)	27.8	(0.2)	7.9	(0.1)

Table A.3: Relationship between student performance in collaborative problem solving and the PISA Index of Economic, Social and Cultural Status (ESCS) and immigration background: OECD and UK administrations

	Slope of socio-economic gradient ¹		Strength of relationship between performance and ESCS ²		Differences in collaborative problem solving performance by immigration background ³	
	%	s.e.	Score points	s.e	Score points	s.e.
Australia	35	(1.9)	6.7	(0.8)	0	(3.7)
Austria	35	(2.1)	9.0	(1.1)	52	(6.0)
Belgium	39	(2.0)	12.8	(1.2)	57	(4.9)
Canada	29	(1.7)	5.3	(0.6)	3	(3.8)
Chile	26	(1.5)	11.3	(1.3)	23	(13.2)
Czech Republic	38	(2.6)	11.2	(1.4)	11	(10.7)
Denmark	25	(2.0)	6.0	(0.9)	61	(4.3)
Estonia	26	(2.1)	5.0	(0.8)	49	(5.0)
Finland	33	(2.7)	5.8	(0.9)	81	(9.8)
France	44	(2.1)	12.3	(1.1)	51	(6.9)
Germany	29	(2.0)	7.6	(1.0)	49	(6.2)
Greece	28	(2.0)	8.3	(1.1)	40	(5.9)
Hungary	40	(1.9)	15.9	(1.3)	-12	(11.5)
Iceland	17	(2.9)	1.7	(0.6)	54	(9.7)
Israel	38	(2.9)	9.4	(1.4)	4	(7.1)
Italy	26	(1.9)	6.7	(1.0)	13	(4.9)
Japan	27	(2.0)	5.2	(0.7)	121	(37.6)
Korea	28	(2.6)	5.1	(1.0)	*	*
Latvia	23	(2.1)	5.6	(0.9)	15	(7.4)
Luxembourg	30	(1.4)	11.3	(0.9)	25	(2.9)
Mexico	22	(1.4)	11.1	(1.4)	63	(12.2)
Netherlands	33	(2.7)	6.6	(1.1)	40	(7.1)
New Zealand	37	(3.2)	7.4	(1.2)	10	(5.3)
Norway	25	(2.1)	3.8	(0.6)	48	(5.7)
Portugal	23	(1.7)	8.8	(1.3)	20	(6.2)
Slovak Republic	30	(2.1)	9.7	(1.2)	68	(14.8)
Slovenia	32	(2.1)	8.0	(1.0)	50	(6.7)
Spain	20	(1.3)	7.0	(0.9)	29	(6.0)
Sweden	33	(2.5)	7.7	(1.1)	59	(6.3)
Turkey	19	(2.0)	7.9	(1.7)	-11	(15.4)
United Kingdom	30	(2.2)	6.3	(0.9)	13	(6.6)
United States	29	(2.1)	7.5	(1.0)	20	(6.0)
England	31	(2.6)	6.5	(1.0)	15	(7.3)
NI	31	(2.9)	9.1	(1.6)	32	(7.0)
Scotland	28	(2.7)	5.6	(1.0)	-4	(9.3)
Wales	19	(2.3)	3.2	(0.8)	-2	(9.3)
OECD average	30	(0.4)	7.9	(0.2)	36	(1.9)

Notes

1: The amount that the average score changes with social background – a lower score implies less change as background changes.

2: The amount of variation in score explained by social background.

3: The mean score for non-immigrant-background pupils (with both parents born in the country of the test) minus the score for immigrant-background pupils. A negative figure implies that immigrant-background pupils score better.

* denotes that data is not available

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