General information Note

Launch of major international study of Irish Students' Performance in Mathematics and Science in TIMSS 2015

Under strict embargo until Tuesday, 29 November 2016 at 10.00 Central European Time (i.e. 09.00 Irish time).

1. Background

1.1 What is TIMSS?

Trends in **I**nternational **Mathematics** and **Science S**tudy (**TIMSS**) is the world's largest study of educational achievement.

- It assesses the Mathematics and Science skills of students at fourth class in primary school and in second year at post-primary school level.
- TIMSS reports on students' mean scores relative to a TIMSS centrepoint of 500. This is a set constant reference point (calculated as the average achieved when TIMSS was first administered in 1995). This provides a solid measure of trends over time, but is not, for clarity, the average score in the 2015 study.
- TIMSS 2015 facilitates the monitoring of Irish performance from previous cycles of TIMSS.
- TIMSS also collects a great deal of contextual information including questionnaires for students, their teachers, their school principal, and their parents (primary only).
- More detailed national analyses of Irish performance on TIMSS, including contextual information from students, parents, teachers and principals, will follow throughout 2017 as the ERC release a series of short reports that will include comparisons to other countries, and comparisons between Fourth class and Second year in Ireland, where appropriate.

1.2 Where does TIMSS come from? What is the origin of TIMSS?

- TIMSS is a project of the International Association for the Evaluation of Educational Achievement (IEA), a non-profit organisation based in The Hague, Netherlands.
- TIMSS was first conducted in 1995, and takes place every four years. 2015 was the sixth cycle. Ireland has taken part in 1995, 2011 (**at primary level only**), and in 2015.

1.3 How many students participate in TIMSS?

- In 2015, more than 582,000 students from 57 countries participated in total. Thirty-one countries, including Ireland, participated at both primary and post-primary level. In twenty-two countries, including Ireland, the tests were administered in more than one language.
- In Ireland, TIMSS was implemented in Ireland in April and May 2015 in 149 primary schools and 149 post-primary schools around the country, which were randomly selected and invited to participate as a representative sample. Approximately 4,300 fourth class students, and 4,700 second year students, completed tests of Mathematics and Science, together with a background questionnaire.

1.4 How are parents, teachers and principals involved?

- The parents of Fourth class students and the principals and teachers of all students completed questionnaires that provide a detailed snapshot of the broader educational context in Ireland

1.5 What does TIMSS assess?

- The TIMSS assessment has two dimensions for Mathematics and Science: content areas and cognitive processes
- **Content areas** refer to the subject matter being assessed.
    - Mathematics - At fourth class, there are three content areas for Mathematics. These are Number, Geometric Shapes & Measures, and Data Display. At second year, there are four content areas for Mathematics. These are Number, Algebra, Geometry, Data & Chance.
    - Science - At fourth class, there are three content areas for Science. These are Life Science, Physical Science, and Earth Science. At second year, there are four content areas for Science. These are biology, Physics, Chemistry, and Earth Science
- **Cognitive processes** refer to the skills needed for students to answer questions correctly. At fourth class and second year levels, the same cognitive processes are assessed in both Mathematics and Science. These are Knowing, Applying, and Reasoning. Knowing is the least complex of these processes and Reasoning is the most complex
- TIMSS also reports on student achievement with reference to four International Benchmarks that represent increasing levels of mathematical or scientific skill. Each Benchmark is associated with a defined set of attributes

that typify the skills that students at that level can demonstrate consistently. The four benchmarks are: Low (400); Intermediate (475); High (550); and Advanced (625)

2. Results of Irish students for Mathematics and Science in 2015

2.1 How well did Irish fourth class students perform in Mathematics?

- There is positive news for Ireland regarding the performance of fourth class students at primary level in Mathematics and Science. TIMSS 2015 indicates a significant improvement in our students' performance since 2011 (and 1995). Fourth class students in Ireland achieved a mean score of 547 on the 2015 Mathematics assessment. This was significantly higher than the Irish performance in 2011 (527) or 1995 (523)
- Of the 49 countries which participated in the Mathematics assessment in TIMSS 2015, seven countries significantly outperformed Ireland, five were similar, and 37 were significantly below Ireland
- In the content domains, Irish students showed a relative strength on Number (+4 points) and a relative weakness on Geometric Shapes & Measures (-5 points)
- In the cognitive domains, Irish students displayed a relative strength on Knowing (+7 points) and a relative weakness on Reasoning (-12 points). Note that Reasoning is regarded as the most complex of the cognitive domains
- About half of students (51%) reached High Benchmark and more than twice as many students in Ireland (14%) as internationally (6%) achieved an Advanced level of performance on the assessment. Overall, performance at each level of the distribution has improved over time at fourth class

2.2 How well did Irish fourth class students perform in Science?

- Again, there is positive news for Ireland regarding the performance of 4th class students in Science
- Irish students scored significantly higher in 2015 (mean of 529) than in 2011 (mean of 516) or in 1995 (mean of 515)
- Forty seven countries participated in the Science assessments. 15 countries significantly out-performed Ireland and nine countries achieved scores that were not significantly different to Ireland. The Irish score was significantly better than 22 other countries

- There are slight differences between the scores of boys and girls. In Ireland, overall, boys outperformed girls in Science, albeit it a small and not statistically significant difference

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- In the content domains, Irish students showed a relative strength in Earth Science topics (+6 points) and a relative weakness in Physical Science topics (-5 points).
- In the cognitive domains, Irish students performed at a broadly similar level across the three cognitive domains of Knowing, Applying and Reasoning.

2.3 How well did Irish second year students perform in Mathematics?

- There is positive news for Ireland regarding the performance of second year students in Mathematics. The mean Mathematics score of students in Ireland was 523, which was significantly above the TIMSS centrepoint of 500.
- Although not statistically significant, Ireland's Mathematics performance improved by about 5 points since 1995 - the last time that Ireland participated in TIMSS at Second year.
- Six countries had significantly higher mean scores than Ireland and the mean scores of five countries did not differ significantly from that of Ireland. Ireland's mean score was significantly higher than 27 countries
- There are some differences between the scores of boys and girls but the differences are not statistically different. More boys than girls reached the advanced and high benchmarks. However, the percentages of boys and girls reaching the intermediate and low benchmarks were exactly the same
- In the content domains, Irish students showed a relative strength on Number (+21 points) and Data and Chance (+10 points) and relative weakness in Algebra (-22 points) and Geometry (-20 points). Boys were significantly ahead of girls in Number.
- In the cognitive domains, Irish students displayed a relative strength on Knowing (+4 points) and a relative weakness on Applying (-3 points). Note that Reasoning is regarded as the most complex of the cognitive domains. There were no gender differences across the cognitive domains (Knowing, Applying, and Reasoning) among second year students in Ireland.
- Most second year students in Ireland (94%) reached *at least* the Low Benchmark, while just over three-quarters reached *at least* the Intermediate Benchmark, 38% reached *at least* the High Benchmark, and 7% reached the Advanced Benchmark (the highest level of performance). For comparison, the

TIMSS median percentage reaching each Benchmark was lower than in Ireland: 84% (Low), 62% (Intermediate), 26% (High), and 5% (Advanced).

2.4 How well did Irish second year students perform in Science?

- There is positive news for Ireland regarding the performance of Second year students in Science. Second year students in Ireland had a mean Science score of 530, which was also significantly above the TIMSS centrepoint of 500.
- Seven countries had significantly higher mean scores than Ireland. Students in six other countries had mean scores that were not significantly different to students in Ireland and Irish second year students scored significantly better than students in 25 countries
- There are differences between the scores of boys and girls. However, these are not significant. Girls scored two points higher than boys.
- In the content domains, Irish students showed a relative strength in Biology (+4 points) and Earth Science topics (+12 points) and a relative weakness in Chemistry (-13 points) and Physics (-5 points).
- In the cognitive domains, Irish students showed relative weakness in Knowing (-7 points) but there performance on Applying and Reasoning was in line with their overall achievement. There were no significant gender differences in the cognitive domains among Second year students in Ireland.

3. What were the main strengths of Irish students' performance in 2015?

- TIMSS 2015 at primary level, both in Mathematics and Science, indicates a significant improvement in our students' performance since 2011 (and 1995).
- At post-primary second year Science performance was significantly higher in 2015 than in 2011 or 1995.
- While our second year students' performance in Mathematics has remained similar to 1995, only six countries (Singapore, the Republic of Korea, Chinese Taipei, Hong Kong, Japan and the Russian Federation) achieved a significantly higher mean Mathematics score.
- Improvements are greater among the lowest achieving students at both fourth class and second year in primary and post-primary grade level.
- There are no significant gender differences, for Mathematics or Science, at fourth class or second year.

- The improvements in Mathematics may reflect to some extent the positive impact of Circular 0056/2011 arising from the *National Strategy: Literacy and Numeracy for Learning and Life 2011-2020* required schools to allocate increased time to literacy and numeracy.
- At both levels, the improvements reflect the commitment of school communities to on-going development in educational provision, including through school self-evaluation which was introduced formally to the Irish education system in 2012. This facilitates school leadership teams in monitoring the performance of students across the domains of learner outcomes and learner experiences as well as considering the impact of teachers' individual and collective practice.
- These positive results are to be welcomed in the Irish context given that the children involved experienced a significant proportion of their education during a period of significant economic decline. The recent economic recession impacted on class sizes, capitation, funding for educational initiatives, CPD and promoted posts at primary and particularly at post-primary level. Considering the challenges this created for schools and parents in this period, these positive results are testimony to the dedication of all partners to the education of our students.

4. What are the main areas for development?

- The teaching of Mathematics at primary level requires greater focus on Shape and Space, Measuring and the skill of Reasoning.
- At post-primary, the teaching of Mathematics requires greater focus on Geometry and Algebra and the skill of Applying.
- The teaching of the Physical Sciences (*Energy and Forces*, *Materials* and *Materials and Change at Primary level)* needs to be strengthened at both primary and post-primary level.
- Concentrated efforts are required to improve the performance of our higher-performing students both at primary and at post primary level. We need to improve upward differentiation and develop an awareness among teachers that overreliance and overuse of text books, which may not reflect the breadth of the curriculum, impacts on the learning and performance of students.
- We need to focus on developing students cognitive skills to a greater extent by focussing on skills development as provided for in the curriculums (such as in Mathematics - applying and problem-solving; communicating and expressing; integrating and connecting; reasoning; implementing;

understanding and recalling; and in Science - questioning, observing, investigating and experimenting, estimating and measuring; analysing; recording and communicating predicting, questioning, applying and reasoning in Science)

5. How can we improve?

The ERC reports which will be published in 2017 will provide more detailed analysis of Irish performance on TIMSS 2015, including contextual information from students, parents, teachers and principals. These will identify factors, including home environment support; school composition and resources; teachers' preparation and classroom practice; and student engagement, which may have impacted on students' performance.

5.1 What are we doing already?

- We have made a strong commitment in the *Action Plan for Education 2016-2019* to focus on improving achievement and seeking continual improvement in standards
- At primary level, the National Council for Curriculum and Assessment (NCCA) is currently engaging in the early stages of developing a new primary Mathematics curriculum. In the course of this work, widespread consultation will take place, and due account will be taken of international best practices and developments in the area of Mathematics
- At post-primary level, Project Maths was introduced on a nationwide basis in 2010 and represented a fundamental change in the way Mathematics is taught in Ireland. The changes that will arise for the introduction of the new Junior Cycle may also have a positive effect on student performance in future TIMMS assessments. The new Junior Cycle Mathematics specification is currently in development with a planned implementation date for first year students of September 2018. The development team will be able to build on the learning from Project Maths when designing the new specification
- The new Junior Cycle specification for Science commenced implementation for first years in September 2016 and this will be accompanied by CPD for Science teachers. The junior cycle for teachers (JCT) support service has a designated Science team. They began providing CPD for teachers in January 2016. They are supporting teachers in their engagement with the learning outcomes and assessment in Junior Cycle Science
- In the meantime, the Irish Mathematics and Science curriculums incorporate provision for the main areas of development mentioned in 4 above.

- The gains made by students at primary level combined with new approaches and emphasis on skills and critical thinking in Project Mathematics at post-primary level will take time to impact on students' performance. We are, however, as a system moving in the right direction.

Other steps that are being taken or that are underway include:

- A sustained system-wide focus on the implementation of actions to support numeracy as proposed in the National Strategy: Literacy and Numeracy for Learning and Life 2011-2020, informed by the interim review of the Strategy which is due to be published shortly
- A continued focus, through the school self-evaluation (SSE) process on promoting improvement across the domains of learner outcomes, learner experiences and teachers' practices
- A STEM Education Policy Statement is due to be published in early 2017. This will further support teaching and learning in Science and Mathematics at all levels of the education system
- The Department's *New Digital Strategy for Schools 2015-2020, Enhancing Teaching, Learning and Assessment,* which was launched in October 2015, sets out an ambitious programme to further embed technology and digital learning tools in primary and post primary schools. Implementation of the actions in the plan will support additional use of information and communications technology (ICT) and digital learning across the curriculum including in Science and in Mathematics
- Continued support by the DES of initiatives and programmes which promote initiatives in Mathematics and Science in primary and post-primary schools
- A new model of Curriculum Evaluation (CE) has been designed in 2016 for primary schools to enable the Inspectorate to conduct regular and in-depth evaluation of students' knowledge, skills and dispositions in the context of the subjects of the Primary School Curriculum. CE will heighten awareness of the spiral nature of the curriculum and its emphasis on the developmental acquisition of curriculum skills and competences. This will support students' learning in Mathematics and Science

Mathematics			Science		
Country	Mean	(SE)	Country	Mean	(SE)
Singapore	618	(3.8)	Singapore	590	(3.7)
Hong Kong SAR	615	(2.9)	Korea, Rep. of	589	(2.0)
Korea, Rep. of	608	(2.2)	Japan	569	(1.8)
Chinese Taipei	597	(1.9)	Russian Federation	567	(3.2)
Japan	593	(2.0)	Hong Kong SAR	557	(2.9)
Northern Ireland	570	(2.9)	Chinese Taipei	555	(1.8)
Russian Federation	564	(3.4)	Finland	554	(2.3)
Norway (G5)	549	(2.5)	Kazakhstan	550	(4.4)
Ireland	**547**	**(2.1)**	Poland	547	(2.4)
England	546	(2.8)	United States	546	(2.2)
Belgium (Flemish)	546	(2.1)	Slovenia	543	(2.4)
Kazakhstan	544	(4.5)	Hungary	542	(3.3)
Portugal	541	(2.2)	Sweden	540	(3.6)
United States	539	(2.3)	Norway (G5)	538	(2.6)
Denmark	539	(2.7)	England	536	(2.4)
Lithuania	535	(2.5)	Bulgaria	536	(5.9)
Finland	535	(2.0)	Czech Republic	534	(2.4)
Poland	535	(2.1)	Croatia	533	(2.1)
Netherlands	530	(1.7)	**Ireland**	**529**	**(2.4)**
Hungary	529	(3.2)	Germany	528	(2.4)
Czech Republic	528	(2.2)	Lithuania	528	(2.5)
Bulgaria	524	(5.3)	Denmark	527	(2.1)
Cyprus	523	(2.7)	Canada	525	(2.6)
Germany	522	(2.0)	Serbia	525	(3.7)
Slovenia	520	(1.9)	Australia	524	(2.9)
Sweden	519	(2.8)	Slovak Republic	520	(2.6)
Serbia	518	(3.5)	Northern Ireland	520	(2.2)
Australia	517	(3.1)	Spain	518	(2.6)
Canada	511	(2.3)	Netherlands	517	(2.7)
Italy	507	(2.6)	Italy	516	(2.6)
Spain	505	(2.5)	Belgium (Flemish)	512	(2.3)
Croatia	502	(1.8)	Portugal	508	(2.2)
Slovak Republic	498	(2.5)	New Zealand	506	(2.7)
New Zealand	491	(2.3)	France	487	(2.7)
France	488	(2.9)	Turkey	483	(3.3)
Turkey	483	(3.1)	Cyprus	481	(2.6)
Georgia	463	(3.6)	Chile	478	(2.7)
Chile	459	(2.4)	Bahrain	459	(2.6)
United Arab Emirates	452	(2.4)	Georgia	451	(3.7)
Bahrain	451	(1.6)	United Arab Emirates	451	(2.8)
Qatar	439	(3.4)	Qatar	436	(4.1)
Iran, Islamic Rep. of	431	(3.2)	Oman	431	(3.1)
Oman	425	(2.5)	Iran, Islamic Rep. of	421	(4.0)
Indonesia	397	(3.7)	Indonesia	397	(4.8)
Jordan	388	(3.1)	Saudi Arabia	390	(4.9)
Saudi Arabia	383	(4.1)	Morocco	352	(4.7)
Morocco	377	(3.4)	Kuwait	337	(6.2)
South Africa (G5)	376	(3.5)			
Kuwait	353	(4.6)			
Average achievement significantly higher than Ireland			Average achievement significantly lower than Ireland		

- Appendix 1: Mean country scores and standard errors for the TIMSS 2015 Fourth grade (4th class) assessments, with significant differences compared to the Irish mean score
- Note: Norway and South Africa assessed students at Grade 5 rather than Grade 4. Jordan and South Africa participated only in TIMSS Numeracy (for mathematics) and did not collect data on science achievement.

Mathematics			Science		
Country	Mean	(SE)	Country	Mean	(SE)
Singapore	621	(3.2)	Singapore	597	(3.2)
Korea, Rep. of	606	(2.6)	Japan	571	(1.8)
Chinese Taipei	599	(2.4)	Chinese Taipei	569	(2.1)
Hong Kong SAR	594	(4.6)	Korea, Rep. of	556	(2.2)
Japan	586	(2.3)	Slovenia	551	(2.4)
Russian Fed.	538	(4.7)	Hong Kong SAR	546	(3.9)
Kazakhstan	528	(5.3)	Russian Fed.	544	(4.2)
Canada	527	(2.2)	England	537	(3.8)
Ireland	**523**	**(2.7)**	Kazakhstan	533	(4.4)
United States	518	(3.1)	**Ireland**	**530**	**(2.8)**
England	518	(4.2)	United States	530	(2.8)
Slovenia	516	(2.1)	Hungary	527	(3.4)
Hungary	514	(3.8)	Canada	526	(2.2)
Norway (G9)	512	(2.3)	Sweden	522	(3.4)
Lithuania	511	(2.8)	Lithuania	519	(2.8)
Israel	511	(4.1)	New Zealand	513	(3.1)
Australia	505	(3.1)	Australia	512	(2.7)
Sweden	501	(2.8)	Norway (G9)	509	(2.8)
Italy	494	(2.5)	Israel	507	(3.9)
Malta	494	(1.0)	Italy	499	(2.4)
New Zealand	493	(3.4)	Turkey	493	(4.0)
Malaysia	465	(3.6)	Malta	481	(1.6)
United Arab Emirates	465	(2.0)	United Arab Emirates	477	(2.3)
Turkey	458	(4.7)	Malaysia	471	(4.1)
Bahrain	454	(1.4)	Bahrain	466	(2.2)
Georgia	453	(3.4)	Qatar	457	(3.0)
Lebanon	442	(3.6)	Iran, Islamic Rep. of	456	(4.0)
Qatar	437	(3.0)	Thailand	456	(4.2)
Iran, Islamic Rep. of	436	(4.6)	Oman	455	(2.7)
Thailand	431	(4.8)	Chile	454	(3.1)
Chile	427	(3.2)	Georgia	443	(3.1)
Oman	403	(2.4)	Jordan	426	(3.4)
Kuwait	392	(4.6)	Kuwait	411	(5.2)
Egypt	392	(4.1)	Lebanon	398	(5.3)
Botswana (G9)	391	(2.0)	Saudi Arabia	396	(4.5)
Jordan	386	(3.2)	Morocco	393	(2.5)
Morocco	384	(2.3)	Botswana (G9)	392	(2.7)
South Africa (G9)	372	(4.5)	Egypt	371	(4.3)
Saudi Arabia	368	(4.6)	South Africa (G9)	358	(5.6)

Average achievement significantly higher than Ireland

Average achievement significantly lower than Ireland

Appendix 2 Mean country scores and standard errors for the TIMSS 2015 Eighth grade (2nd year) assessment, with significant differences compared to the Irish mean score

Note: Two countries (Botswana and South Africa) assessed students at Grade 9 rather than Grade 8, while Norway assessed students at both Grades 8 and 9