COMMISSION ON SCHOOL REFORM

Broken STEM – Maths & Science Attainment in S4

December 2024

Membership of the Commission on School Reform is as follows:

- **Keir Bloomer (Chair):** Education Consultant and former Director of Education
- **Cllr Sarah Atkin:** Independent Councillor at The Highland Council and member of the Education Committee. Former Parent Council Chairwoman and School Governor.
- **John Edward:** Scottish Council on Global Affairs, Former Director SCIS; Trustee of Scottish European Educational Trust and Board Member of AGBIS.
- **Carole Ford:** Former head teacher of Kilmarnock Academy and former president of School Leaders Scotland.
- **Heather Fuller:** Head Teacher at The High School of Glasgow Junior School, former Development Officer at Education Scotland
- **Jim Goodall:** Former Head of Education and Community Services at Clackmannanshire Council and former Lib Dem councillor at East Dunbartonshire Council
- **Anna Hazel-Dunn:** Deputy head teacher, Blackhall Primary, Edinburgh
- **Johann Lamont:** Former teacher (1979-99) and retired Member of Scottish Parliament (1999-2022)
- **Frank Lennon:** Former Head of Dunblane High School and St Modan's, Stirling
- **Darren Leslie:** Teacher in Fife and host of The Becoming Educated Podcast
- **Ross Martin:** Economic agitator with experience in a variety of roles in education – including school teacher, voluntary tutor, chair of local education authority, member of college board and university court, Chair of a charity, and, most importantly, a parent and former student.
- **Cllr Alix Mathieson:** Conservative Councillor at East Dunbartonshire Council, member of education committee and Former Chairperson of a third sector nursery
- **Lindsay Paterson:** Professor emeritus of education policy in the School of Social and Political Science at Edinburgh University.
- **Bruce Robertson:** An experienced secondary headteacher and best-selling author of *The Teaching Delusion* trilogy and *Power Up Your Pedagogy: The Illustrated Handbook of Teaching*.

*All members of the Commission participate in an individual capacity and that the views of the Commission do not represent the views of any other organisation to which individual members belong.

Summary

Against a backdrop of declining maths and science scores in PISA, the Commission on School Reform carried out research to look at National 5 attainment levels by year cohort.

The published SQA data provides attainment levels and pass rates for those who sit exams. However, it gives no indication of the qualifications that are being achieved by the broad cohort. For example, if 100 pupils sit Nat 5 Maths and 90 pass, this would generate a pass rate of 90% and looks to be a positive result. However, if the total number of pupils was actually 200, and only 100 sit the exam, the overall proportion of the cohort gaining the qualification is only 45%, which looks far less positive.

By using Freedom of Information, the results highlighted:

- A growing proportion of the S4 cohort are gaining a pass at Nat 5 English, with 75% passing in 2024. In contrast only 40% achieved a pass in Nat 5 Maths.
- The proportion of S4 pupils gaining a pass at Nat 5 in computing, physics, chemistry and biology have all fallen over the past ten years.
- The proportion of the S4 cohort gaining a pass in Nat 5 Maths is only 4% higher than the proportion of the cohort gaining a pass in Nat 5 PE.
- Although 22% of the S4 cohort gained a pass in Nat 5 Applications of Maths in 2024, 50% of those individuals also gained a pass in Nat 5 Maths, with just over 20% of those who sat both, getting an A in both subjects (2% of double maths entries only received a pass in Applications)
- Only around half of S5 pupils who sit Nat 5 exams in maths or science pass. The proportion of S5 pupils passing computing and biology Nat 5s has fallen considerably over the past decade with a drop from 54% to 35% in biology and 71% to 55% in computing.

Background

PISA

In December 2023 the latest PISA results were published, highlighting worrying declines in Scotland's maths and science scores.

For maths the score in 2022 was 471, just below the OECD average of 472 and down from 489 in 2018 and 491 in 2015. It was ahead of Wales (466), but behind Northern Ireland (475) and England (492).

In science, Scotland's score was 483, down from 490 in 2018 and 497 in 2015. Again this was better than Wales (473) but behind Northern Ireland (488) and England (503).

The decline could not be explained away by the pandemic, not least because it carried on a trend of decline that began before Covid.

At the time the results were published, Lindsay Paterson wrote on a blog for Reform Scotland[1]:

"*Scottish attainment fell from early in the century to the middle of the first decade, stabilised for a few years, and then, from 2012, started a steady decline which was unmitigated except for a brief rise in reading in 2018 (which was wiped out by the 2022 fall).*

"As a result, over the whole decade from 2012 to 2022, the Scottish decline was equivalent to about 16 months of schooling in mathematics, 8 months in reading, and 18 months in science."

[1] PISA 2022 in Scotland: declining attainment and growing social inequality - Lindsay Paterson - Reform Scotland

Standard Grades to Nationals

Reform Scotland has undertaken previous research[2] which suggests that the introduction of National 5s, which replaced Standard Grades as the main exam taken in S4, led to an unintended consequence of a reduction in subject choice. Under the previous system, most pupils sat exams in seven or eight subjects. However, the change saw some schools initially offer as few as five subjects in S4, regardless of the ability of the individual. Our research noted that the independent sector still enabled pupils to sit eight, or even nine, subjects in S4.

Current SQA exam data provides information on all entries for any given subject, along with the results. However, whereas the vast majority of entries under the old Standard Grade system were pupils in S4, that has changed, with many older pupils sitting National 5 in later years, especially in English and Maths. This means that the data, as produced at present, don't give a sense of what proportion of the S4 cohort are sitting, and passing, each subject. So while there is plenty public debate around the importance of STEM, the data that is published doesn't give a sense of what is happening more broadly in those areas subjects. For example, has the reduction in subject choice contributed to a fall in pupils sitting science subjects?

This lack of good educational data is holding back our ability to understanding the problems we're facing, and how to fix them.

Data 'black hole'

There is a general lack of good education data in Scotland which means that it is effectively impossible to track learning or teaching, to assess the outcome of schooling for leavers, and therefore to evaluate government policies intended to improve schooling.

As a result when PISA data is published and highlights trends that should cause alarm, we have no basis to work from either to understand the problem, or how to fix it.

In a recent report, 'Why Educational Data Matters', the Commission on School Reform set out how it would be possible to put a credible data structure in bringing together evidence from the Scottish National Standardised Assessments and the SQA assessment process and adding a regular sample survey at key stages. The report called recommended:

- A longitudinal sample survey of pupils as they progress through P1, P4, P7, S3 and after leaving school. There would be a new survey of this kind every three years.
- Annual tracking data using the existing Scottish National Standardised Assessments and SQA assessments, which are currently held separately and unaligned
- An Office for Scottish Education Data to oversee the new structure, accountable to Parliament, not Government

Statistics

We asked the SQA, under Freedom of Information, to outline, for each of the last ten years, the National 5 exam results broken down by year cohort. We also asked the number of pupils in each cohort. This meant that we have been able to track the change, not just in the number of pupils entering each subject, but the proportion of the overall S4 year group who are achieving a pass in each subject.

For example, while the proportion of S4 *entries* in Nat 5 English achieving an A-C pass has fallen from 91.2% in 2015 to 87.3% in 2024, the actual *overall proportion of the S4 cohort* passing Nat 5 English has increased from 65.3% to 75.2%.

[2] National 4s & 5s: The accidental attainment gap - Reform Scotland

In contrast, the percentage of the S4 cohort passing each of the main sciences has fallen. It is worth noting that pupils who do not pass a STEM subject at Nat 5 in S4 will be unable to sit the Higher in S5 and are therefore less likely to be able to go on to straight to Higher Education from school with the aim of becoming medics and scientists.

S4 cohort attainment in science, maths and English

	Year	number of S4 pupils	number of S4 entries	% of S4 entered	Number of As	% of entries awarded As	% of S4 pupils awarded As	Number of A-C	% of entries awarded A-C	% of S4 pupils awarded A-C
English	2015	45,002	32,211	71.6%	15,557	48.3%	34.6%	29,366	91.2%	65.3%
	2016	44,815	34,264	76.5%	15,160	44.2%	33.8%	31,162	90.9%	69.5%
	2017	44,685	36,007	80.6%	15,740	43.7%	35.2%	32,686	90.8%	73.1%
	2018	43,526	35,767	82.2%	15,047	42.1%	34.6%	31,850	89.0%	73.2%
	2019	44,861	37,191	82.9%	15,183	40.8%	33.8%	33,462	90.0%	74.6%
	2020	46,292	38,632	83.5%	17,262	44.7%	37.3%	36,240	93.8%	78.3%
	2021	47,160	39,424	83.6%	20,868	52.9%	44.2%	36,844	93.5%	78.1%
	2022	48,605	40,946	84.2%	19,236	47.0%	39.6%	37,329	91.2%	76.8%
	2023	50,072	42,614	85.1%	18,793	44.1%	37.5%	38,017	89.2%	75.9%
	2024	50,387	43,436	86.2%	17,685	40.7%	35.1%	37,898	87.3%	75.2%
Maths	2015	45,002	24,604	54.7%	9,960	40.5%	22.1%	17,517	71.2%	38.9%
	2016	44,815	25,472	56.8%	10,504	41.2%	23.4%	18,619	73.1%	41.5%
	2017	44,685	25,858	57.9%	11,232	43.4%	25.1%	19,023	73.6%	42.6%
	2018	43,526	25,456	58.5%	11,333	44.5%	26.0%	19,167	75.3%	44.0%
	2019	44,861	26,383	58.8%	11,314	42.9%	25.2%	19,961	75.7%	44.5%
	2020	46,292	26,783	57.9%	12,467	46.5%	26.9%	22,817	85.2%	49.3%
	2021	47,160	25,083	53.2%	12,088	48.2%	25.6%	20,463	81.6%	43.4%
	2022	48,605	26,644	54.8%	12,586	47.2%	25.9%	21,041	79.0%	43.3%
	2023	50,072	27,247	54.4%	9,903	36.3%	19.8%	19,568	71.8%	39.1%
	2024	50,387	26,627	52.8%	13,120	49.3%	26.0%	20,227	76.0%	40.1%
Applications of Mathematics	2018	43,526	532	1.2%	166	31.2%	0.4%	387	72.7%	0.9%
	2019	44,861	2,152	4.8%	739	34.3%	1.6%	1,461	67.9%	3.3%
	2020	46,292	6,417	13.9%	2,388	37.2%	5.2%	5,213	81.2%	11.3%
	2021	47,160	6,172	13.1%	1,800	29.2%	3.8%	4,382	71.0%	9.3%
	2022	48,605	8,879	18.3%	2,850	32.1%	5.9%	6,380	71.9%	13.1%
	2023	50,072	12,998	26.0%	4,007	30.8%	8.0%	8,860	68.2%	17.7%
	2024	50,387	16,566	32.9%	5,256	31.7%	10.4%	10,872	65.6%	21.6%
Biology	2015	45,002	16,485	36.6%	4,900	29.7%	10.9%	12,573	76.3%	27.9%
	2016	44,815	16,341	36.5%	5,774	35.3%	12.9%	12,853	78.7%	28.7%
	2017	44,685	16,736	37.5%	5,522	33.0%	12.4%	12,780	76.4%	28.6%
	2018	43,526	16,477	37.9%	6,082	36.9%	14.0%	12,896	78.3%	29.6%
	2019	44,861	17,270	38.5%	5,990	34.7%	13.4%	13,195	76.4%	29.4%
	2020	46,292	17,460	37.7%	6,999	40.1%	15.1%	15,088	86.4%	32.6%
	2021	47,160	17,499	37.1%	7,195	41.1%	15.3%	13,951	79.7%	29.6%
	2022	48,605	18,818	38.7%	6,926	36.8%	14.2%	14,433	76.7%	29.7%
	2023	50,072	19,236	38.4%	7,410	38.5%	14.8%	14,879	77.3%	29.7%
	2024	50,387	18,801	37.3%	5,923	31.5%	11.8%	13,049	69.4%	25.9%
Computing Science	2015	45,002	6,391	14.2%	2,416	37.8%	5.4%	5,506	86.2%	12.2%
	2016	44,815	6,554	14.6%	2,465	37.6%	5.5%	5,603	85.5%	12.5%
	2017	44,685	6,319	14.1%	2,072	32.8%	4.6%	5,319	84.2%	11.9%
	2018	43,526	5,565	12.8%	1,789	32.1%	4.1%	4,349	78.1%	10.0%
	2019	44,861	5,377	12.0%	1,880	35.0%	4.2%	4,183	77.8%	9.3%
	2020	46,292	5,315	11.5%	2,320	43.7%	5.0%	4,858	91.4%	10.5%
	2021	47,160	5,461	11.6%	2,642	48.4%	5.6%	4,825	88.4%	10.2%
	2022	48,605	5,674	11.7%	2,514	44.3%	5.2%	4,619	81.4%	9.5%
	2023	50,072	6,089	12.2%	2,740	45.0%	5.5%	4,920	80.8%	9.8%
	2024	50,387	6,083	12.1%	2,891	47.5%	5.7%	4,921	80.9%	9.8%

Physics	2015	45,002	12,083	26.8%	4,120	34.1%	9.2%	9,491	78.5%	21.1%
	2016	44,815	12,237	27.3%	4,443	36.3%	9.9%	9,615	78.6%	21.5%
	2017	44,685	11,837	26.5%	4,257	36.0%	9.5%	9,042	76.4%	20.2%
	2018	43,526	11,424	26.2%	4,018	35.2%	9.2%	9,024	79.0%	20.7%
	2019	44,861	11,536	25.7%	4,138	35.9%	9.2%	9,010	78.1%	20.1%
	2020	46,292	11,669	25.2%	5,102	43.7%	11.0%	10,235	87.7%	22.1%
	2021	47,160	11,245	23.8%	5,257	46.7%	11.1%	9,421	83.8%	20.0%
	2022	48,605	11,592	23.8%	4,381	37.8%	9.0%	8,967	77.4%	18.4%
	2023	50,072	11,539	23.0%	4,334	37.6%	8.7%	8,558	74.2%	17.1%
	2024	50,387	11,771	23.4%	4,360	37.0%	8.7%	9,028	76.7%	17.9%
Chemistry	2015	45,002	14,512	32.2%	5,178	35.7%	11.5%	10,971	75.6%	24.4%
	2016	44,815	14,860	33.2%	5,573	37.5%	12.4%	11,690	78.7%	26.1%
	2017	44,685	14,414	32.3%	5,518	38.3%	12.3%	11,345	78.7%	25.4%
	2018	43,526	13,990	32.1%	5,528	39.5%	12.7%	11,147	79.7%	25.6%
	2019	44,861	14,199	31.7%	5,294	37.3%	11.8%	11,278	79.4%	25.1%
	2020	46,292	14,364	31.0%	6,517	45.4%	14.1%	12,804	89.1%	27.7%
	2021	47,160	13,652	28.9%	6,485	47.5%	13.8%	11,453	83.9%	24.3%
	2022	48,605	14,052	28.9%	6,349	45.2%	13.1%	11,505	81.9%	23.7%
	2023	50,072	14,107	28.2%	6,294	44.6%	12.6%	11,268	79.9%	22.5%
	2024	50,387	14,392	28.6%	6,287	43.7%	12.5%	11,325	78.7%	22.5%

Proportion of S4 cohort gaining A-C in Nat 5 exam in top 20 subjects

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
English	65.3%	69.5%	73.1%	73.2%	74.6%	78.3%	78.1%	76.8%	75.9%	75.2%
Mathematics	38.9%	41.5%	42.6%	44.0%	44.5%	49.3%	43.4%	43.3%	39.1%	40.1%
Physical Education	26.7%	27.1%	28.5%	29.9%	32.1%	33.5%	35.0%	35.6%	35.9%	36.4%
Biology	27.9%	28.7%	28.6%	29.6%	29.4%	32.6%	29.6%	29.7%	29.7%	25.9%
Chemistry	24.4%	26.1%	25.4%	25.6%	25.1%	27.7%	24.3%	23.7%	22.5%	22.5%
Applications of Mathematics				0.9%	3.3%	11.3%	9.3%	13.1%	17.7%	21.6%
History	24.2%	24.5%	22.8%	23.0%	23.4%	26.1%	25.6%	24.2%	24.3%	21.4%
Physics	21.1%	21.5%	20.2%	20.7%	20.1%	22.1%	20.0%	18.4%	17.1%	17.9%
Modern Studies	17.4%	16.8%	18.5%	17.2%	17.6%	20.6%	21.9%	20.0%	19.0%	17.8%
Art and Design	16.5%	16.6%	16.6%	16.3%	16.1%	18.2%	17.8%	17.2%	17.3%	17.3%
Business Management	11.5%	11.6%	11.0%	10.8%	10.7%	12.0%	12.0%	13.2%	13.9%	14.2%
Geography	18.4%	17.5%	16.1%	14.4%	14.0%	16.6%	16.8%	15.9%	14.4%	13.9%
Music	14.8%	14.7%	14.1%	14.1%	13.8%	14.6%	15.5%	13.6%	12.7%	12.9%
Practical Woodworking	5.0%	5.5%	5.9%	5.8%	6.8%	8.3%	9.0%	10.1%	11.0%	11.0%
French	20.1%	17.0%	17.1%	15.2%	13.9%	14.6%	12.9%	11.2%	10.9%	10.5%
Spanish	6.9%	8.0%	8.2%	9.2%	8.9%	10.5%	9.3%	9.6%	9.4%	10.1%
Practical Cookery						7.6%	7.9%	8.4%	8.9%	10.0%
Computing Science	12.2%	12.5%	11.9%	10.0%	9.3%	10.5%	10.2%	9.5%	9.8%	9.8%
Drama	8.9%	8.6%	8.5%	8.9%	9.3%	9.9%	9.1%	8.3%	7.9%	8.2%
Graphic Communication	11.3%	9.8%	10.3%	8.1%	7.6%	8.8%	8.2%	7.1%	6.9%	6.2%

Trends can also be seen for those studying National 5s in later years – for example only around 50% of the S5 cohort sitting stem subjects at Nat 5 level pass. It is likely that some of these pupils either sat the National 4 in their fourth year, or are repeating the qualification. With such a low pass rate there is a question over whether the system is failing these pupils.

S5 entries at Nat 5, STEM, 2015-2024

	Year	S5 pupils	S5 entries	% of S5	As	% entries A	A-C	% entries A-C
Mathematics	2015	24,706	9,773	39.6%	878	9.0%	4,364	44.7%
	2016	24,732	10,779	43.6%	1,106	10.3%	5,329	49.4%
	2017	23,476	10,358	44.1%	1,119	10.8%	5,059	48.8%
	2018	22,113	9,997	45.2%	939	9.4%	4,824	48.3%
	2019	21,398	9,384	43.9%	770	8.2%	4,455	47.5%
	2020	21,691	9,253	42.7%	1,507	16.3%	6,066	65.6%
	2021	20,984	7,272	34.7%	917	12.6%	3,760	51.7%
	2022	20,865	7,931	38.0%	1,021	12.9%	4,034	50.9%
	2023	20,428	6,947	34.0%	367	5.3%	2,536	36.5%
	2024	20,964	6,799	32.4%	824	12.1%	3,188	46.9%
Applications of Mathematics	2018	22,113	1,067	4.8%	114	10.7%	521	48.8%
	2019	21,398	1,386	6.5%	121	8.7%	610	44.0%
	2020	21,691	2,483	11.4%	297	12.0%	1,519	61.2%
	2021	20,984	3,013	14.4%	311	10.3%	1,486	49.3%
	2022	20,865	3,760	18.0%	417	11.1%	1,965	52.3%
	2023	20,428	4,190	20.5%	408	9.7%	1,905	45.5%
	2024	20,964	5,432	25.9%	459	8.4%	2,290	42.2%
Computing Science	2015	24,706	962	3.9%	142	14.8%	683	71.0%
	2016	24,732	1,005	4.1%	95	9.5%	694	69.1%
	2017	23,476	788	3.4%	72	9.1%	557	70.7%
	2018	22,113	579	2.6%	54	9.3%	307	53.0%
	2019	21,398	636	3.0%	56	8.8%	354	55.7%
	2020	21,691	597	2.8%	117	19.6%	484	81.1%
	2021	20,984	531	2.5%	104	19.6%	371	69.9%
	2022	20,865	517	2.5%	81	15.7%	301	58.2%
	2023	20,428	462	2.3%	75	16.2%	270	58.4%
	2024	20,964	423	2.0%	60	14.2%	231	54.6%
Physics	2015	24,706	2,337	9.5%	145	6.2%	1,293	55.3%
	2016	24,732	2,046	8.3%	154	7.5%	1,065	52.1%
	2017	23,476	1,743	7.4%	118	6.8%	965	55.4%
	2018	22,113	1,586	7.2%	106	6.7%	857	54.0%
	2019	21,398	1,590	7.4%	101	6.4%	842	53.0%
	2020	21,691	1,386	6.4%	202	14.6%	1,024	73.9%
	2021	20,984	1,166	5.6%	181	15.5%	713	61.1%
	2022	20,865	1,104	5.3%	96	8.7%	510	46.2%
	2023	20,428	1,224	6.0%	124	10.1%	544	44.4%
	2024	20,964	1,066	5.1%	98	9.2%	528	49.5%
Biology	2015	24,706	4,260	17.2%	237	5.6%	2,312	54.3%
	2016	24,732	3,791	15.3%	325	8.6%	2,125	56.1%
	2017	23,476	3,606	15.4%	218	6.0%	1,883	52.2%
	2018	22,113	3,379	15.3%	248	7.3%	1,757	52.0%
	2019	21,398	3,208	15.0%	192	6.0%	1,454	45.3%
	2020	21,691	3,278	15.1%	427	13.0%	2,282	69.6%
	2021	20,984	2,754	13.1%	313	11.4%	1,502	54.5%
	2022	20,865	2,854	13.7%	252	8.8%	1,381	48.4%
	2023	20,428	2,889	14.1%	253	8.8%	1,386	48.0%
	2024	20,964	2,655	12.7%	150	5.6%	923	34.8%
Chemistry	2015	24,706	1,750	7.1%	141	8.1%	901	51.5%
	2016	24,732	1,742	7.0%	165	9.5%	1,034	59.4%
	2017	23,476	1,468	6.3%	125	8.5%	849	57.8%
	2018	22,113	1,455	6.6%	137	9.4%	831	57.1%
	2019	21,398	1,349	6.3%	132	9.8%	718	53.2%
	2020	21,691	1,233	5.7%	231	18.7%	955	77.5%
	2021	20,984	1,052	5.0%	179	17.0%	643	61.1%
	2022	20,865	1,054	5.1%	151	14.3%	625	59.3%
	2023	20,428	1,045	5.1%	179	17.1%	597	57.1%
	2024	20,964	1,019	4.9%	153	15.0%	548	53.8%