reform scotland

Computing the Future: Creating Digital Leaders, Not Just Consumers

May 2024

reformscotland.com

About Reform Scotland

Reform Scotland, a charity registered in Scotland, is a public policy institute which works to promote increased economic prosperity, opportunity for all, and more effective public services. Reform Scotland is independent of political parties and any other organisations. It is funded by donations from private individuals, charitable trusts and corporate organisations. Its Director is Chris Deerin and Alison Payne is the Research Director. Both work closely with the Trustee Board, chaired by Lord Jack McConnell, which meets regularly to review the research and policy programme and carry out their legal responsibilities.

Reform Scotland's Trustee Board

- Rt Hon Lord McConnell of Glenscorrodale (Chair)
- Geraldine Gammell
- Anna Macdonald
- Sandy Kennedy
- Gareth Williams

Foreword

When we say that financial services comprise 8% of today's Scottish economy, this is also making a point about the importance of the Scottish technology sector.

Modern economies are becoming software-led. A new UK bank like Monzo has more in common with Scottish companies like Skyscanner (travel sector) or Wood Mackenzie (energy sector) as a company than it does with, say, the RBS of 25 years ago.

If there were to be a new Scotland-headquartered bank, the customer experience would mainly involve an app or a website. Moving and storing money would almost entirely be performed digitally. A lot of the jobs that would be created in Scotland for that new bank would be software-related. A new Scottish bank would of course take its place in the financial sector, but it would have technology at its core. As will most other modern enterprises.

This is a key reason behind the growing necessity that we educate ourselves – and especially our children – in the area of computer science.

Here's another way to look at it. The proportion of net-positive Scottish tax contributors (by employees and companies) whose main work relates to software is becoming fundamental to our ability to fund the state's spending priorities. Understanding the economy just by its different sectors obscures this. And as the role of technology, now including AI, expands – as it certainly will - its importance to the Scottish economy will only increase. This is a trend that is accelerating across the planet. Computer science is not a geeky side-show, but is now foundational to a successful modern economy.

Even in the most software-orientated companies, a majority of the staff are not actually writing software. But their roles do require understanding the capability, opportunities and limitations of existing and new software. The ability to learn this requires a broader development of computational and mathematical thinking. This is what a general education that includes computer science provides. Computer science education in schools isn't job training – it's preparing children for the world they will inhabit as adults.

The Scottish tech-based sector *is* growing, but despite this, as this Reform Scotland report shows, the provision of computer science education is reducing in Scottish schools. The 2020 review of Scotland's tech eco-system by Mark Logan articulates that the school-age cohort is the foundation of a pyramid that can bring greater success to the Scottish economy. Computer science plays a crucial role in this. And yet the number of computer science teachers in Scottish schools is decreasing each year and has been for the past 20 years. As this report points out, it's not simple to hire more teachers in this subject, but it *can* be done.

Many people care about computer science education and there are pockets of valuable progress. Ground-up initiatives are making a difference. dressCode inspires girls into computer science. Glasgow University's Scottish Teachers Advancing Computer Science (STACS) programme is doing great work. The Saltire Scholars internship

program run by Entrepreneurial Scotland gives hundreds of university students each year invaluable (and paid) opportunities. But those initiatives, and others, rely on sustained effort by government at every level for support and to set national focus. In turn, each area of the state benefits from their success.

Countries that lag behind in enhancing the computational skills of their workforce will increasingly struggle to compete in the modern world. It is vital that we address the issues impeding children's education in computer science, and that Scotland wakes up to how important this is.

There is an opportunity for political leadership in this area to generate a compounding impact on our future together - not least via the impact of securing tax revenues in a fast-changing economy. However there is too little progress and further cohorts of pupils stand to miss out. Informatics and computing is a new science which is changing rapidly. Unless we respond as a nation in how we educate our children, we will miss out on participating in and influencing some of the most radical (both positive and negative) changes to society we will have seen since the development of the printing press. We will be instead be passive recipients of that change, allowing other nations to thrive at our expense.

Gareth Williams
Co-Founder, Skyscanner & Reform Scotland Trustee

Introduction

On 25 January 2024 the Scottish Parliament unanimously passed the following motion:

"*That the Parliament recognises the fundamental role of technology, science and innovation in shaping the modern world; notes the global trends that will impact upon Scotland's future economy and society; celebrates the successes of Scotland's high-tech industries and the benefits that they bring in generating economic prosperity, enabling the transition to a green economy, offering solutions to the challenges of the 21st centre, providing thousands of high-skilled jobs and generating inward investment and export opportunities, and recognises the role of the Scottish Government in supporting Scotland to become a hub of world-class technology, building on the strengths of these industries to play a central role in the delivery of an economy that is fair, green and growing and benefits all of Scotland's communities.*"

It is perhaps unsurprising that the motion had all parties in agreement. The current and future importance of technology in our society is obvious to all. Even if we don't work directly in the sector, we all are increasing reliant on technology in our day-to-day lives and it is playing an ever bigger role in all industries. The continuing development of AI will increase this reliance even further.

But in order to be a leading player that develops and creates high-tech companies, rather than simply using imported technology, Scotland must ensure it has a workforce with the knowledge and skills necessary to meet that challenge. The development of those skills starts in school.

In August 2020, Scotland's Chief Entrepreneur Mark Logan published his review of the Scottish tech ecosystem. Describing the system as a funnel, with school as the base layer, the report noted that "*The larger the pool of engaged and skilled young people at this stage, the easier it will be later for start-ups to form and to grow*".[1] The report went on to include the recommendation that computing science be treated like maths and physics.

However, it appears the importance of computing science in our schools continues to be overlooked:

- teacher numbers have fallen dramatically
- there has been a decline in take-up at Nat 5 and Higher level
- it has one of the biggest gender divides
- over 32,000 pupils attend a Scottish secondary school with no qualified computing science teacher
- not all pupils have computing as a compulsory subject in S1 and S2 as part of Broad General Education, while those that do won't necessarily be taught by someone with a computing background.

In other words, our base layer is in a mess and is getting worse, not better.

[1] Scottish technology ecosystem: review - gov.scot (www.gov.scot)

While access to technology in school is important, there is a difference between simply consuming digital devices and properly understanding and seeing the potential in that technology. As Daniel Johnson MSP commented in that debate on 25 January, 2024:

"*Frankly, our children do not need to be taught how to consume technology; they need to be taught how to use and manipulate it*".

Background

Statistics

While the importance of computer science has grown outside the classroom, in schools the number of pupils studying the subject is in decline, alongside falling numbers of teachers.

Table 1: National 5 Entries in 2023

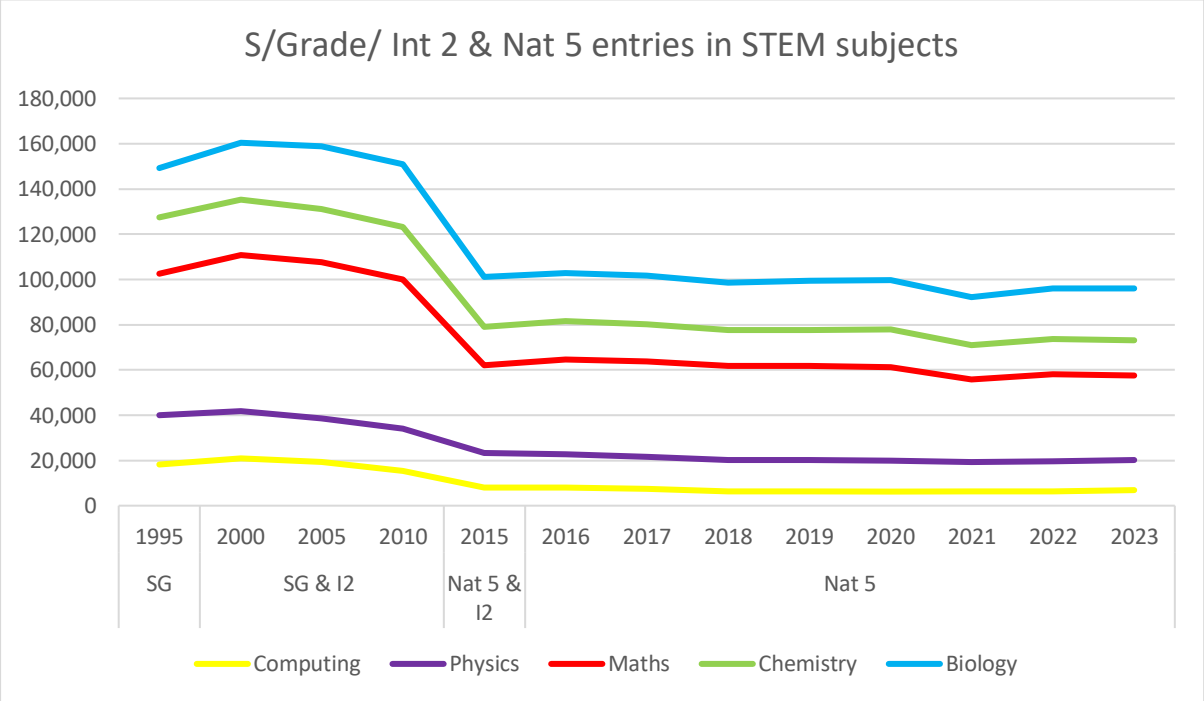
Subject	Entries	Subject	Entries	Subject	Entries
English	49,000	Administration and IT	5,465	Economics	490
Mathematics	37,500	Graphic Communication	5,150	Environmental Science	415
Biology	22,940	Drama	4,625	Latin	340
Physical Education	20,025	Design and Manufacture	4,260	Philosophy	255
Applications of Maths	19,025	RMPH	2,395	Classical Studies	245
History	16,235	Engineering Science	1,875	Mandarin (Simplified)	245
Chemistry	15,560	Practical Metalworking	1,710	Sociology	235
Modern Studies	13,725	Health & Food Technology	1,650	Gàidhlig	230
Physics	13,235	German	1,490	Italian	155
Geography	10,315	Music Technology	1,425	Care	140
Art and Design	10,285	English (SOL)	1,350	Gaelic (Learners)	115
Business Management	9,930	Media	1,300	Urdu	95
Practical Woodworking	7,955	Practical Cake Craft	1,285	Matamataig (Maths)	60
Music	7,555	Psychology	1,135	Eachdraidh (History)	30
Practical Cookery	7,465	Accounting	795	Mandarin (Traditional)	25
French	6,820	Dance	765	Nuadh-eòlas (MS)	25
Computing Science	**6,795**	Practical Electronics	685	Cruinn-eòlas (Geography)	20
Spanish	5,900	Fashion & Textile Technology	630	Cantonese	10

Table 2: Higher entries 2023

Subject	Entries	Subject	Entries	Subject	Entries
English	35,520	Psychology	2,930	Environmental Science	585
Mathematics	18,705	Photography	2,670	German	520
Physical Education	11,485	Spanish	2,605	Classical Studies	490
History	10,115	Drama	2,555	Dance	475
Modern Studies	9,975	French	2,280	Care	370
Chemistry	9,685	Politics	2,135	Fashion & Textile Technology	350
Business Management	8,710	Design and Manufacture	2,035	Childcare & Development	225
Physics	7,995	Applications of Mathematics	1,615	Italian	215
Geography	7,425	Health and Food Technology	1,390	Latin	215
Biology	7,075	Media	1,280	Mandarin (Simplified)	190
Human Biology	7,035	Engineering Science	1,245	Gàidhlig	125
Art and Design	5,890	Accounting	1,230	Urdu	80
Music	5,060	Music Technology	1,075	Gaelic (Learners)	65
Administration and IT	4,325	Economics	890	Matamataig (Mathematics)	40
RMPH	3,890	English (SOL)	855	Mandarin (Traditional)	25
Computing Science	3,560	Sociology	845	Cantonese	20
Graphic Communication	3,085	Philosophy	655		

Table 3: Change in entries over time & by gender in STEM at Nat 5/Standard Grade/ Intermediate 2 level[2]

	Standard Grades			Standard Grades and Intermediate 2									Nat 5 and Int 2			Nat 5								
	1995			2000			2005			2010			2015			2016			2020			2023		
	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F
Computing	18,248	65	35	20,898	63	37	19,331	65	35	15,469	66	34	7,896	80	20	7,926	82	18	6,217	80	20	6,795	78	22
Physics	21,831	68	32	20,887	69	31	19,271	73	27	18,477	71	29	15,294	73	27	14,886	73	27	13,655	71	29	13,235	72	28
Maths	62,364	51	49	68,978	50	50	69,014	50	50	65,928	50	50	38,785	49	51	41,778	48	52	41,285	48	52	37,500	50	50
Chemistry	24,927	50	50	24,493	48	52	23,604	49	51	23,225	49	51	17,123	49	51	17,043	49	51	16,801	48	52	15,560	48	52
Biology	21,811	29	71	25,154	29	71	27,549	30	70	27,924	33	67	22,082	33	67	21,208	34	66	21,791	34	66	22,940	35	65



[2] It is worth a word of caution when comparing the three types of exams sat predominantly in S4 – Standard Grades, Intermediates and Nationals. Each operated differently, enabled different progression to Higher, and took in a different proportion of pupils in later years. The data shows all Credit, General and Foundation Standard Grade entries for maths and computing, whereas there were no entries below General level for individual sciences. A Credit Standard Grade is equivalent to a National 5. However, the SQA archive data does not break down entries by Standard Grade level, therefore, the data presented gives some general trends using the best data available.

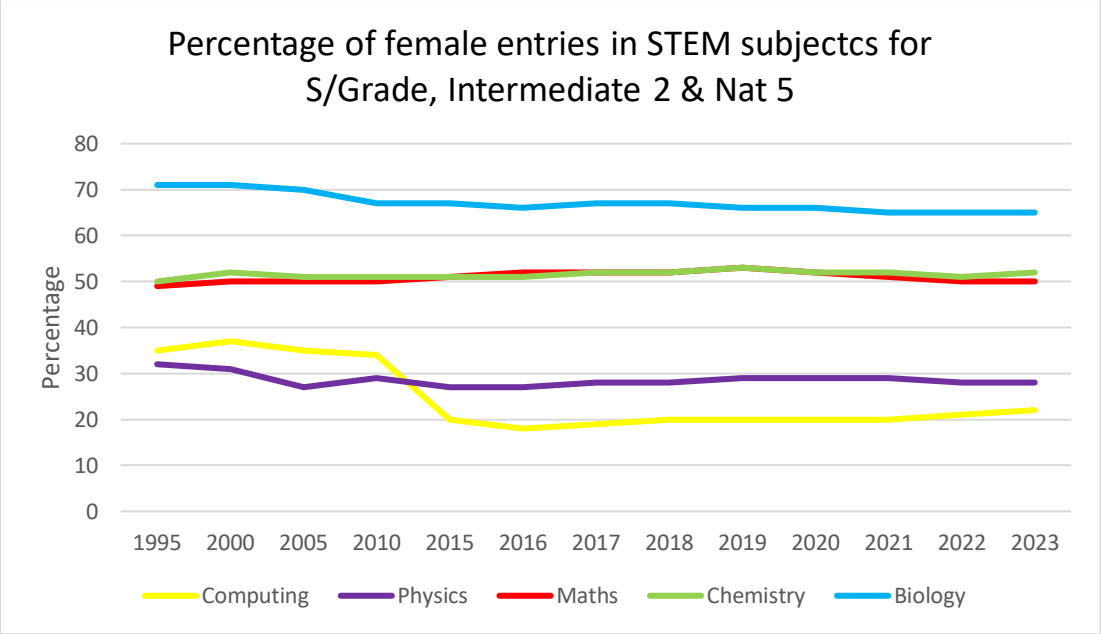
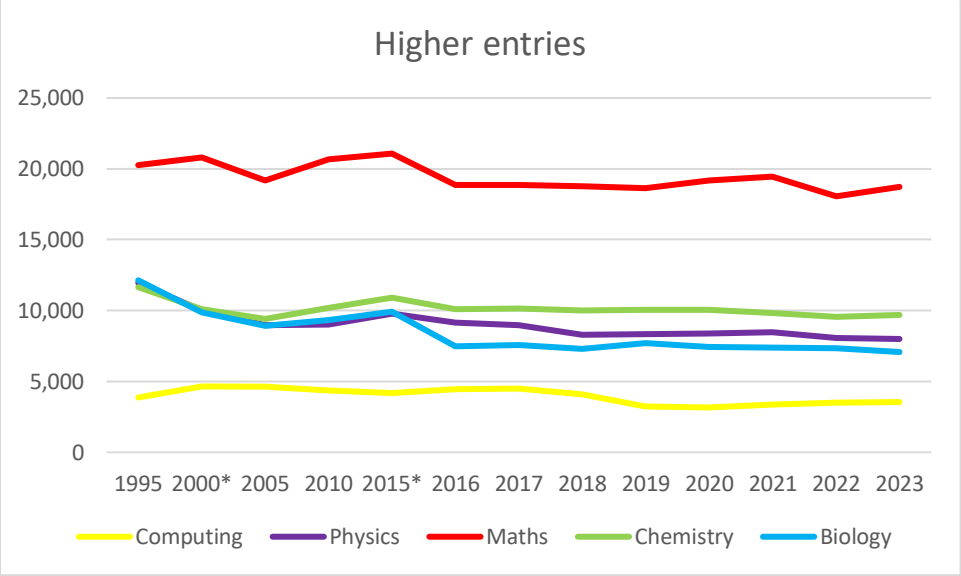
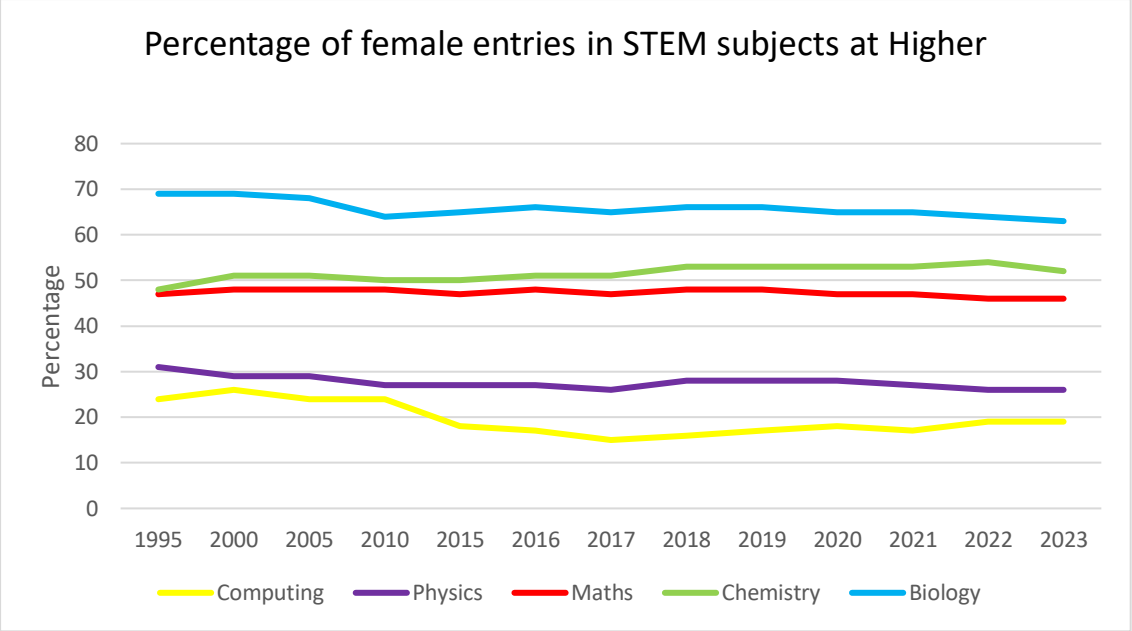


Table 4: Change in entries over time and by gender in STEM subjects at Higher

	1995			2000*			2005			2010			2015*			2016			2020			2023		
	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F	Total	% M	% F
Computing	3,868	76	24	4,646	74	26	4,628	76	24	4,356	76	24	4,190	82	18	4,454	83	17	3,164	82	18	3,560	81	19
Physics	11,951	69	31	10,029	71	29	8,952	71	29	9,018	73	27	9,780	83	27	9,129	73	27	8,392	72	28	7,995	74	26
Maths	20,262	53	47	20,782	52	48	19,181	52	48	20,657	52	48	21,075	53	47	18,871	52	48	19,181	53	47	18,705	54	46
Chemistry	11,651	52	48	10,103	49	51	9,411	49	51	10,179	50	50	10,893	50	50	10,077	49	51	10,038	47	53	9,685	48	52
Biology	12,137	31	69	9,863	31	69	8,943	32	68	9,308	36	64	9,903	35	65	7,492	34	66	7,428	35	65	7,075	37	63

* Details for 2000 includes Highers and New Highers. 2015 includes New Highers & New New Highers for original and revised exams





Although there was a decline in uptake ahead of the introduction of National 5 exams in 2015, there does appear to be a particular decline in pupils studying computing science following this change.

Previous Reform Scotland research highlighted that the change in exams and the extension of the Broad General Education phase into S3 led to a drop in the number of subjects many pupils studied in S4. Under the old Standard Grade system, subjects were studied over 2 years, in S3 & S4, with many pupils studying eight subjects. However, the change saw some schools reduce the number of subjects studied to only six.[3] The reduction in choice will no doubt have impacted the number of pupils choosing computing.

The decline in pupil numbers sits alongside a decline in the number of computing science teachers in Scottish schools, with a 25% drop between 2008 and 2023, as illustrated in Table 5 below.

It should be noted that there has also been a decline in a number of other subjects over this period, including a 12% reduction in maths and 8% in physics. However, when looking at the main subjects, computing science has seen the biggest drop. (German and French have seen individual larger drops but modern languages overall has seen a smaller decline due to increases in Spanish and 'other modern languages'.)

[3] https://www.reformscotland.com/publication/national-4s-5s-the-accidental-attainment-gap/; https://www.reformscotland.com/publication/national-4s-and-5s-unintended-consequences/

Table 5: Teacher numbers by main subject taught, 2008-2023[4]

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	change 08 - 23
All	24,418	23,724	23,177	22,571	22,460	22,188	21,925	21,590	21,528	21,707	21,861	22,057	22,623	23,318	23,383	23,526	-3.7%
English	2,992	2,915	2,794	2,678	2,636	2,590	2,537	2,509	2,466	2,483	2,473	2,491	2,575	2,646	2,652	2,632	-12%
Maths	2,787	2,718	2,644	2,533	2,504	2,441	2,403	2,350	2,331	2,361	2,364	2,362	2,412	2,464	2,456	2,456	-12%
PE	1,728	1,725	1,711	1,704	1,726	1,735	1,755	1,754	1,796	1,805	1,844	1,908	1,956	2,031	2,051	2,061	19%
Biology	1,177	1,177	1,162	1,157	1,169	1,190	1,179	1,165	1,183	1,153	1,213	1,256	1,312	1,343	1,356	1,370	16%
Technical Education	1,345	1,331	1,316	1,305	1,311	1,297	1,277	1,237	1,237	1,245	1,225	1,212	1,223	1,239	1,228	1,192	-11%
Art	1,192	1,155	1,133	1,108	1,121	1,110	1,058	1,063	1,053	1,071	1,092	1,116	1,132	1,180	1,170	1,187	-0.4%
History	874	852	820	817	833	848	865	843	872	887	897	914	933	974	985	1,004	15%
Chemistry	989	963	936	928	935	935	937	932	942	982	948	967	999	1,019	1,004	989	0%
Music	884	882	871	862	886	890	895	876	898	891	912	926	967	992	990	985	11%
Business Studies	969	938	914	878	881	853	826	821	823	832	861	894	924	961	962	979	1.%
Learning support	945	1,014	1,026	941	942	952	811	787	802	821	836	820	835	885	914	971	2.8%
HE	978	945	910	898	877	871	846	826	786	777	758	743	775	791	800	832	-15%
Physics	887	865	868	850	837	822	823	807	814	826	806	806	824	836	821	814	-8.2%
Geography	824	790	780	758	760	752	755	750	755	776	755	741	753	777	779	779	-5.5%
Modern Studies	560	538	545	535	520	542	533	525	553	572	595	623	653	687	698	705	26%
French	1,070	1,004	952	900	860	826	780	744	716	722	688	648	655	650	632	613	-43%
RE	676	676	658	665	660	662	660	649	611	620	618	591	603	608	617	601	-11%
Computing Science	766	728	699	675	660	649	636	601	594	582	595	579	595	595	588	578	-25%
Drama	340	332	361	371	370	377	377	383	391	403	409	431	440	451	451	467	37%
Other Modern Languages	290	297	280	286	299	276	300	313	339	354	378	396	387	408	386	395	36%
Spanish	64	66	78	71	71	93	96	96	95	107	119	127	132	156	161	169	164%
General Science	153	137	143	141	143	116	129	128	131	136	144	149	151	165	175	167	9.2%
German	180	175	166	153	152	136	128	118	106	100	90	80	88	84	83	74	-59%
Gaelic	57	57	59	60	61	60	61	59	60	57	58	58	61	61	62	64	12%
Mandarin	x	x	X	x	x	x	x	x	x	x	x	x	x	x	23	20	
Media Studies	13	11	13	10	11	12	13	11	11	9	13	12	13	12	13	11	-15%
Classical Studies	27	24	21	13	12	11	9	10	8	7	7	10	11	12	10	8	-70%
English AAL	39	42	39	32	10	9	7	5	4	5	6	6	8	7	8	7	-82%
Italian	12	9	10	11	10	8	8	9	7	6	9	11	10	6	7	5	-58%
Community Languages	8	7	7	8	7	6	6	5	4	5	5	5	5	5	5	5	-38%
Russian	x	x	X	x	x	x	x	x	x	x	x	x	x	x	0	0	
Economics	11	8	8	6	6	5	5	6	6	3	3	1	1	0	0	0	-100%
Other	782	430	257	219	214	145	271	247	206	199	229	215	211	279	294	346	-56%

The decline in teacher numbers is not matched by an overall fall in the secondary school roll. Although there have been fluctuations over the years, the number of secondary school pupils in Scotland has increased from 303,978 in 2008 to 313,061 in 2023. The number of pupils in exam years, S4-S6, has increased from 133,281 to 139,456 over the same period.[5]

Given the decline in teacher numbers, Reform Scotland was curious as to what this meant in terms of pupils' access to qualified computing science teachers.

[4] Teacher census supplementary statistics - gov.scot (www.gov.scot)

[5] https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2019/07/pupil-census-supplementary-tables/documents/pupil-census-supplementary-statistics-2023---december/pupil-census-supplementary-statistics-2023---december/govscot%3Adocument/Pupil%2Bcensus%2Bsupplementary%2Bstatistics%2B2023%2B-%2BMarch.xlsx

In terms of deciding what a "qualified" computing science teacher is, the General Teaching Council for Scotland (GTCS) sets the entry requirements for Initial Teacher Education programs. It states that computing teacher applicants "*must have an undergraduate degree with 80 SCQF credit points which has 40 SCQF credit points at SCQF Level 8 (or above) from at least two of: computer systems, software development, databases or web design. The other 40 credits are required in any computing area relevant to the computing curriculum in Scottish schools.*"[6]

We submitted Freedom of Information questions to all local authorities in Scotland asking them how many teachers qualified in a) maths; b) chemistry; c) physics; d) biology; and e) computing taught in each school in their area. All local authorities responded to our query, though South Lanarkshire did not set out numbers of teachers if they were below five.

Using information from the Scottish secondary schools dashboard[7] we were also able to calculate how many pupils attended schools with no qualified computing science teachers.

The FOIs revealed that:

- 32,616 pupils in 31 council areas attend a secondary school with no qualified computing science teacher. That is roughly 12% of all secondary pupils
- 66 secondary schools have no computing science teacher, including 27 with a school roll of over 500 and 10 with more than 1,000 pupils
- 25 secondary schools with a roll of over 1,000 pupils have only one qualified computing science teacher
- The problem seems to be particularly prevalent in rural areas, with 54% of pupils and 10 out of 16 schools in Dumfries and Galloway without a qualified computing science teacher, and 47% of pupils and 17 out of 29 schools in Highland. That is not to say only small schools are impacted: in both authorities there are schools of around 1,000 pupils without a computing science teacher.

In addition to the data, it is worth noting that not all qualified computing science teachers will always be available for teaching. Individuals who have guidance or promoted positions will have less teaching time and therefore this further impacts the availability of teachers in a school.

The full results by school can be viewed here.

We also know anecdotally that not all schools timetable computing science (or digital literacy) as a compulsory subject for all S1s and S2s.

We asked local authorities some Freedom of Information questions around this issue. The responses were not answered in a consistent way and a number of local authorities were unable to respond. However, through some of the answers we did receive, it was

[6] Document > Memorandum on entry requirements to programmes of Initial Teacher Education in Scotland (gtcs.org.uk)
[7] Secondary School Information Dashboard (shinyapps.io)

revealed that at least 15 secondaries do not offer computing science as a subject for all pupils in S1 and 15 do not offer it to all pupils in S2 (these are not the same 15). That break in learning will no doubt impact subject choice.

It is worth highlighting that at present computing below exam level does not need to be taught by a computing science teacher, and is often taught by business, technologies, maths or occasionally other science teachers. This will undoubtedly impact the level of teaching and potentially the interest a teacher from a different background can create in computing for their students.

As worrying as these results are, the situation is likely to get worse. The Scottish Government's initial teacher intake figures for 2023 showed just 16 for computing science, against its target of 52.[8] As Table 6 below illustrates, there appears to have been a particular decline in intake in the last couple of years.

Table 6: Scottish Government Initial Teacher education student intake statistics[9]

	Target	Intake
2023	52	16
2022	52	26
2021	47	44
2020	47	44
2019	53	44
2018	55	46
2017	60	41
2016	52	41

It should be noted that computing science isn't alone in this problem. For example, the intake for maths in 2023 was 83 against a target of 250, and 38 against a target of 131 for physics. Again, there seems to have been a similar decline in the last couple of years with these two subjects as well – in 2021 for maths there was an intake of 172/224 and 59/117 for physics.

The figures published by the Scottish Government are "indicative figures" for numbers at university at the start of the academic session and are not classed as official statistics.[10] As a result we asked the Scottish Government some Freedom of Information questions on the number of people who have graduated from PGDE courses in STEM subjects as well as the number of people who have then taken up places on the Teacher Induction Scheme. Table 8 details the number of people who have graduated from teacher training, while Table 9 sets out the number who have taken a place on the Teacher Induction Scheme. The figures will not be directly

[8] Teacher Workforce Planning Advisory Group: initial teacher education intake figures 2023 - gov.scot (www.gov.scot)

[9] Teacher Workforce Planning Advisory Group: initial teacher education intake figures 2023 - gov.scot (www.gov.scot); Teacher Workforce Planning Advisory Group: initial teacher education intake figures 2022 - gov.scot (www.gov.scot); Teacher Workforce Planning Advisory Group: initial teacher education intake figures 2021 - gov.scot (www.gov.scot); Initial teacher education: 2020 student teacher intake statistics - gov.scot (www.gov.scot); Initial teacher education: 2019 student teacher intake statistics - gov.scot (www.gov.scot); Initial teacher education: 2018 student teacher intake - gov.scot (www.gov.scot); Initial teacher education figures: provisional university admissions 2016 to 2018 - gov.scot (www.gov.scot)

[10] Teacher Workforce Planning Advisory Group: initial teacher education intake figures 2023 - gov.scot (www.gov.scot)

comparable as some graduates may choose not to take up a place, or to defer it. Once again, computing science has the lowest number when compared to the other sciences.

Table 7: All teacher training qualifiers by subject for last five years available

	2017-18	2018-19	2019-20	2020-21	2021-22
Biology	110	110	115	140	120
Chemistry	60	65	85	80	75
Computing	30	35	35	35	25
Mathematics	110	110	115	140	120
Physics	65	80	90	105	60

Source: SG FOI response referencing Higher Education Statistics Agency (HESA) Student data, SG secondary analysis Figures have been rounded to the nearest 5

Table 8: Probationer teachers placed on the Teacher Induction Scheme in the last five years available and in the subjects specified:

	2019-20 (May 2019)	2020-21* (August 2020)	2021-22** (August 2021)	2022-23 (May 2022)	2023-24 (May 2023)
Biology	127	117	111+10	127	109
Chemistry	72	66	78+4	84	35
Computing	40	30	29+3	43	28
Mathematics	115	102	135+7	150	126
Physics	59	40	52+6	72	48

Data is drawn from General Teaching Council for Scotland (GTCS) allocation returns to the Scottish Government, usually provided in May. A small number of probationers may be dual registered across two subjects (e.g., Mathematics and Physics). In such cases the probationer is captured within data for the first subject listed.
* As a result of disruption to reporting during the pandemic the Scottish Government does not hold a breakdown by subject of allocation data for May 2020-21. The figures above reflect reporting in August 2021, which takes into account some probationers who may have deferred or withdrawn from the scheme after allocation. It follows that the figures above for 2021-22 are not directly comparable to allocation data from other years.
** In 2021-22 probationers were allocated in two stages as a result of disruption due to the pandemic, with most allocated in May and some in August. This is reflected in the two figures provided above.

Logan report

In May 2020 former Skyscanner executive Mark Logan, now Professor of Computing Science at the University of Glasgow and the Scottish Government's Chief Entrepreneur, was commissioned by Kate Forbes, the then Cabinet Secretary for Finance, to undertake a short review into how Scotland's technology sector could help contribute to economic recovery following the pandemic. The final report, The Scottish Technology Ecosystem, was published in August 2020 and set out recommendations which could help support and nurture technology businesses in Scotland.

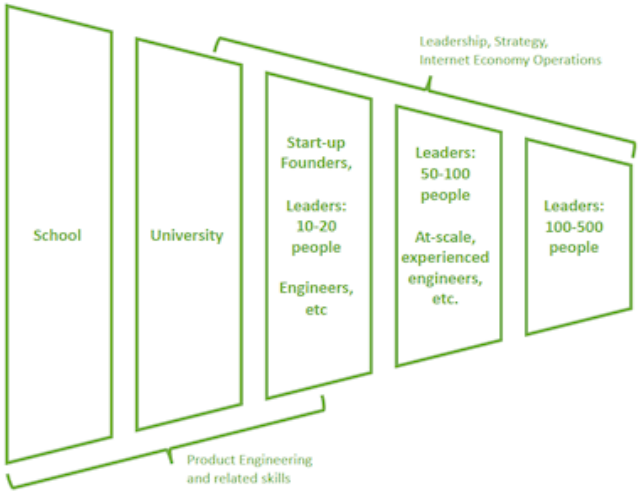
The report described the technology ecosystem as a funnel going from potential start-ups through to unicorns. The report goes on to note that the success of the tech ecosystem is dependent on the education system and ensuring we are creating the right talent:

"*It is generally understood that interventions in our ecosystem that create more talent in programming, engineering and adjacent disciplines are essential to increasing the output of our ecosystem…*

"…The outcomes of our ecosystem are therefore heavily dependent on our education funnel. The more people our education funnel produces with the above capabilities, the higher will be the output of our ecosystem."[11]

In other words, for the tech ecosystem to thrive, education needs to thrive, and that starts at school, as the report goes on to explain:

The Education Funnel from "The Scottish Technology Ecosystem":



"*.. we are first concerned with nurturing the foundational skills in software programming at school level. This constitutes much of the engine that will power future tech start-ups. The larger the pool of engaged and skilled young people at this stage, the easier it will be later for start-ups to form and to grow.*"

"*the more people we equip at school level with a basic level of competence in Computing Science, the more start-ups we'll eventually produce and the greater the pool of engineers we'll have available for those start-ups to hire from as they develop. In a country with a very small population such as ours, this point is of even greater importance.*"

The report goes on to make four recommendations with regard to how computing science is taught in schools:

[11] Scottish technology ecosystem: review - gov.scot (www.gov.scot)

- treat computing science like maths or physics and follow through on the consequences of that decision
- establish an industry partnership with schools to give computing science pupils summer work experience
- school-stage extra-curricular programming clubs should be strategically supported
- overcome gender-stereotyping in early years.

There is a question over what we should be aiming for within "basic level of competence in computing science". Is it having it as a compulsory part of Broad General Education and taught only by qualified computing science teachers? Or is it increasing the number of pupils who leave school with computing science qualifications? And what impact does the subject's curriculum have in this regard?

Despite the prominence and welcome given to the Logan report in general, little has changed in terms of school education - teacher numbers have continued to decline and while there has been a slight increase in the number of entries for National 5 and Higher computing science since the review was published, it has been only very minor. In 2020, there were 3,164 Higher entries for Computing Science. In 2023, this had increased by 396 to 3,560. Across the three-year period the increase in entries worked out at less than an additional one Higher pupil per school per year, and remains considerably lower than the number of entries in 2000, which stood at 4,646.

There is a danger that despite the warm words expressed in Parliamentary motions, the Scottish Government is failing to heed the warnings set out in the Logan report.

Scottish Government action

The Scottish Government has been trying to attract more computing graduates to the teaching profession as part of its drive to attract more STEM teachers in general. This includes the £20,000 teacher bursary scheme for those considering a career change.

Applicants to the scheme need to hold a 2.1 degree or meet the minimum initial teacher education (ITE) entry requirement with a relevant masters qualification, and need to have been in paid employment for at least 36 months out of the last 84 months. In 2022/23 there were 129 applications to the Bursary Scheme with 84 approved. Of those 84, eight were for computing. (32 Maths; 13 Home Economics; 11 Physics; seven for technical education; six for maths/physics; five for chemistry; one for chemistry/biology; and one for maths/biology).[12]

Reform Scotland asked the Scottish Government a number of questions about its wider programme of trying to recruit more teachers. These answers are detailed below:[13]

[12] stem-bursary-evaluation-report-2022-23.pdf (skillsdevelopmentscotland.co.uk)
[13] Scottish Government FOI response 16 April 2024

a) What work is the Scottish Government undertaking to encourage more people to become qualified computing teachers in school?

The Scottish Government funds the Teaching bursary scheme which provides £20,000 for career- changers wishing to undertake a one year PGDE in hard to fill in subjects such as Maths, Physics and Computing Science.

The Strategic Board for Teacher Education is also considering issues around the recruitment to initial teacher education programmes and retention of teachers in Scotland in detail, including geographical and subject specific issues together with work to improve the promotion of teaching as a valued career.

b) Has a rapid-access path into teaching for computing science graduates been created? If not, what progress is there toward this.

The GTCS is the independent, regulatory body for the teaching profession and is responsible for determining what constitutes a recognised teaching qualification for individuals seeking registration with them. Universities develop and provide programmes which are then accredited by the GTCS. In terms of current provision then the shortest route to achieving the Standard for Provisional Registration, which is awarded to graduating students, is the PGDE. PGDE programmes in computing science are currently offered by the Universities of Glasgow, Highlands & Islands and Strathclyde. The PGDE programme is 36 weeks of full-time study with a minimum of 18 weeks developing professional practice in schools. It is not considered viable to develop a route shorter than the PGDE due to the need for extensive placement experience and to cover a substantial amount of content with the university.

c) What active promotion of teaching as a career option to undergraduates on computer science courses is being undertaken?

The Scottish Government has a Programme for Government commitment to "work with our partners on a joint campaign to promote teaching as a highly rewarding career with the opportunity to make a difference to the lives of children and young people, improving recruitment and retention and attracting more high quality individuals into teaching in areas where they are most needed" . We are actively working with the Strategic Board for Teacher Education is taking forward this commitment and agreeing a set of key messages to promote teaching as a valued career.

In 2018, a survey of CS undergraduates identified a fear of deskilling as a key reason for not entering the teaching profession, and the survey report proposed braided careers as a possible solution, where one person has two part-time jobs, one in industry and one in teaching. Scottish Teachers Advancing Computing Science (STACS) is involved in the scoping of a trial of the braided career concept, intending to draw both industry professionals and new graduates into the teaching profession.

d) What plans are there to give computing science teachers dedicated training time each year in order to ensure that they stay current and up to date due to the unique pace of change in the subject?

A minimum of 35 hours of professional development per year is required for teachers in Scotland. This is included in the SNCT Handbook, which sets out the aspects of teachers' terms and conditions that have been negotiated nationally by the tripartite SNCT.

More broadly Education Scotland has the strategic responsibility for Professional Learning and Leadership Development and aims to ensure that teachers and education professionals are supported by a streamlined and coherent professional learning offer. Central to this is the national Model of Professional Learning which provides guidance on what high quality, effective professional learning looks like for education professionals. It identifies the key principles and features of professional learning, and offers strategic guidance for education professionals and leaders on how to support, structure and plan for professional learning.

Teachers are supported in identifying areas for development within their Professional Review and Development process and they are required to undergo Professional Update sign-off every five years as part of their registration with the GTCS.

e) Would the Scottish Government consider salary enhancements to attract computing graduates to teaching to help compete with industry opportunities?

The 2024-25 Budget further supports teachers with an investment of £390 million to protect teacher numbers and fund the teacher pay deal. Teachers in Scotland are the highest paid teachers within the UK.

It is also worth highlighting that the answers point to the important role the GTCS plays in determining entry to becoming a computing science teacher.

The comment in the answers with regard to the "fear of de-skilling" is an important consideration, particularly given computing science changes and advances far more rapidly than other sciences.

This highlights the importance of the work of the Scottish Teachers Advancing Computer Science (STACS), which has undoubtedly been a successful innovation.

Scottish Teachers Advancing Computing Science (STACS)

In response to Mark Logan's report, the Scottish Government created and funded STACS to help advance computer science in school by supporting and working with the teaching community, with the aim of increasing the uptake of the subject and closing the gender gap.[14] It is led by two computing science teachers, Toni Scullion and Brendan McCart, who work alongside a wider group of expert teachers. STACS also works with the SQA to identify areas where pupils most struggle and targets teacher training in those areas.

Other work being undertaken includes:

- a national upskilling resource
- support and resources for primary teachers to deliver computing science
- connecting teachers looking for particular skills to enable an exchange of ideas
- providing teaching resources for Broad General Education (S1-3).

Writing for Future Scot, and referencing STACS' first year, Mark Logan outlined some of the key work achieved:[15]

"*STACS has already created a full set of resources to support the teaching of computing science to 1st and 2nd year pupils, where existing teaching materials have been severely lacking. This matters because losing the interest of pupils at this early stage makes it much harder to re-engage them later on… In a field that evolves rapidly, many teachers, for example, those who have cross-trained from other specialisms, report a lack of confidence in teaching computing science at advanced levels. STACS addresses this by hosting a platform where our more experienced teachers help those with less experience to skill-up and stay current with the subject as it evolves.*"

[14] STACS - Scottish Teachers Advancing Computing Science | About Us

[15] 'Let teachers lead change, it works,' says Scotland's chief entrepreneur | FutureScot

STACS is a fantastic initiative, using computing science teachers to support and upskill their sector and help all those involved in the delivery of computing science education. There is potential to use the model in other subject areas as well as ensuring all non-computing teachers have the confidence and skills necessary to make the most of technology. This is particularly important in helping up-skill primary school teachers.

However, STACS is not a permanent organisation. It was given funding for five years, and is currently in year three. Temporary organisations, regardless of their success, cannot embed sustainable change in schools. There is a danger that the good work that has been achieved will be lost unless this situation is rectified.

Global discussion

Improving computing science education is an issue that many countries are grappling with as they realise the potential and importance of the tech sector. And while globally there is a drive to up-skill citizens' digital knowledge, this further highlights the difference between teaching skills in order to use technology as opposed to developing knowledge and understanding of the subject.

International Computer & Information Literacy Study

According to the IEA International Computer & Information Literacy Study 2018 (the 2023 update will be published in November 2024) more than one third of 13-14 year olds who participated did not have basic digital skills.[16] Neither Scotland nor the rest of the UK participated in the study, but the 13 participating countries included the US, France, Germany and Finland.

The study explained that teachers were more likely to promote digital learning and influence students if they themselves were confident users of ICT. It also noted that pupils from more advantaged backgrounds tended to have significantly higher computer and information literacy scores. This highlights a potential concern that more privileged pupils can make up for poorer in-school computer education by what happens outside the classroom, either at home or through extracurricular activities Poorer digital education can widen the knowledge and skills gap for those from more disadvantaged backgrounds.

OECD

A 2020 report from the OECD's Directorate of Education and Skills, 'Digital strategies in education across OECD countries'[17], commented that half had published digital education strategies. Scotland published its own strategy, 'Enhancing learning and teaching through the use of digital technology', in 2016, under the then Education Secretary, now First Minister, John Swinney. It noted the challenges of trying to ensure digital technologies and skills were incorporated across the curriculum:

[16] Digital Education Action Plan (2021-2027) | European Education Area (europa.eu)
[17] https://one.oecd.org/document/EDU/WKP(2020)14/en/pdf

"*The importance of our learners being able to use a variety of digital technologies and possessing a range of digital skills in today's increasingly digitised world is clear. Yet our consultation exercise has indicated that our learners tend to have limited opportunities to use digital technologies and develop the associated digital skills during their education. This is because digital technology is still seen as the preserve of specialist teachers and is therefore not being fully utilised to deliver experiences and outcomes across Curriculum for Excellence. It is only when digital technology finds a place in all curriculum areas that our learners will be able to fully benefit from an education enhanced by digital technology*."[18]

To address these challenges the strategy set out four objectives:[19]

- develop the skills and confidence of educators in the appropriate and effective use of digital technology to support learning and teaching
- improve access to digital technology for all learners
- ensure that digital technology is a central consideration in all areas of curriculum and assessment delivery
- empower leaders of change to drive innovation and investment in digital technology for learning and teaching.

However, it is clear that these objectives are more about the *use* of technology in delivering education. The 2020 OECD report notes that this is a common theme: "*In as far as digital education strategies mention technologies, it is often with regard to the opportunities for education*". It goes on to state that "*A distinction can be made between generic skills to live and work in a digital age on the one hand and specific skills to apply technologies on the other*", echoing the point made by Daniel Johnson in the Jan 2024 Holyrood debate.

Again, ensuring teachers have the necessary training is identified as a key component of success, with the suggestion that investment in equipment without providing the necessary teaching skills can prove ineffective:

"*While digital technologies should ideally be designed to facilitate teachers, their potential cannot be reached if teachers do not have the right skills to deploy them. There is a continuous risk that investments in digital technologies have no return or even prove ineffective for education, if the technologies are not (proficiently) used in class*."[20]

This is an important point to remember in the Scottish context – we may have given pupils iPads, but for their full potential to be realised, teachers and pupils alike must have the necessary knowledge and understanding.

PISA

The 2022 PISA report echoed the sentiment that simply using digital devices did not necessarily guarantee better learning:

[18] Contents - Enhancing learning and teaching through the use of digital technology - gov.scot (www.gov.scot)
[19] Enhancing learning and teaching through the use of digital technology - gov.scot (www.gov.scot)
[20] pdf (oecd.org)

"The availability and quality of instructional materials, in themselves, do not guarantee better learning; schools and teachers must be able to use these resources effectively to enhance learning and teaching. This is particularly true regarding digital devices in education."

"On average across OECD countries, the largest improvements in schools' preparedness for digital learning observed between 2018 and 2022 concern the availability of an effective online learning-support platform; teachers having the necessary technical and pedagogical skills to integrate digital devices into their instruction; and the availability of effective professional resources for teachers to learn how to use digital devices. [21]

It is worth noting that PISA 2025 will include an assessment on computing science and how well students can engage in an '*autonomous learning process using computational tools to solve problems and build their knowledge and understanding*'.[22]

European Commission Digital Education Action Plan 2021-2027
The gender gap that exists in computing in Scotland is not just a domestic problem. The European Commission's Digital Education Action Plan highlighted that across the EU women only hold 17% of tech sector jobs and that girls tend to steer away from STEM subjects.[23] It noted that there was only a 0.5% increase in the share of jobs held by women between 2012 and 2016.

As a result, the Commission is looking at strategies to hasten the pace of change with the aim of engaging 40,000 female students in training in the circular economy and digital skills by 2027.

Part of the plan to reach that goal is through PR and changing attitudes and perceptions of the subject - for example, by organising 'E-stream festivals' with different activities for girls aged 9-11, 12-15 and 16-18, encouraging interest in STEM.[24]

Is there a problem? And if so, how do we fix it

Too often in politics there is a tendency to look for headline-grabbing initiatives, such as free iPads for pupils. This can capture the imagination and, more importantly, voters' attention. But normally what is required to make a real impact is far more nuanced. Addressing this starts with admitting where the problem lies.

In trying to improve the number of pupils leaving school with a good knowledge of computer science we face the twin problems of supply and demand – the need for more computing science teachers to teach, and more pupils wanting to study the subject.

[21] 5. Investments in a solid foundation for learning and well-being | PISA 2022 Results (Volume II) : Learning During – and From – Disruption | OECD iLibrary (oecd-ilibrary.org)
[22] PISA 2025 LEARNING IN THE DIGITAL WORLD ASSESSMENT FRAMEWORK (SECOND DRAFT) (oecd.org)
[23] https://education.ec.europa.eu/focus-topics/digital-education/action-plan/action-13?
[24] https://eismea.ec.europa.eu/news/empowering-women-and-girls-through-digital-and-entrepreneurial-competences-esteam-fests-and-2022-03-07_en

While addressing the former will have a huge impact on the latter, it is not enough on its own.

But there is a third issue that also needs to be addressed, and arguably comes first – whether Scotland actually accept there is a problem here that needs to be solved.

Given this report details a wide range of statistics that point to a subject in crisis and decline, the answer might seem obvious.

While there is no doubt agreement on the importance of increasing tech skills for the benefit of the current and future economy of Scotland, is meeting this challenge a responsibility of our schools?

Computing science teacher numbers have been in decline for many years, while the number of pupils choosing computer science has been falling since the current Education Secretary was herself a school pupil. These are not new problems and they have been growing against the backdrop of an increase in the prominence and importance of the tech sector.

The crisis was outlined by Mark Logan in his 2020 report. The Ferret drew attention to the issue in a 2019 investigation.[25] The Royal Society's 2017 report, After the Reboot, raised concerns across the UK, with specific commentary on Scotland.[26] As have many others. Why is nothing changing?

Is there a feeling that computer science in schools doesn't matter – after all, if you want to study the subject at university, Higher computing or even National 5 is not a pre-requisite. Normally maths is specified as an entry requirement.

Many of the international studies referenced highlight the difference between acquiring the skills necessary to use technology, skills increasingly necessary for our day-to-day lives, and the knowledge necessary to actually develop that tech.

Are we satisfied with simply equipping our school pupils to be technology consumers, leaving anything beyond that to industry and to the higher and further education sectors?

For some, the answer will be yes. They may feel it is not the place of schools to deliver the specific skills required by the economy at any given time, but to produce well-rounded school leavers with a broad-based knowledge. There will always be different trends in the labour market, and supply and demand for particular skills will vary.

However, Reform Scotland would argue that this approach overlooks the major impact computing science has, and will continue to have, on every aspect of our lives. Technology is increasingly prevalent in every sphere. This is not a skill-set focused on one industry, but a growing science which is impacting everything.

[25] Teachers and students in decline: the computing 'crisis' in Scotland's schools (theferret.scot)
[26] After the reboot: computing education in schools (computingatschool.org.uk)

We don't need every pupil to leave school with qualifications in computing science, just as we don't need every pupil to have qualifications in a language, or music or chemistry. However, we do require to increase the digital literacy levels of all students.

If the number of pupils studying computing science is falling, despite the prominence of the subject outside the classroom and the broad and varied career opportunities it presents, at the very least we be should be examining why.

Computing in schools also helps ensure that it is not a subject reserved for an elite, for those whose parents can afford to provide the hardware and encourage extracurricular coding clubs. The more that can be done to reverse declining uptake and spark greater interest in school, the more likely gender divides can also be addressed.

It is worth remembering that Scotland is part of a global community where tech skills are becoming more and more important. PISA 2025 recognises this with the inclusion of an assessment on computing. Countries which have made the subject a core part of their curriculum will potentially see a boost to their rankings. Can Scotland's education system afford to fall even further behind in international comparisons?

Supply – The teachers

Data suggests that computing science is far from alone in struggling to attract new recruits – rather, the problem is intensified due to its starting from a lower base.

The work that the Scottish Government is doing around career-change bursaries, and with STACS to look at the "braided career" concept to attract industry professionals and new graduates, is to be welcomed. However, it is worth reflecting that only eight out of the 84 bursaries were awarded for computing career-changers. More has to be done to specifically attract computing science teachers.

If the goal is for computing science to be on a similar level to other STEM subjects, we have to acknowledge just how steep a mountain there is to climb – in 2023, the least popular science at Higher level was biology, with 7,075 entries. That is twice as many entries as computing. Should there be a target number of candidates? Regardless of what such an aim may be, increasing entries in computing to a similar level to other sciences will require a huge increase in teacher numbers that current government policies simply don't have the capacity to address. A far broader and longer-term strategy would be required.

Give permanent status to STACS: The STACS initiative is helping to address upskilling, ensuring computing science teachers have the confidence and abilities to teach the subject to the highest levels in schools. It is also supporting non-computing teachers, and has the potential to do much more, but only if it is funded beyond its current five year period. STACS is a laudable and effective initiative, but it cannot deliver lasting, sustainable change if it is only a temporary body. Placing the organisation on a

permanent footing is essential. To fail to do so would suggest that the policy was little more than a PR exercise from the Scottish Government to begin with.

Examine pay & conditions: The Scottish Government commented in response to our FOI about considering salary enhancements, that "*Teachers in Scotland are the highest paid teachers within the UK*". However, that is to ignore the fact that we are not simply competing with schools across the UK for computing graduates. We are competing in a global marketplace where such skills are in high demand, and not just for teaching. There is no denying the stiff competition that exists from lucrative careers in industry. While pay differentials within teaching may be a sensitive topic, the fact is that graduates from different subjects can demand different salaries outside of teaching. An investigation into the impact pay and conditions may be having on attracting candidates should be carried out.

It is also worth considering the working environment. The Behaviour in Scottish Schools research has reported that school staff have experienced worsening levels of low-level disruption as well as serious disruptive behaviours since 2016. The following reasons were highlighted as potential underlying reasons for the falling standards of behaviour:[27]

- *a perceived lack of consequences for pupils who engage in serious disruptive behaviour, particularly in the context of restorative approaches to relationships and behaviour*
- *a lack of support for pupils with additional support needs, particularly Autism Spectrum Disorders and ADHD*
- *changes in society and parenting such as a general lack of respect, increased use of mobile phones and social media and parents' attitudes to school and behaviour*
- *disengagement from school and learning*
- *poor mental health and lack of resilience among pupils.*

Poor behaviour in school has many consequences, not least for pupils. However, trying to attract any teaching recruits against such a back drop will always be more challenging. Addressing problems within the education system in general will also help.

Primary teachers' skills: The Scottish Government should considering carrying out an evaluation of the digital skills of primary school teachers. When the Scottish Government launched its 1+2 languages policy for all primary school children to learn two languages in school, it carried out no audit of primary school teachers' language skills, despite these being the individuals it expected to deliver the lessons. This immediately undermined the policy. There is a danger again that an onus is placed on primary school teachers to introduce computing science but without the necessary training. The international studies highlight a link between teachers' confidence and ability in using technology and the impact that has on the education provided. STACS has an important role in helping to address any skill gaps.

[27] Behaviour in Scottish schools: research report 2023 - gov.scot (www.gov.scot)

GTCS flexibility: As the FOI response from the Scottish Government indicates, it is the GTCS that is the gatekeeper in setting out qualification requirements for each subject. Should greater flexibility be introduced on the specified qualifications a computing science teacher should achieve?

For example, in its Memorandum on Entry Requirements to Programmes of Initial Teacher Education, for most secondary subjects it stresses that applicants "*must have an undergraduate degree with at least 80 SCQF credit point*". However, for PE, there is more flexibility as it states "*Applicants would normally be expected to have an undergraduate degree with 80 SCQF credit points*".[28] '*Normally expected*' offers some room for flexibility. With the competing demands from industry, could reviewing the strict requirements help attract more computing science candidates? After all, many pupils in S1-3 will currently not be taught by someone with a computing qualification.

Such a review could also help develop braided career paths for people working in industry but willing to teach part-time.

Independent sector collaboration – Attracting, training and recruiting new teachers will take time, but there is potentially a short term opportunity in working with the independent sector to help. Robert Gordon's College in Aberdeen is working with the tech industry (including the Scottish Tech Army) and academics from Robert Gordon University and MIT to develop an online, live-taught programme offering SQA Higher Computing Science and making it available to students who cannot access the subject in their local state school. Live online lessons are taught twice weekly with work completed through Google classrooms and there is a bespoke diploma programme with modules on emerging technologies such as AI and Quantum Computing.[29] If independent schools are willing to share such resources, as Robert Gordon's College has, this provides an opportunity to help reach a far wider cohort of pupils.

Development of broad digital skills: While the focus of this paper is specifically on computer science and the knowledge and skills that subject can provide, we need all pupils leaving school to have a better understanding of digital literacy. And increasingly that education will need to start at a younger age. Consideration needs to be given as to how this can be delivered in the face of such teacher shortages. Can or should courses be developed that are perhaps along the lines of "technologies studies"?

Demand – Pupil interest

More teachers alone will not solve the problem. Between 2016 and 2023 there was a 20% drop in Higher entries. The 3% decline in teacher numbers over the same period will have been a large contributing factor, especially given some of those losses may have been the only qualified computing science teacher in a school. But we need more pupils to want to study the subject.

---

[28] Document > Memorandum on entry requirements to programmes of Initial Teacher Education in Scotland (gtcs.org.uk)

[29] Cross-sector and Community Partnership working in Scotland's independent schools by SCIS - Issuu

Young people are avid consumers of the latest technology and are continually finding new and innovative ways to use software for their own benefit and interest. But there seems to be a disconnect between that awareness and a desire to study the subject in school.

As Reform Scotland has previously highlighted, an unintended consequence of the extension of Broad General Education into S3 alongside the introduction of National 5s was a reduction in subject choice for pupils in S4. This no doubt hastened the downturn in computer science candidates, but the number of pupils choosing the subject in S4 was already in decline.

If pupils are not being taught the subject in S2 when choices begin to be made, it makes sense this will have an impact on their decisions.

While extracurricular computing clubs in schools can help increase interest and have a role to play, they are self-selecting – pupils who engage in these are already more interested in the subject. There is a need to reach those who don't otherwise engage in computing, especially girls.

Innovations such as dressCode[30] are vital in this regard. dressCode is an award-winning free online portal which aims to bridge the gap between education and industry to help girls see the potential opportunities available in tech. It is an example of extending the opportunities that pupils have to learn from qualified individuals and see and hear about the potential the subject offers.

Curriculum review: Computing science is a new science and it is rapidly changing. As a result, there is a danger that the curriculum fails to keep up. The SQA needs to be more fleet of foot in updating to keep pace – the syllabus needs refreshed far more regularly than for other subjects.

The lack of Higher or Nat 5 computing science as a requirement to study computing at university also raises questions about the curriculum content. This is in contrast to the entry requirements for other sciences, which normally require a specific qualification in biology, physics or chemistry. Is the content of computing science in schools not relevant for further study? Or would including the requirement impact the number of students that would apply?

Work needs to be done, in partnership with industry and further and higher education institutions, to review the course content and consider how more frequent updates can be incorporated.

Promotion of the subject: There is also a role for Skills Development Scotland to do more to partners with others, including industry, to promote the subject to pupils and parents. While all politicians might agree on the importance of computing, as they did in the January 2024 debate, and recognise the huge range of employment opportunities

[30] Dresscode | Our Mission

it brings, do pupils? Do parents? Careers guidance in schools, which needs to begin before subject choices are being made, must be relevant to the 21st century. Industry experts can be important role models in helping to get that message across. If the sector in Scotland wants to succeed, it must play a role in developing and encouraging its next generation of workers.

Conclusion

It should be uncontroversial to say that Scotland needs to increase both teacher numbers and student uptake in computing.

Computing science should matter. This report isn't calling for one subject to be given greater value over any other, rather it is a warning that there will be consequences to such a vital area being allowed to decline in our schools. These alarm bells have been ringing for some time, but policy-makers need to start listening.

Action must be taken to reverse the decline. There is no silver bullet – rather, a package of reforms, working in conjunction with partners across business, the third sector, and higher and further education needs to be explored.

The future is digital. Scotland needs school leavers who are able and ready to be at the centre of this technological revolution – for their sake and for the nation's.