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CURRICULUM FOR EXCELLENCE REVIEW: A RESPONSE FROM THE LEARNED SOCIETIES' GROUP ON SCOTTISH STEM EDUCATION TO THE SCOTTISH GOVERNMENT

Executive Summary

While Curriculum for Excellence (CfE) began as a promising development in Scottish education – and indeed, it continues to have many strong features that should be further consolidated – its implementation has unfortunately been characterised by a number of problems. Perhaps the most visible and high profile of these issues has been a decline in subject choice, namely at the S4 level. Reduced subject choice has made it difficult for students to choose the STEM subject combinations that would best prepare them for certain career fields and has likely contributed to an observed drop in STEM entries at SCQF levels 4 and 5 between 2014 and 2020.

Curriculum delivery should resemble a continuum, with congruity between successive stages and a sensible and sustained rate of progression throughout. As it stands, the pace and intensity at which the curriculum is taught is not uniform across the system, with steep increases in expectations interspersed with periods of comparative inertia.

A decrease in subject choices, timetabling, and limited staff capacity to cover different levels of qualifications has resulted in multi-course teaching becoming a common feature of STEM provision in an effort to increase the number of course offerings. STEM subjects are particularly vulnerable to the negative effects of multi-course teaching due to the frequent need for an associated practical laboratory component. This can result in inadequate supervision and less support being made available to students, as well as a correspondingly large increase in teacher workload.

In the primary years, STEM teaching can be hampered by a lack of confidence by teachers in their ability to teach STEM subjects, which may have implications for the depth of learning that can take place.

Executive Summary

Technicians are essential to the delivery of safe and effective practical laboratory work in secondary schools, a role which has only grown in importance as social distancing and increased hygiene measures have become indispensable features of classrooms under COVID-19. Unfortunately, the number of available technicians has been in decline for several years.

The cancellation of the 2020 exam diet and subsequent introduction of an alternative assessment model raised critical questions about the functioning – and rationale for – Scotland's current system of national qualifications and assessment.

While some may say there is currently too much assessment taking place in Scottish schools, the issue is arguably not so much the quantity of assessment but the purpose of that assessment, with insufficient focus on assessments which will inform teaching and learning.

The introduction of assignments in N5 gave learners a chance to demonstrate initiative and learn practical skills and thus were initially welcomed. However, in practice, the majority are centred on desk-based study followed by the production of a written report. Therefore, the time required might be more usefully directed to other learning and teaching activities, including alternative opportunities for practical work.

It is necessary to develop the curriculum with a clear initial view of the outcomes and assessments to which it leads in order to ensure coherence across the system.

Issues such as teacher workforce planning and the underrepresentation of certain demographics across STEM entries cannot be fully understood without the gathering of reliable and nationally applicable data.

At the heart of CfE lies a tension between teacher agency and the need for sufficient system-wide commonality of curriculum provision.

Key Recommendations

1 Curriculum for Excellence (CfE) was never evaluated in the early stages of its implementation and so there was never an opportunity to identify and rectify issues before they became embedded in the system. It is recommended that any further changes are subjected to regular independent evaluation, not only to prevent problems becoming entrenched but also to capitalise upon proven successes. This will necessarily involve the collection of robust and comprehensive baseline data, as highlighted by the previous OECD review (2015), which is currently lacking in Scotland.

2 We welcome the review's commitment to examining the articulation between Broad General Education (BGE) and the senior phase and suggest this could also include the relationship between other stages within the system, such as coherence across the S1-S3 years and across the primary school and senior school divide.

3 One way in which reduced subject choice might be circumvented could be to rationalise the distribution of the curriculum and qualifications across successive years. There could be an opportunity to make more efficient use of S3 by enabling National 4 (N4) material to be covered and awarded as such, effectively freeing up more time during the senior phase for students to pursue a wider range of courses. This same philosophy could be applied to the link between S2 and S3 (with a shift in content from S3 to S2) and in running N4 and National 5 (N5) courses across both S3 and S4.

4 Resolving the adverse impacts of multi-course teaching could involve a redesign of corresponding N4 and N5 units in order to make them more similar, with a core plus extension or foundation/general design, and thus lend themselves to being taught simultaneously in instances where this is necessary. In the shorter term, it might be prudent to consider renaming units across N4, N5, Higher, and Advanced Higher to better reflect their respective content and so discourage overlapping these courses within the same slot in a school's timetable. At present, many of these units share a name, which could give the impression to school leaders and timetablers that there is more commonality between them than actually exists.

5 Ensuring that core STEM concepts are covered during Initial Teacher Education (ITE) would help to ensure that primary teachers have the requisite knowledge and understanding to deliver STEM learning most effectively, though these positive impacts will only become apparent over the longer term. In the short term, the LSG recommends that career-long professional learning (CLPL) is made widely accessible and promoted across the system in order to build capacity in STEM teaching at the primary school level. Such CLPL should also include opportunities for subject-specific learning.

6 Ensuring access to high-quality practical laboratory work is heavily dependent on technician presence and expertise. Appropriate action should be targeted towards increasing technician numbers and improving job security and satisfaction to ensure staff are retained over the longer term.

7 The CfE review can be an important first step at determining what a fit-for-purpose approach to assessment in Scottish schools should look like, including in the wake of COVID-19 and the agility it has demanded of the system. This should necessarily be paired with consideration given to the purpose of qualifications at various levels and whether these are being realised in practice, in order to ensure that curriculum, assessments, and qualifications form an integrated whole.

8 The review might provide recommendations on a future model for assignments and how to ensure the skills they teach, such as research and critical thinking, are still developed by students.

9 International examples have illustrated the benefits of a more planned, cyclical approach to curriculum and assessment development, which helps to avoid some of the aftershocks of periodic curriculum upheavals while still allowing for measured, meaningful change. A similar approach might prove suitable for Scotland, particularly if it involves some piloting of proposed changes.

10 In terms of teacher workforce planning, the LSG has previously commented on the need for data on the number of Initial Teacher Education (ITE) entrants that complete their courses and go on to teaching careers. Such quantitative data should be supplemented with more qualitative studies in order to understand motivations behind pursuing teaching as a profession and how more students might be encouraged to enter the field. It will also be essential to collect more data on socioeconomic status, gender, and other characteristics and how they influence entry figures, attainment, and future career paths.

11 There is a need for an open and genuine debate within the Scottish education system – with substantial input from practising teachers – on their role as empowered professionals and as curriculum-makers. The challenge will be to reconcile an appropriate degree of local autonomy with the benefits that a more centralised approach to curriculum design can provide.

Background

1 Formed in 2012, the Learned Societies' Group on Scottish STEM Education (LSG) brings together the learned societies and professional associations with a focus on the provision of STEM education at school.[1] We welcomed Scottish Government's commitment to commissioning a review of Curriculum for Excellence (CfE) in its entirety. The LSG had advocated that a comprehensive review of both the Broad General Education (BGE) and the senior phase be undertaken, with a particular emphasis on how the two are integrated in practice. We also appreciated the opportunity to contribute to the Organisation for Economic Co-operation and Development's (OECD's) virtual stakeholder sessions in support of the ongoing review of CfE in October 2020 and have expanded upon points made by our representative in the response below, as well as highlighting other longstanding areas of interest and concern. Given the unique breadth of our membership and our longstanding contributions, we are well-placed to provide insights into how the STEM subjects have been impacted during the implementation and delivery of CfE. We would be pleased to engage in further discussions with OECD and Scottish Government as the review progresses should they consider this helpful. A list of follow-up resources produced by the LSG can be found at the end of this paper.

Subject choice

2 While CfE began as a promising development in Scottish education – and indeed, it continues to have many strong features that should be further consolidated – its implementation has unfortunately been characterised by a number of problems. Perhaps the most visible and high profile of these issues has been a decline in subject choice. Although CfE increased subject choice in theory by expanding the total number of available courses and qualifications, pupils often do not have access to this same scope of courses in practice due to institutional limitations and practical restrictions. This narrowing of subject choice has been most evident at the S4 stage. The primary contributing factor has been a shift from two-year courses completed over the S3/S4 years to predominantly one-year, 160-hour courses completed entirely in S4. This has reduced the amount of time available for students to study different subjects, with six qualification courses at S4 the most common approach. This narrowing is not the result of any conscious policy decision; rather, it is an unintended consequence of the confusing national guidance on the relationship between the BGE and the senior phase, particularly in relation to the extent to which the BGE can be used to prepare learners for qualifications.

3 The availability of subjects can also be a function of advantage, with students in more advantaged areas having access to a greater number of subjects on average than students in more deprived areas.[2,3]

1 This response has been signed off by the LSG membership comprising: The Association for Science Education; BCS, the Chartered Institute for IT; Edinburgh Mathematical Society; Institute of Physics; Institution of Engineering and Technology; Royal Society of Biology; Royal Society of Chemistry; Royal Society of Edinburgh; and the Scottish Mathematical Council. More information about the LSG is available at: https://www.rse.org.uk/policy/standing-committees/learned-societies-group/

2 Shapira, M. & Priestley, M. (2019) Do schools matter? An exploration of the determinants of lower secondary school subject choices under the Scottish Curriculum for Excellence [online] Available at: https://bera-journals.onlinelibrary.wiley.com/doi/full/10.1002/rev3.3180

3 Black, B. (9 December 2019) 'The poorer you are, the fewer choices you get' (Tes) [online] Available at: https://www.tes.com/news/poorer-you-are-fewer-subject-choices-you-get

4 A decline in subject choice has compromised students' ability to combine two or more subjects across different cognate subjects. In the case of STEM subjects, specific synergies arise from the concurrent pursuit of two or more subjects. Enhancing subject choice would not only benefit the study of medicine and related fields. Combinations such as Mathematics, Physics, Computer Science, Engineering Science, and Graphic Communication would allow progression on to many degrees and career pathways in engineering, Information Technology (IT), and architecture, among others.

5 One way in which reduced subject choice might be circumvented could be to rationalise the distribution of the curriculum and qualifications across successive years. For example, national guidance states that CfE 3rd and 4th levels should be studied until the end of S3. In reality, some schools are already introducing National 4 (N4) content during S3 due to its similarity to BGE 4th level content, though this coursework is ultimately recognised under the banner of BGE. Therefore, there could be an opportunity to make more efficient use of S3 by enabling N4 material to be covered and awarded as such, effectively freeing up more time during the senior phase for students to pursue a wider range of courses. This same philosophy could be applied to the link between S2 and S3 (with a shift in content from S3 to S2) and in running N4 and National 5 (N5) courses across both S3 and S4. Such an approach would also likely increase the pace of learning and prove more motivating to pupils.

6 The above reveals a more fundamental issue, one of curricular momentum. Curriculum delivery should resemble a continuum, with congruity between successive stages and a sensible and sustained rate of progression throughout. As it stands, the pace and intensity at which the curriculum is taught is not uniform across the system, with steep increases in expectations interspersed with periods of comparative inertia. For example, even before the introduction of CfE, the S1/S2 years were cited as a weak point in the system at which students made relatively little progress as they waited for the more demanding senior phase and pursuit of national qualifications to begin. This stop-start approach to curriculum delivery can make it more difficult for students to consolidate their understanding and make connections between different ideas, especially across STEM subjects that require students to gradually build upon core concepts. As such, we welcome the review's commitment to examining the articulation between BGE and the senior phase and suggest this could also include the relationship between other stages within the system, such as coherence across the S1-S3 years and across the primary school and senior school divide. A helpful resource might be the Royal Society of Chemistry's recent projects to support transitions in science learning between P7 and S1.[4]

7 There has been a noticeable reduction in entries across several STEM subjects at SCQF levels 4 and 5 level between 2014 and 2020. Over this period, Chemistry entries have declined by 18.6%, Physics entries are down by 17.5% and Computing-related entries[5] are down by 28%.[6] The changing structure of the senior phase, especially the reduction in subject choice at S4, has likely had a negative effect on learners' ability to take up STEM courses and progress in these disciplines.

8 A decrease in subject choices, timetabling, and limited staff capacity to cover different levels of qualifications has resulted in multi-course teaching becoming a common feature of STEM provision in an effort to increase the number of course offerings, the detrimental impacts of which are discussed under the following section on 'Multi-course teaching.'

4 More information on this survey can be obtained directly from the Royal Society of Chemistry at educationpolicy@rsc.org.

5 Includes Computing, Computing Studies, Computing Science, and Information Systems

6 SQA Attainment Statistics for 2014 to 2020. https://www.sqa.org.uk/sqa/70972.html

Multi-course teaching

9 The LSG was among the first to draw attention to the pervasive issue of multi-course teaching and its inordinate impact on the STEM subjects, arguably before it had gained significant traction among national education bodies and within Scottish Government as a growing problem. Its commentary has included media articles,[7, 8] as well as evidence submitted to the Scottish Parliament's Education and Skills Committee as part of its inquiry into subject choice in 2019.[9] To help inform the LSG's work in this area and to build the available evidence base, the Royal Society of Chemistry conducted a valuable survey on the prevalence and impact of multi-course teaching in 2016,[10] whose worrying findings were reflected in the results of a follow-up survey undertaken in 2019.

10 STEM subjects are particularly vulnerable to the negative effects of multi-course teaching due to the frequent need for an associated practical laboratory component. In some cases, successive courses in the same subject (e.g. N4 and N5 in Chemistry) are characterised by significantly different content rather than by the level of assessment taking place, meaning teachers are effectively teaching two courses at once rather than one course at two different levels of difficulty.

11 It is extremely difficult for teachers to teach more than one course to different groups of students in the same room. This can result in inadequate supervision and less support being made available to students, as well as a correspondingly large increase in teacher workload. Recent research by the Royal Society of Chemistry has revealed that multi-course teaching characterises almost half of all secondary school chemistry classes in Scotland, occurring most often in the N4/N5 combination. Significantly, of those classes containing N4 students, 92.7% were multi-level and of those containing N5, 65.8% were multi-level. Surveyed chemistry teachers expressed concerns that multi-course teaching could compromise the quality of instruction and that navigating the demands of teaching dual courses was contributing to excessive workloads.[11]

12 Resolving the adverse impacts of multi-course teaching could involve a redesign of corresponding N4 and N5 units in order to make them more similar, with a core plus extension or foundation/general design, and thus lend themselves to being taught simultaneously in instances where this is necessary.

13 In the shorter term, it might be prudent to consider renaming units across N4, N5, Higher, and Advanced Higher to better reflect their respective content and so discourage overlapping these courses within the same slot in a school's timetable. At present, many of these units share a name, which could give the impression to school leaders and timetablers that there is more commonality between them than actually exists.

Primary

14 Past reports by Education Scotland have shown that STEM teaching in the primary years can be hampered by a lack of confidence.[12] Initial Teacher Education (ITE) entrants are not required to have a science qualification in order to be accepted into teaching programmes and a significant proportion of primary school teachers report a lack of confidence in their ability to teach STEM subjects, which may have implications for the depth of learning that can take place.[13] As such, there is a risk that pupils leave primary school less prepared to study these subjects at secondary school level. Ensuring that core STEM concepts are covered during ITE would help to ensure that primary teachers have the requisite knowledge and understanding, though these positive impacts will only become apparent over the longer term. In the short term, the LSG recommends that career-long professional learning (CLPL) is made widely accessible and promoted across the system in order to build capacity in STEM teaching at the primary school level. Such CLPL should also include opportunities for subject-specific learning.

7 Cole-Hamilton, D. (28 December 2016) Agenda: Teaching young people at different levels in same class harms learning (*The Herald*) [online] Available at: https://www.heraldscotland.com/opinion/14989441.agenda-teaching-young-people-at-different-levels-in-same -class-harmslearning/

8 Yellowlees, L. (14 January 2020) Agenda: Assessing the impact of multi-course teaching on STEM subjects (*The Herald*) [online] Available at: https://www.heraldscotland.com/opinion/18158033.agenda-assessing-impact-multi-course-teaching-stem-subjects/

9 LSG (2019) Subject choices: a response from the Learned Societies' Group on Scottish STEM Education to the Scottish Parliament's Education and Skills Committee [online] Available at: https://www.rse.org.uk/wp-content/uploads/2019/03/LSG_Subject_Choice.pdf

10 *ibid*

11 More information on this survey can be obtained directly from the Royal Society of Chemistry at educationpolicy@rsc.org.

12 Education Scotland (2013) The Sciences 3-18: September [online] Available at: https://education.gov.scot/improvement/documents/sciences/sci14_sciencescurriculumimpact/sciences-3-to-18-2013-update.pdf

13 LSG (2019) STEM experiences in early years and primary education: a response from the Learned Societies' Group on Scottish STEM Education to the Scottish Parliament's Education and Skills Committee [online] Available at: https://www.rse.org.uk/wp-content/uploads/2019/05/Response_LSG_STEM_Experiences.pdf

15 Primary teachers are also facing increasingly challenging expectations of what they must deliver in the classroom, ranging from STEM to modern languages to literacy and numeracy to health and wellbeing. This is coupled with the often difficult task of interpreting the broadly worded Experiences and Outcomes at each level and translating these into tangible learning activities. This crowded set of priorities leaves less time to devote to pursue CLPL and other development opportunities and increases teacher workloads. Making greater use of subject specialists in the primary years, particularly during the later phase, might be one way of remedying this.

16 There remains confusion regarding the differentiation between computing science and digital education particularly at primary level, with some centres regarding the use of a computer in any capacity as being synonymous with studying computing science. Particular concerns have been raised that computing science is often not taught to the level outlined in the Experiences and Outcomes and is often absent at the S1 level. The lack of specialist computing science teachers, particularly at the BGE level, is a key contributor to these issues.

Technician support for STEM

17 Technicians are essential to the delivery of safe and effective practical laboratory work in secondary schools, a role which has only grown in importance as social distancing and increased hygiene measures have become indispensable features of classrooms under COVID-19. Unfortunately, the number of available technicians has been in decline for several years. A Freedom of Information request filed by the Scottish Labour party in December 2019 revealed there are the full-time equivalent of 879 STEM technicians currently working in Scottish schools, a decline of over 333 since 2010.[14] The LSG itself first examined the issue of reduced technician support in 2014. A commissioned survey undertaken by Pye Tait showed a significant proportion of teachers (41%) were dissatisfied with the amount of technician support available to them. As one respondent explained: 'The erosion of services such as the staffing ratio of technicians to pupils seriously threatens the delivery of practical science as teachers cannot teach and prepare experiments at the same time.'[15] With fewer technicians comes increased workloads for those who remain, and a survey by the Association for Science Education from June 2020 showed over 80% of respondents are concerned about rising workloads in response to COVID-19 while fears of redundancy were also common.[16]

Assessments and qualifications

18 The cancellation of the 2020 exam diet and subsequent introduction of an alternative assessment model raised critical questions about the functioning – and rationale for – Scotland's current system of national qualifications and assessment.

19 The CfE review can be an important first step at determining what a fit-for-purpose approach to assessment in Scottish schools should look like, including in the wake of COVID-19 and the agility it has demanded of the system. This should necessarily be paired with consideration given to the purpose of qualifications at various levels and whether these are being realised in practice, in order to ensure that curriculum, assessments, and qualifications form an integrated whole. Questions to be considered could include:

- With increased staying-on rates among young people in education – whether that be in schools, colleges, or other educational settings – is it necessary to have three successive 'two term dashes'[17] to a diet of national examinations in each of the last three years of secondary school?
- Linked to the preceding question, how do we achieve greater diversity in approaches in S4-S6 and parity of esteem for different pathways, so that the totality of achievement in S4-S6 becomes the focus?
- Is the current extent and balance of assessments in national qualifications appropriate with the relatively long examinations and assignments that are at times not fit for purpose, and where similar skills are assessed multiple times across several subjects?

14 SP OR 22 January 2020, col 37 [online] Available at: https://www.parliament.scot/parliamentarybusiness/report.aspx?r=12471&mode=pdf

15 LSG (2014) Resourcing School Science in Scotland: An Indicative Study of Primary and Secondary Schools (prepared by Pye Tait Consulting) [online] Available at: https://www.rse.org.uk/wp-content/uploads/2016/09/Pye-Tait-LSG-Resourcing-Science-Report-November-2014.pdf

16 ASE (2020) Good Practical Science - making it happen post-COVID-19: report on an extensive survey of science educators, investigating new opportunities and challenges for secondary schools and colleges [online] Available at: https://www.ase.org.uk/news/new-ase-report-highlights-concerns-over-practical-science-post-lockdown

17 The term 'two term dash' denotes pupils having the first two terms of a school year in which to complete a Higher subject.

- What use should be made of teacher assessment, especially given the experience during the COVID-19 pandemic, and what further support do teachers need to ensure objective assessment? What is the role for unit assessments in providing objective measures of student performance?
- What use should be made of online assessments, and what infrastructure and professional support needs to be put in place to facilitate these?

Over-assessment

20 Teachers' time and efforts have been drawn away from improving formative assessment and diagnostic questioning towards summative assessment of national qualifications and assessment for accountability purposes. While some may say there is currently too much assessment taking place in Scottish schools, the issue is arguably not so much the quantity of assessment but the purpose of that assessment, with insufficient focus being placed on assessments which will inform teaching and learning.

21 An overemphasis on assessment for accountability purposes also means that student learning is regularly interrupted by the need to prepare for exams. For meaningful learning to take place, students should be allowed enough time to digest material and recognise how different concepts link together. This is particularly applicable to the STEM subjects. As it stands, learning is often rushed in favour of preparing for assessments, compromising students' depth of understanding.

22 Concerns have been raised about assessments in their present form, including assessment burdens on pupils and teachers and impacts on student uptake of certain courses. Recent 'simplifications' to national qualifications removed the assessment of units but resulted in the lengthening of examinations in many subjects, including in STEM – in some cases surpassing the length of university exams for these same subjects – and the introduction of examinations in subjects which previously did not have them (e.g. Practical Electronics). This has perhaps affected the perceived relative difficulty of different subjects, often impacting negatively on the STEM subjects in particular.

Assignments

23 The introduction of assignments in N5 gave learners a chance to demonstrate initiative and learn practical skills and thus were initially welcomed. However, in practice, the majority are centred on desk-based study followed by the production of a written report. Therefore, the time required might be more usefully directed to other learning and teaching activities, including alternative opportunities for practical work. The review might provide recommendations on a future model for assignments and how to ensure the skills they teach, such as research and critical thinking, are still being developed by students.

The relationship between curriculum, assessment, and qualifications

24 It is necessary to develop the curriculum with a clear initial view of the outcomes and assessments to which it leads in order to ensure coherence across the system. A continued focus on, and ongoing changes to, the assessment of national qualifications diverts secondary teachers' attention, time, and resources towards reverse engineering the curriculum to align with the assessment. It is very unfortunate that assessment developments have driven CfE reforms when the original intentions of CfE were focused on transforming learning and teaching through strengthening teacher agency in curriculum development, rather than on reforming qualifications.

25 International examples have illustrated the benefits of a more planned, cyclical approach to curriculum and assessment development, which helps to avoid some of the aftershocks of periodic curriculum upheavals while still allowing for measured, meaningful change. In particular, Finland follows a planned curriculum refresh cycle of eight years. A similar approach might prove suitable for Scotland, particularly if it involves some piloting of proposed changes.

Data

26 Issues such as teacher workforce planning and the underrepresentation of certain demographics across STEM entries cannot be fully understood without the gathering of reliable and nationally applicable data.

27 In terms of teacher workforce planning, the LSG has previously commented on the need for data on the number of Initial Teacher Education (ITE) entrants that complete their courses and go on to teaching careers, as this gives a more accurate picture of workforce growth and replenishment than ITE intake figures alone. There is also a lack of information on the number of active subject specialist teachers, as well as on who is delivering science education during the S1 to S3 years. These data shortages combine to make it difficult to identify acute shortages and engage in meaningful teacher workforce planning.[18] Such quantitative data should be supplemented with more qualitative studies in order to understand motivations behind pursuing teaching as a profession and how more students might be encouraged to enter the field, such as a study commissioned by Skills Development Scotland and led by University of Edinburgh Professor Judy Robertson on computing science undergraduate students.[19]

28 It will also be essential to collect more data on socioeconomic status, gender, and other characteristics and how they influence entry figures, attainment, and future career paths. We highlight the work of the ASPIRES studies in understanding how young people's STEM aspirations can evolve over time and differ across various demographics.[20] Performing a similar longitudinal study in a Scottish context would be invaluable in understanding how to attract and retain students from underrepresented groups and support their success.

Guidance

29 At the heart of CfE lies a tension between teacher agency and the need for sufficient system-wide commonality of curriculum provision. The introduction of CfE has run in parallel to a number of other policy developments in Scottish education.[21] Not all of these have been mutually supportive of the aims of CfE, resulting in mixed messages about the role and expectations of teachers. There is a need for an open and genuine debate within the Scottish education system – with substantial input from practising teachers – on their role as empowered professionals and as curriculum-makers. The challenge will be to reconcile an appropriate degree of local autonomy with the benefits that a more centralised approach to curriculum design can provide, such as helping to avoid duplication of effort and enabling easier transitions across different schools. Providing some uniformity in curriculum entitlement is also important from an equality perspective. Marked variations in curriculum can perpetuate and exacerbate existing inequalities, such as when schools with fewer resources and access to specialist teachers are not afforded enough support to deliver experiences comparable to those of more advantaged schools.

30 The lack of clear national guidance regarding curriculum implementation and the empowerment of headteachers and schools to make decisions on curriculum structures has resulted in a wide variety of provisions. While this has no doubt resulted in some examples of very good practice, this large degree of variation will inevitably also include weaker examples. The choices available to pupils can also be the product of decisions made by individual headteachers and school senior leadership teams as well as school timetabling concerns, rather than reflecting the preferences of pupils or being driven by national priorities. For example, the recent Scottish Technology Ecosystem Review recommended that computing should be treated as a core science in the school curriculum.[22] Similarly, the STEM Education and Training Strategy outlines a clear aim of increasing STEM uptake among children.[23] However, we acknowledge the relationship between different STEM policies is not always clear and there may be a need for a more simplified set of national priorities to better guide curriculum development.

18 LSG (2017) Teacher workforce planning for Scotland's schools: a response from the Learned Societies' Group on STEM education to the Scottish Parliament's Education and Skills Committee [online] Available at: https://www.rse.org.uk/wp-content/uploads/2017/04/LSG_Teacher_Workforce.pdf

19 Robertson, J. (2019) Towards a sustainable solution for the shortage of computing teachers in Scotland (The Centre for Research in Digital Education) [online] Available at: https://www.research.ed.ac.uk/portal/en/publications/towards-a-sustainable-solution-for-the-shortage-of-computing-teachers-in-scotland(a7387517-439d-4942-b693-4d7215ec46b1).html

20 https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/aspires-research

21 These have included the Donaldson review of teacher education, the McCormac review of salaries and conditions of service, the introduction of the GTCS Professional Standards and Professional Code, the National Improvement Framework, governance changes, and the introduction of the Regional Improvement Collaboratives.

22 Logan, M. (2020) Scottish Technology Ecosystem Review: An independent review commissioned by the Scottish Government [online] Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/independent-report/2020/08/scottish-technology-ecosystem-review/documents/scottish-technology-ecosystem-review/scottish-technology-ecosystem-review/govscot%3Adocument/scottish-technology-ecosystem-review.pdf

23 Scottish Government (2017) Science, Technology, Engineering, and Mathematics (STEM) Education and Training Strategy [online] Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2017/10/science-technology-engineering-mathematics-education-training-strategy-scotland/documents/00526537-pdf/00526537-pdf/govscot%3Adocument/00526537.pdf?forceDownload=true

Additional Information

For further information, please contact Daria Tuhtar (dtuhtar@therse.org.uk).

Other relevant publications by the Learned Societies' Group include:

Rapid review of the National Qualifications experience 2020 by Professor Mark Priestley (September 2020):
https://www.rse.org.uk/wp-content/uploads/2020/09/Rapid-Review-of-National-Qualifications-Experience-2020-LSG-letter.pdf

SQA consultation on proposed modifications to National 5, Higher, and Advanced Higher assessments for 2020-21 (August 2020):
https://www.rse.org.uk/wp-content/uploads/2020/09/SQA-consultation-on-assessment-modifications-LSG-response.pdf

Recruiting and training new teachers (January 2020):
https://www.rse.org.uk/wp-content/uploads/2020/02/Recruiting_training_teachers_inquiry.pdf

Early years and primary school STEM experiences (May 2019):
https://www.rse.org.uk/wp-content/uploads/2019/05/Response_LSG_STEM_Experiences.pdf

Subject choices at secondary school (March 2019):
https://www.rse.org.uk/wp-content/uploads/2019/03/LSG_Subject_Choice.pdf

Entry requirements to programmes of Initial Teacher Education in Scotland (December 2018):
https://www.rse.org.uk/wp-content/uploads/2019/01/LSG_GTCS_ITE.pdf

Teacher workforce planning for Scotland's schools (April 2017):
https://www.rse.org.uk/wp-content/uploads/2017/04/LSG_Teacher_Workforce.pdf

Changes to National Qualifications' course assessment (April 2017):
https://www.rse.org.uk/wp-content/uploads/2017/04/LSG_Sciences_Assignment.pdf

Further comments to Education Scotland on the Curriculum for Excellence Science Benchmarks (November 2016):
https://www.rse.org.uk/wp-content/uploads/2016/11/LSG_science_benchmarks_further_comment.pdf

Initial comments on the purpose of the Curriculum for Excellence Science Benchmarks (October 2016):
https://www.rse.org.uk/wp-content/uploads/2016/11/LSG_science_benchmarks_final.pdf

Scottish Government review into improvements to National Qualifications and assessment (March 2016):
https://www.rse.org.uk/wp-content/uploads/2016/09/LSG_qualifications_review.pdf

The Draft National Improvement Framework for Scottish Education (November 2015):
https://www.rse.org.uk/wp-content/uploads/2016/09/LSG_NIF.pdf

Reform in Scottish schools science education (January 2015):
https://www.rse.org.uk/wp-content/uploads/2016/09/Curriculum_Structures_Assessment_Survey_Report.pdf

Resourcing of schools science in Scotland (November 2014):
https://www.rse.org.uk/wp-content/uploads/2016/09/Pye-Tait-LSG-Resourcing-Science-Report-November-2014.pdf

Interdisciplinary learning in STEM education (April 2014):
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