Decisions on future assessment arrangements for GCSE (9 to 1) computer science

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Executive Summary

We recently consulted on revised assessment arrangements for GCSE computer science. Our proposals concerned the way in which students' programming skills should be assessed as part of this qualification.

We have decided to implement our preferred option – assessing programming skills via examination. However, we are not specifying the form this assessment should take beyond the requirement that it meets our definition of an exam[1]. This affords exam boards the opportunity to be innovative in their approach to assessing programming skills.

The current interim assessment arrangements (where schools and colleges are required to set aside 20 hours for students to undertake a programming task which does not contribute to their qualification grade) will remain in place for students sitting examinations in 2021.

For students sitting their GCSE exams in the subject in 2022 onwards, programming skills will be assessed by examination. The original Assessment Objective weightings for this qualification will be reinstated, and students' ability to analyse problems in computational terms to make reasoned judgements and to design, program, evaluate and refine solutions will again constitute 30% of the final qualification grade.

Introduction

In this document, we set out our decisions on the long-term assessment arrangements for GCSE computer science. These will replace the interim assessment arrangements implemented in this qualification in January 2018, in response to evidence of malpractice in the conduct of non-exam assessment (NEA). At the time these interim assessment arrangements were introduced, we also announced that we would be holding a subsequent consultation on how programming skills would be best assessed in GCSE computer science in the future.

Our decision has been informed by responses to the public consultation that we ran from 5 November to 3 December 2018. A copy of this consultation is available at:

https://www.gov.uk/government/consultations/future-assessment-arrangements-for-gcse-computer-science

We received 394 responses to our consultation. We are grateful to everyone who expressed a view on our proposals. These responses are summarised in the consultation analysis published alongside this decision document.

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[1] Ofqual's definition of assessment via examination is "exams that are taken by all students at once, under formal supervision, and are set and marked by the exam boards".

Summary of decisions

Following consultation, we have decided to implement the following changes to the assessment arrangements for GCSE computer science:

- From 2022 (i.e. for students whose teaching will start in 2020) exam boards will be required to assess all of the DfE prescribed subject content for GCSE computer science through assessments which meet our definition of exam assessment. This includes the assessment of students' programming skills, which will fully contribute to the overall qualification grade.

- Exam boards must ensure that at least one of the assessments taken by students sitting GCSE computer science exams from 2022 will require them to complete the following steps to a set task or to solve a problem. Each of these steps could be undertaken as separate activities to separate tasks or to solve individual problems, or addressed in combination:

  i. Design a program – using one or more high-level programming language with a textual program definition.
  ii. Write a program – using one or more high-level programming language with a textual program definition.
  iii. Test a program – using one or more high-level programming language with a textual program definition.
  iv. Refine a program – using one or more high-level programming language with a textual program definition.

- Beyond the requirement that all subject content is assessed and that all assessments within GCSE computer science meet our definition of an exam, we will not place any additional requirements on the form those assessments must take beyond our General Conditions. Subject to meeting our general requirements, exam boards will be free to design their exams as they see fit.

- We will reinstate the original Assessment Objective weightings, replacing the ranges that we adopted under the interim arrangements. This means that AO1 ('Demonstrate understanding of the key concepts and principles of computer science') and AO2 ('Apply knowledge and understanding of key concepts and principles of computer science') will contribute 30% and 40% of the overall qualification grade respectively, and AO3 ('Analyse problems in computational terms to make reasoned judgements and to design, program, evaluate and refine solutions) will contribute the remaining 30%.

- Exam boards will be required to collect a statement from Heads of Centre entering students for GCSE computer science exams from 2022 onwards, confirming that students have been given the opportunity to design, write, test and refine programs using a high-level programming language with a textual

definition, either to a specification or to solve a problem. We will not impose any requirements on how or when schools and colleges provide such an opportunity.

- The interim assessment arrangements for GCSE computer science (whereby schools and colleges are required to timetable 20 hours for the completion of a programming task specified by their exam board) will remain in place for students taking their examinations in 2019-2021. This will not be required for students taking their exams from 2022 onwards.

Form of assessment

In our consultation we discussed three broad approaches for assessing programming skills:

- assessing programming skills through non-exam assessment (NEA)
- separately reporting an endorsed grade for programming skills alongside the 9 to 1 grade
- our preferred approach: assessing programming skills by examination.

The majority of consultation responses supported our view that programming skills should be assessed by examination. Support was particularly strong among teachers. Some who did not believe that assessment by examination offered the best approach to assessing programming skills *per se* nevertheless felt that this approach was likely to ensure the most valid outcomes in this qualification at this time.

Beyond specifying that the approach exam boards adopt must meet our definition of an examination and fulfil our other expectations within the General Conditions, we do not propose to place any additional assessment requirements on the form of the assessments. This will allow each exam board to adopt the approach to assessing programming skills which they feel to be most suitable, and potentially to introduce innovative approaches within this qualification.

We have concluded that assessing programming skills under exam conditions will ensure that outcomes in this qualification can be trusted and that all students are assessed on a level playing field. Previous experiences within this qualification, as we discussed in detail in the consultation, have demonstrated that there are particular opportunities for malpractice in NEA in GCSE computer science (in the form of access to worked solutions, etc.). Applying additional rules to this qualification did not sufficiently mitigate these threats to validity, and risked compromising the experience of students and placing an unreasonable burden on teachers.

The exam boards share our concerns about NEA in this qualification and recognise the challenges of managing the potential for malpractice. Despite putting in place additional safeguards such as shortened assessment windows, monitoring visits,

and statistical and online monitoring, exam boards could not address all instances of solutions being shared online (some of which were hosted on websites outside of the UK, and potentially outside of the legal reach of the boards) and would likely not have been able to identify all instances of malpractice.

Additionally, the safeguards intended to reduce the risk of malpractice were found by teachers to place unreasonable pressures on them: requiring them to intensively police the work of their students, stopping them from offering support to students where needed, and preventing them from discussing the NEA tasks with their colleagues.

We have concluded, therefore, that programming skills should be assessed and contribute to the overall qualification grade, and that the only feasible way to do so is under exam conditions. This will allow exam boards to be confident that all work is a student's own.

We understand that features of working practice, such as collaboration and reference to online coding repositories, would not normally be allowed in exams. Exams are by their nature artificial constructs which allow a particular aptitude to be measured. There are many subjects where the established form of assessment does not reflect how the skills and understanding imparted during the course of study might be used in real-life contexts. Students will, of course, be able to work collaboratively and use online resources as they develop their programming skills.

We also noted the point made by one teacher that assessment by examination is in fact the predominant form of assessment used in recruitment in industry: "Many organisations use only [exam] assessment to recruit new developers. It is therefore reasonable to assume that similar methods of assessment can be used by the exam boards."

Some stakeholders felt that assessing programming skills by examination would not be appropriate as there are aspects of programming aptitude such as creativity, problem solving and resilience, which they did not feel could be adequately assessed in examinations. These respondents generally favoured some form of extended project instead. However exam boards will be able to develop more extended assessments, online or on-screen examinations, or assessments which made use of pre-release material which could require students to solve problems, albeit under exam conditions. The assessment design might also allow access to 'approved' reference resources or compiling tools. The process of completing these assessments could provide students with a more realistic experience of programming than they might have completing an extended project, given the rules which the exam boards previously found it necessary to put in place around the NEA. All of these approaches to assessment by examination would be available to exam boards under our proposals.

The majority of respondents agreed that there is a range of different ways by which programming could be assessed which would meet our definition of an examination. This included the teaching unions, a subject association, and all of the exam boards, as well as a significant majority of teachers. Teachers expressed preferences for different forms of assessment by exam, to which the exam boards will be able to decide how to respond.

One area of concern about our proposals was the potential for increasingly divergent forms of exam – particularly if both online or on-screen approaches to assessment

were available alongside more traditional forms of examination. However, the majority of teachers thought that the choice of different forms of assessment, and the ability to select a specification which best suited the needs of their learners, was an advantage of allowing boards to determine the best approach to assessing programming skills by exam.

Assessment Objective weightings

There was strong agreement with our proposal to reinstate the original Assessment Objective weightings for this qualification.

Teachers told us that they felt reinstating the original Assessment Objective weightings would increase the emphasis on practical programming skills which they (and their students) felt was a key element of this qualification. They also argued that it would have a beneficial impact on students' motivation and the number of students staying on to study computer science at A level, as it would make teaching and learning more reflective of their expectations. This was confirmed by the responses that we received from students. Other teachers felt that this would mean that students with a broader range of learning styles or aptitudes (i.e. those with greater practical than theoretical skills) would have their achievement recognised, and that this would make the qualification fairer.

We were also mindful that returning the weightings to 30% for AO1 ('Demonstrate knowledge and understanding of the key concepts and principles of computer science'), 40% for AO2 ('Apply knowledge and understanding of key concepts and principles of computer science'), and 30% for AO3 ('Analyse problems in computational terms to make reasoned judgements and to design, program, evaluate and refine solutions) will align them more closely with the original policy intention when the qualification was first devised. Particularly, increasing the weighting of AO3 from 15-20% (under the interim arrangements) back to 30% will reinforce the emphasis on programming skills as a key aspect of the assessed content in GCSE computer science.

There were some concerns voiced about increasing the weighting of AO3 because of the perception that any assessment of programming skills could be susceptible to malpractice. These individuals expressed a desire for the weighting for AO3 to be removed from the qualification altogether, or for only theoretical understanding of programming to be assessed in the exam. However, we are satisfied that assessing AO3 under exam conditions will address this risk.

Year of introduction

When we introduced the interim arrangements, we were clear that we would consult again on longer term arrangements which would allow the assessment of programming skills to be incorporated back into the overall qualification grade. In the meantime, we are confident that the interim arrangements are providing students with a meaningful experience of programming as part of the qualification, and that the programming project, while it is no longer assessed, contributes to students' understanding of concepts which are directly assessed in the exam. There does not

then seem to be an immediate need to replace the interim arrangements, particularly if this could undermine the quality of the longer term arrangements.

The majority of respondents agreed with our proposal to maintain the interim assessment arrangements for an additional year. This has confirmed our view that we should allow the exam boards until first examination in 2022 to implement their revised assessments in this subject. This will allow the exam boards additional time to refine their preferred approach and will ensure that revised specifications are available to schools and colleges in sufficient time for teachers to plan and prepare schemes of work.

We are also mindful of the fact that allowing additional time for the exam boards to develop their offerings is more likely to result in more innovative and developed approaches to assessing programming skills by examination.

Some teachers were of the view that the interim assessment arrangements were damaging to students' motivation, as they feel that the project has little value. On this basis they argued that the introduction of our proposals should be brought forward. However, this was balanced by teachers who argued that the interim arrangements were proving popular with pupils and that they were finding the freedom offered by the removal of the previous restrictions to be particularly beneficial to teaching and learning.

Others felt that the proposed changes could be accomplished more quickly if we specified one particular model for assessing programming skills by examination for the exam boards to adopt – particularly if this closely reflected one of the approaches currently in use. However we have decided not to do so for two reasons. Firstly, we are hesitant of mandating any one specific approach to assessing programming skills via examination as we do not wish to constrain the ability of the exam boards to innovate, or to cause them all to adopt a particular approach that might not best suit their centres. Secondly, the majority of schools and colleges would still need time to adapt to the revised specifications to be able to deliver them effectively, and in the interests of fairness to all students it would not seem to be appropriate to bring forward the implementation date earlier than 2022.

The exam boards also agreed that there would be risks to the delivery of the revised qualifications if we required them to be implemented prior to first examination in 2022 and that they would benefit from additional opportunities to engage with teachers to determine the most suitable approach to assessing programming skills by examination. One exam board (AQA) told us that introducing the revised assessment arrangements for first examination from 2022 would still be too soon, but we are satisfied that the remaining three boards feel that this is achievable.

Centre statement requirement

In our consultation, we sought views on the merits of a statement from Heads of Centre that students had been given the opportunity to design, write, test and refine programs using one or more high-level programming languages with a textual programming definition as part of their course of study (as specified in the DfE subject content for GCSE computer science) if programming skills were to be assessed by exam.

The majority of respondents (and a significant majority of teachers) felt that such a statement would be redundant if programming skills were to be assessed as part of the examinations for this subject. Many pointed out that Centres would be deliberately undermining their own students' performance if they did not teach programming skills. Some were concerned about the potential for such a statement to be burdensome, or to constrain teaching, and pointed out that it is not required for other aspects of the course currently assessed by examination. Others doubted the validity of such a statement, arguing that it would be open to abuse or that Heads of Centre would not be sufficiently close to teaching of the subject to state whether this had, in fact, occurred.

However, some teachers acknowledged that there were potential advantages to such a statement. This was a view which was shared by the subject association CAS, the headteachers' association ASCL, the exam board AQA, and notably all of the students who responded to our consultation. In particular it was felt that such a statement may have positive impacts in terms of ensuring that the senior leadership teams of schools and colleges were aware of the importance of these skills within the qualification and the need to ensure that computer science departments are adequately resourced to allow them to be delivered. Others felt that the statement would raise the status of GCSE computer science by providing parity and consistency with other science subjects at this level, which also require Head of Centre statements, and serve to rebuild trust in the qualification eroded by previous issues with malpractice.

Students were particularly concerned that not requiring a statement would mean that they would not be taught this aspect of the course in sufficient depth, and their responses elsewhere indicated that with the removal of the NEA (and with it, in their view, programming skills from the qualification grade) they did not feel this was always the case currently.

Having considered this issue further, and in view of the strong feeling from some stakeholders, we have decided that we will stipulate that exam boards must get a statement from Heads of Centres for this qualification. This statement will require Heads of Centre to confirm that students studying the course have been given the opportunity to design, write, test and refine programs using a high-level programming language with a textual definition, either to a specification or to solve a problem.

In reaching this decision we have balanced the likely burden arising from the requirement against the potential benefits to the status and resourcing of computer science departments in schools and colleges, as well as the messages which it sends on teaching.

As the statement will be confirmed by Heads of Centre, the actual burden upon classroom practitioners will be very small – particularly as teachers should be delivering this content anyway as part of the course in preparation for the assessments. Indeed, a number of teachers reported that the requirement for a statement would have little or no impact on their teaching as they would routinely teach students these programming skills regardless of their status within the assessed subject content, or had already covered them as part of the Key Stage 3 curriculum before students began their GCSE studies.

We are satisfied that any minor additional burden entailed by requiring a statement is mitigated by the potential benefits to students, teachers, and the perception of the

subject as a whole. This has confirmed our view that the Head of Centre statement on programming skills is a proportionate requirement in this instance.

Exam boards will be required to gather these statements, and to monitor that they are a true reflection of the opportunities that have been extended to students. This will require some resource on behalf of the boards, but it will not increase the administrative burden placed upon them because boards are already gathering statements from Centres to confirm students have been afforded the opportunity of 20 classroom hours to undertake the programming project. This was required for the first time in 2018 under our interim arrangements. It is reasonable to believe that both of these forms of statement gathering are likely to require considerably less resource than was previously expended on monitoring and moderating the NEA, which was originally present in this qualification.

Implementation timescales

As outlined above, we will require exam boards to assess programming skills via examination for the first time from 2022. The interim arrangements will remain in place until examinations in 2021.

As there will be two versions of the subject-level conditions for GCSE computer science in effect at the same time (those for the 2021 and 2022 exam cohorts), for this period we will ensure that both versions of the conditions will be available.

Once the 2021 cohort has received their certificates, the subject-level conditions covering the interim assessment arrangements will be removed and the revised subject-level conditions will apply for the 2022 cohort onwards. Students who wish to resit GCSE computer science in 2022 will not be able to do so under the interim assessment arrangements, and must instead take qualifications which meet the requirements of the revised subject-level conditions.

We expect that exam boards will be in a position to provide schools and colleges with amended specifications reflecting changes to their assessment arrangements in sufficient time to allow teachers to prepare to deliver their courses. This includes providing Centres with revised sample assessment materials, along with any other relevant support materials which the approach to assessment of programming skills adopted by an individual exam board might require.

Equalities impact assessment

The majority of respondents agreed with our view that the proposed changes would not have a negative impact upon students with particular protected characteristics which could not be mitigated through reasonable adjustments.

Most teachers noted that disabled students already receive reasonable adjustments (such as extra time) which could mitigate any disadvantage arising from a change in the form of assessment. In this, teachers did not feel that computer science differed from any other GCSE subject in the range and availability of reasonable adjustments which could be made for disabled students. It was also pointed out that 100%

assessment by exam is now the norm for the majority of GCSEs, and for all EBacc subjects.

When we originally consulted on our decision to remove NEA from the qualification grade we determined that it was only disabled students who might be adversely affected by our proposals, or those receiving long term medical treatment or with other personal circumstances who might be disadvantaged or unable to take all of the exam assessments at the time they were scheduled. We are satisfied that the impact on these students can be mitigated through their entitlement to reasonable adjustments, and the requirement for exam boards to have in place clear arrangements for Special Consideration.

The teacher union NEU disagreed, arguing that a shift to assessing programming skills via examination would disadvantage SEND students. However, we are not persuaded that this would necessarily be the case. The NEU's argument assumes that these students are less able to demonstrate their true ability under exam conditions. Elsewhere the NEU expressed the belief that "100% exam assessment could lead to an increase in paper-based working… and the disengagement of those students who enjoy working with computers." This assumes the form of assessment which exam boards would adopt would fit a 'conventional' model of traditional examinations completed with pen and paper. Our proposals would not require this, however, and there is an opportunity for exam boards to assess programming skills using technology.

Indeed the approaches to assessing programming skills by examination, which the boards may choose to implement under our proposals, could afford additional opportunities for disabled students to use assistive technology, broadening the scope of reasonable adjustments available to disabled students. This is a view which is shared by the exam board OCR, who felt that on-screen assessments in particular would allow them to make access arrangements more adaptive to the needs of students.

As in our previous consultation in 2017, some teachers argued that the practical nature of some of the GCSE computer science course and the opportunity to work with computers would be likely to attract students to take the qualification, and therefore they could be disproportionately negatively impacted by our decision. An often-cited example was that of autistic students. Conversely, some respondents to our previous consultation indicated that autistic students were being caused particular distress by the NEA assessment arrangements because of the way in which they were conducted, and that they would benefit from its removal.

One teacher queried whether our proposals might prove detrimental to the attainment of girls, something they felt was a particular concern in light of the recognised gender imbalance in the subject. We considered this issue in our 2017 consultation on the removal of the NEA, building on more detailed consideration of the impact on different forms of assessment on gender, carried out in the GCSE reform equality impact assessment. We did not consider then that proposals to increase the use of assessment by exam would disadvantage female students: while we acknowledged the *perception* that female students might perform better in non-exam assessment (and male students better in exams), the overall body of evidence did not support this conclusion. Our view on this matter has not changed, and we are content that our proposals to assess programming skills by examination in this subject will not disadvantage girls.

Other respondents suggested that there may be certain students predisposed to a certain form of assessment or with a specific learning style who would be disadvantaged by the change in the form of assessment. However this is not a protected characteristic and does not fall within the scope of an equalities impact assessment.

We would emphasise that the requirement for the programming statement means that students will still be afforded the opportunity to design, write, test and refine programs in class. The approach to assessments allowed under our proposals would mean that boards could implement innovative forms of assessment such as online or on-screen testing. This could reduce the differences in candidate experience between NEA and exam assessment.

In view of the responses to the consultation we are satisfied that our proposals will not have a negative impact on students with protected characteristics which cannot be mitigated through reasonable adjustments.

Regulatory impact assessment

In our consultation we considered two significant potential impacts arising from our proposals – the impact on Centres (including the implications for resourcing), and the impact on the exam boards. While we acknowledged that it would be difficult to accurately estimate the impact because this would to some extent depend on the approach to assessment by examination which the exam boards choose to adopt under our proposals, we did suggest some potential impacts on which we invited feedback.

In terms of the impact on Centres, we felt that our proposal to require the exam boards to assess programming skills by exam would lead to an overall reduction in the burden on teachers by removing the requirement for them to set aside 20 hours of classroom time for students to complete the programming task – something which some felt was an onerous requirement which negatively constrained teaching. We were also of the view that assessment by examination was likely to be the least burdensome approach for teachers to assessing programming skills. Any of the other broad approaches discussed would require teachers to assess students and submit samples of work for moderation. This, in turn, would require them to be subject to monitoring and inspection by the exam boards. In comparison, the external assessment required under our definition of an examination moves this burden on to the exam board and allows teachers to focus on delivering the course.

This view was confirmed by the responses we received to the consultation. Further consideration of their responses is included in the [Regulatory Impact Assessment published alongside our decision](#).

We also considered the potential impact on the IT resources of Centres of any approach to assessment which required programming skills to be tested within the context of an examination. It is possible that exam boards may adopt an approach to assessing programming skills which involves online or on-screen assessment. Teachers responding to our consultation confirmed our belief that this may create issues for some schools and colleges who do not currently possess adequate IT infrastructure to facilitate such assessments. This was balanced, however, by the

significant number of teachers who advocated this form of assessment or who stated that they were already making use of on-screen or online assessment. Others said this would not create any issues for them.

Our proposals do not specify that exam boards must adopt any single approach to assessing programming skills via examination. While they would be able to adopt online or on-screen assessment if they felt that this offered the best approach to assessing programming skills, the level of resourcing in schools and colleges is likely to be one of the factors which influences their decision as to the most suitable approach. Indeed, exam boards have an obligation to ensure that their assessments are manageable. It is reasonable to expect, then, that exam boards will engage with schools and colleges over their ability to implement different approaches to assessing programming skills by examination. Furthermore, by introducing the revised assessment arrangements for first examination from 2022 we are providing Centres with additional time to switch to another GCSE computer science specification if that is more suited to their circumstances. Keeping the interim arrangements in place for an additional year will also allow more time for schools and colleges to enhance their IT infrastructure to deliver online or on-screen assessments and for the boards to test those forms of assessment with Centres.

Our consultation also considered the potential impact of our proposals on the exam boards. A detailed consideration of their responses is provided in the [Regulatory Impact Assessment published alongside our decision](#).

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