AQA
Questions matter

Making it Click: The case for digital examinations in England

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About the author

Adam Steedman Thake is the Policy and Evidence Manager at AQA, where he leads the development of evidence-based policy. He has a decade of experience working in education and began his career as a primary school teacher in Tottenham. He then moved into the Civil Service and worked in policy and strategy roles across the Department for Education and the Ministry of Justice. Adam has an MSc in Social Research from Birkbeck College, University of London and an MA in History from the University of Manchester.

About the report

This report explores the potential benefits of and attitudes to digital exams. It also examines potential implementation issues digital exams may face and the mitigations that can be taken to overcome these. This report is informed by a large variety of evidence from different sources. These are:

1. Desk research of academic research, official government reports, and case studies of jurisdictions which have already moved towards digital exams; links to sources are provided throughout.
2. Quantitative research:
    a. Polling of over 6000 teachers through TeacherTapp.[1]
    b. Polling by Savanta of over 2000 members of the general public, nearly 1,000 parents of secondary school-aged children, and over 1,000 young people aged 11-18[2]; all samples (a. and b.) were appropriately weighted to be nationally representative.
3. Qualitative research:
    a. AQA's own pilot studies of digital exams in schools across England. These included quantitative questionnaires of students (sample of nearly 1700) and focus groups with students (over 200 participants) and teachers (over 30 participants) to gain a deeper understanding of the experience of taking digital exams
    b. 17 in-depth interviews with Special Education Needs Co-ordinators (SENCOs) and exams officers about the potential for digital exams to facilitate greater inclusion.
    c. 10 focus groups and 6 in depth interviews with teachers and senior leaders across the UK to identify the benefits and challenges of digital exams, conducted by Yonder Consulting.
4. An initial analysis estimating carbon impacts associated with digital exams and traditional paper-based examinations; the results of this are summarised in this report, undertaken by Blue Marble.

1 TeacherTapp polled 6,198 teachers in July 2023. Results are weighted to reflect national teacher demographics and school characteristics.

2 Savanta polled: 1,010 young people aged 11-18; 974 English parents of children aged 11-18; and 2,089 English adults as the 'general population' sample. Data were weighted to be representative of England by age, gender, region, and social grade. Interviews were conducted online between 27th July – 17th August 2023.

3 It is important to note that Savanta conducted interviews with all groups over the internet; this means there may be an over-representation of those who have access to digital devices, even though there was careful weighting of lower income groups.

4 Yonder ran 10 focus groups with teachers across multiple different subjects and 6 in depth interviews with senior leaders in different roles across schools in the UK.

About AQA

AQA is an independent education charity with over 120 years of expertise and knowledge; we are experts in assessments and qualifications.

AQA designs, creates, and delivers rigorous and fair assessments to more than one million students every year, making us the most chosen general qualifications awarding body in England. We provide high quality assessments that are fair and reliable which is why they are valued by students, universities, and employers around the world.

We are more than an exam board. AQA's purpose is to improve education and assessment outcomes for teachers and learners. We achieve that aim by using our world-class research and expertise to help every teacher and learner we work with, wherever they are. We fund cutting-edge development of assessment products and teacher support to help learners realise their potential. We also share our knowledge and insight to inform policy by engaging with teachers, students, parents, politicians, policymakers and thought leaders. One of the ways we do this is by publishing policy reports, like this one.

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Foreword from the Chief Executive

Technology has always been part of education. From replacing quills with fountain pens and then ball point pens, to moving from scrolls to printed books to scanned documents on a computer screen, technological improvement and change are two of the few constants in education. We believe moving to digital exams is the next stage of this evolution.

Our view at AQA is straightforward, but, we think, profound. We believe that moving some topics in some subjects to be examined digitally on-screen is a real opportunity to deliver benefits to learners, teachers, and the education sector as a whole. As the largest provider of GCSEs and A-levels, we at AQA are determined to play a key role in making the move to digital a success.

As a leading exam board with 120 years of experience, we are excited to innovate in how we assess students. Throughout our existence, AQA has strived to improve the way we do things, giving students and learners the best possible assessments to measure accurately what they know and can do. The move towards digital exams is the next step in this journey and we look forward to continuing to improve the way we do exams today, tomorrow and for at least the next 120 years.

This is why we are setting out the benefits of digital examinations now, to make the case for why this move is important and necessary. Digital exams better develop digital skills in young people; they are more environmentally sustainable; are more authentic to the digital world that young people are growing up in, and will work in; and they have the potential to be more inclusive, and more fair. These are the initial benefits, but there are also longer-term benefits in terms of validity, accessibility, personalisation, and efficiency. Crucially, it's what teachers and young people themselves want.

Digital exams will be another tool in our kit for assessing learning and we believe they have a place among a suite of different tools, including pen and paper, but also many other methods that are already widely used. Drama and sport performance, science practicals and spoken language are all already assessed in different ways, alongside traditional pen and paper exams. We believe that digital examinations in some topics can work alongside continued pen and paper assessment in adjacent topics: we should be using all the media available to us.

We cannot change the way we sit exams overnight by throwing a technology lever and decreeing it so. That would be a bad idea, even if it were possible. AQA has spent time – several years, in fact – trialling and piloting digital exams. We believe that the time is now right to take this next step and set out a clear vision for when we will begin to implement change.

We are excited to make the first steps towards a more digital exam system, and to propose that the first components to move to digital exams for mocks in 2025 and examination in 2026 will be:

- GCSE Italian, Reading and Listening
- GCSE Polish, Reading and Listening

We intend to roll out digital exams over a period of years, learning along the way and progressing steadily. Our ambition is to implement a digital exam component in a major subject by 2030.

We are also making this announcement to begin a conversation with teachers, leaders and exams officers across the country about how they want to see these changes made. We want to have a discussion with as many people as possible from right across the education sector, to ensure we can make digital exams a reality and a success by supporting our teachers, schools, and colleges through this process. Following this, in March we will set out in more detail the practical support that will be available to facilitate this transition.

The world has changed a huge amount in the 120 years that AQA has been conducting exams, and we have improved and changed our processes throughout that time. We are continuing this tradition of improving and innovating by moving to digital exams. We want to do the very best we can for young people sitting exams, giving them the most accurate results and the best experience. Undoubtedly there are challenges, but experience from other countries that have already moved to digital exams shows these challenges are surmountable, and the benefits are substantial.

AQA will be delighted to welcome you on this journey with us.

Colin Hughes
Chief Executive of AQA

Executive summary

Well-designed assessments delivered effectively are crucial for determining what students have learnt and what they can do. We owe it to young people to ensure the education system prepares them for the world they will enter when they reach adulthood. One part of that is moving to digital examinations for GCSEs and A-levels.

We believe the time is now right to begin moving towards digital exams in some subjects.

There is tremendous positive potential for digital exams to unlock new opportunities for learning. We are excited by the potential, but also conscious of the need to move at a sensible pace. We will be taking a measured, evidence-based approach, to ensure schools and students are well prepared for the changes, and that implementation is as smooth as possible.

Desks in a hall with individual students writing with pen and paper as an invigilator walks the rows – this could describe any normal exam season over the last hundred years or so. Part of this is to do with the fact that some things never change – the way to work out the length of a hypotenuse has not changed since Pythagoras' time, so the method of assessing has not needed to either. While paper-based exams continue to be one useful way of assessing students, AQA believes it is time to widen the range of media we use. **Digital and on-screen technologies have tremendous potential to improve our assessment practices, to the benefit of learners, schools, and the education system.** We need to adapt our exam practices to the modern world, to ensure we are assessing the skills and knowledge of the next generations in the most appropriate way.

It is a well-known fact that we live in an increasingly digital world. In 2020, 81% of adults owned at least one device able to connect to the internet (i.e., PCs, laptops, or tablet computers). Younger generations are more connected to technology and the internet than ever before. Following the disruption over the Covid pandemic, exams were cancelled, and learning moved largely online. Schools and colleges were forced into delivering digital education, and exams were not able to pivot to a digital realm fast enough and ended up being cancelled. The increased use of technology during the Covid pandemic has highlighted the importance of technology in education and the potential for digital tools to improve teaching and assessment. From our polling of 11–18-year-olds, students want to have a more digital exam experience. Crucially, students from lower-socio-economic backgrounds were actually more positive about digital exams than their higher-socio-economic background peers.

To continue in the same old way in a world that has changed drastically not only does not make sense but also leaves the important benefits of an increasingly digital education system unrealised. Moving to digital exams in a measured, evidence-based way will ensure the English education system is more resilient to shocks, more flexible to candidate needs, and more closely aligned to the world in which our young people are growing up, meaning that education better prepares them for life outside the school gates. The introduction of onscreen digital assessment in New Zealand has encouraged the use of digital technology in the classroom and this has enhanced learning, improved engagement, and stimulated reflective learning. Digital exams also have the potential to measure a broader range of skills and knowledge than traditional pen and paper exams and to be more environmentally sustainable.

"My students would definitely like to go online, for programming, because this is the reality. You run it and look at errors. On paper that's taken away from you"

– Computer Science teacher

"For [Modern Foreign Languages], it could be interactive, like in a restaurant setting for example. I could see that working in a fun way"

– Member of Senior Leadership Team

Digital exams also have the potential to improve levels of inclusion, particularly for students with special educational needs and disabilities (SEND). Digital exams are already used in assessments to help students with additional needs with assistive technology. Moving to digital exams for all students means that assistive technologies can be turned on for more students who need extra support or similar accommodations. In our polling, all groups surveyed felt that students with SEND, students with impairments to their sight or hearing, and those who needed extra support would benefit most from digital exams.

"Certain kids struggle with writing now like, maybe if you're dyslexic, for example... if you're dyslexic, [digital exams] will work really well"

– Member of Senior Leadership Team

"Being able to do online assessments that don't need to have that scribe or that reader, it does give [the student] independence not having to rely on an adult to help them with those parts of their exam."

– Interview H - SENCO

We believe now is the right time to build a stronger, more resilient form of assessment that delivers real benefits for the education system. Indeed, other countries have already moved their exams from paper and onto computers and electronic devices with success, and we want to learn from this. There are many benefits for students, teachers, schools and the wider education system which moving to fully digital

Figure 1: To what extent do you agree or disagree that more digital (on screen) schoolwork and exams (rather than using pen and paper) will better prepare you for the future (e.g. training, university, work)? 11-18 year olds

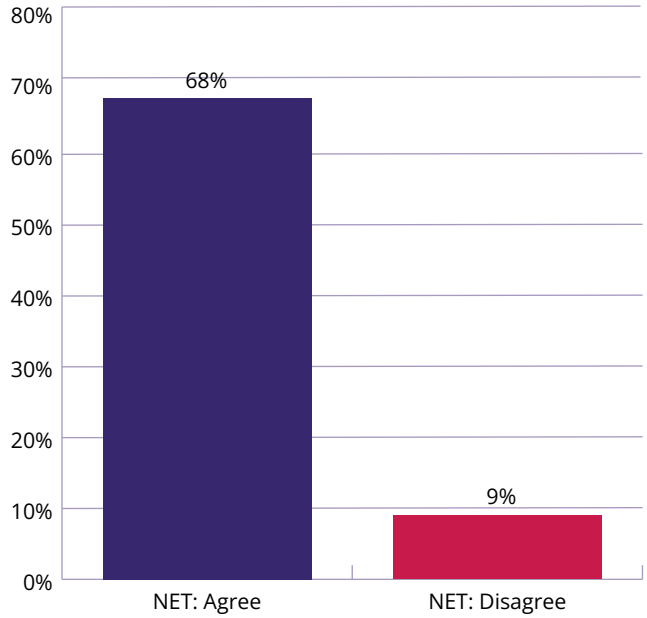


Figure 2: Comfortable using for longer 1 hour or longer Computers vs. Pen and Paper - 11-18 year olds

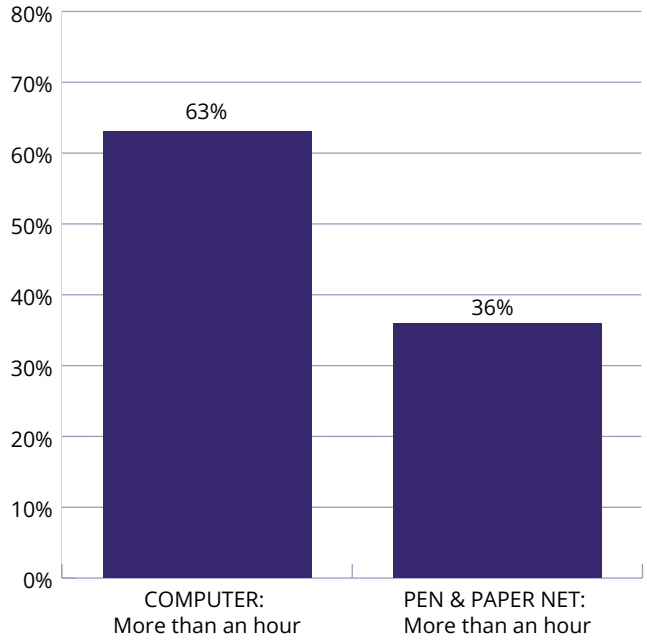
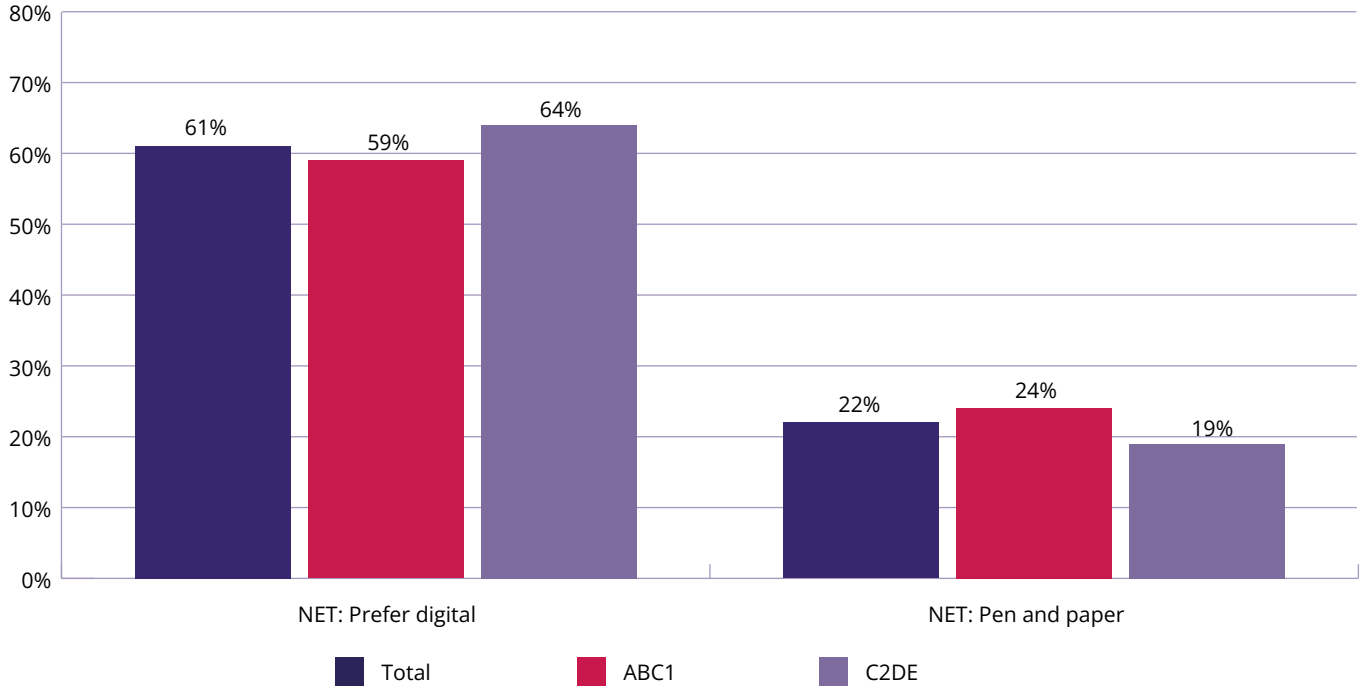


Figure 3: Would you prefer to sit an exam using pen and paper, or on-screen digitally? – 11-18 year olds by socio-economic status



exams will realise, but we also recognise the potential risks and challenges. Any move towards more digital exams must be done building on evidence and research. We will not do away with traditional pen and paper exams in a rush and anticipate an exam system where some components of some GCSE or A-level courses are delivered in a paper-based manner and other components are digitally delivered.

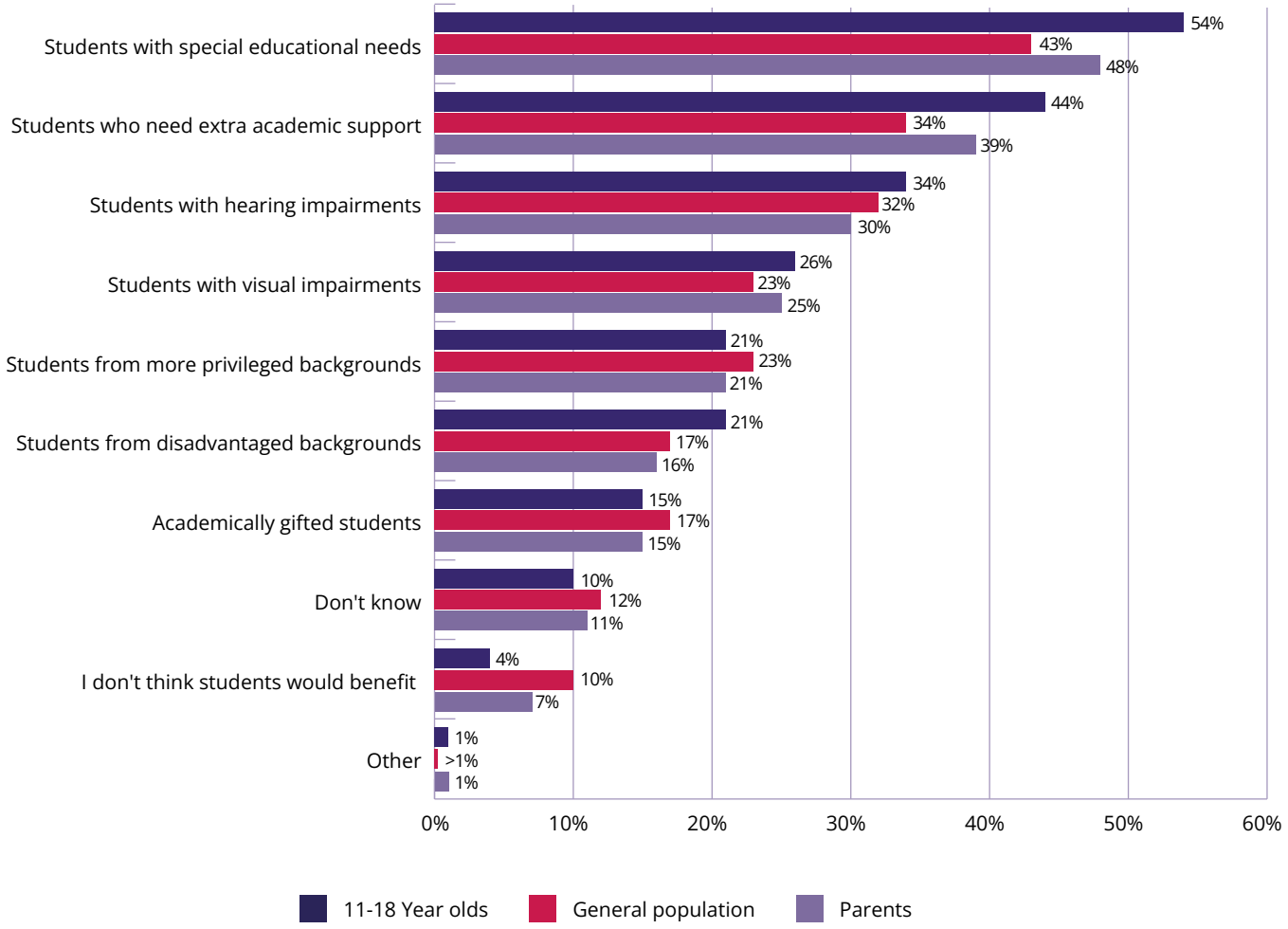
AQA are beginning to make the first steps towards a digital exam system in an evidence-based way. We understand and appreciate that some people will have concerns about such a big change, which is why we are taking an evolutionary, not revolutionary, approach, informed by evidence and iterating our process throughout. We are announcing our high-level plans now, before beginning a period of engagement across the education sector. We will use this engagement to gather insights and feedback to help inform our work going forward. Following this period of engagement, we will firm up our proposals and announce more detailed plans in 2024 around what support will be available for schools to make the transition, as well as which subjects will move to digital after 2026.

We have run and learnt from detailed pilot programmes of digital exams – what went well, and what could have gone better – to help develop our approach as we build towards the first mock digital exams taking place in 2025. These mocks will help students, teachers, and schools be prepared before the first full, live exams sat digitally in 2026. The first components we propose to move to digital exams for mocks in 2025 will be:

- GCSE Italian, Reading and Listening
- GCSE Polish, Reading and Listening

The speaking component of GCSE Italian and Polish will be unchanged in 2026. The first exams will take a paper behind glass approach, meaning we will largely replicate the existing paper exam on screen. In the longer term, there is much potential for more innovative and interactive assessment. We chose these components in GCSE Italian and Polish as the question types allow for a sound digital assessment and modern foreign languages tested well with students in our pilots. We also do not want to overburden centres with large scale changes in the first year, and these two subjects have an average cohort size of 4. In 2023, 7,000 students sat AQA GCSE Polish, while 3,000 students sat AQA GCSE Italian.

Figure 4: Which group of students would benefit most from on-screen exams?



We intend to roll out digital exams over a period of years, learning along the way and progressing steadily. Our ambition is that students will sit a large-entry major subject – that means, in our case, hundreds of thousands of simultaneous exams - digitally by 2030.

This report sets out the benefits of digital exams and explores the evidence while looking at the potential challenges ahead. It begins by outlining the positive benefits of moving towards a digital exam system; this section is informed by academic research, international evidence from jurisdictions that have already moved to digital exams, AQA's digital exam pilots with schools, an AQA-commissioned environmental impact study of digital exams, and nationally representative polling of teachers, parents, young people, and the general public. The report then explores the longer-term benefits of digital exams, particularly focusing on the potential of adaptive assessment and the potential impacts on teacher workload. The report then considers the potential implementation of digital exams and explores mitigations for potential risks to successful delivery. It concludes with the next steps for our programme of making digital exams a reality.

While our key announcement – moving to digital GCSE exams from 2026 – is focused on summative exams, the report also covers the benefits that digital exams can have for formative assessment as well. Formative assessment gives learners immediate feedback on their learning and gives teachers rich data about class progress, enabling them to support their students on their individual learning journeys.

Technology has always been part of education, from moving from scrolls to books, from ink wells to ballpoint pens; moving to a digital exam system is the next logical step and we are excited to make this change a reality.

The benefits of digital exams

Innovative assessment methodologies can deliver benefits to both students and teachers. Reliable and valid assessments provide a strong indicator of what a student knows and can do. Assessments tell us what a student has learned, how well they have grappled with core skills and knowledge, and what areas they are finding difficult. Not only can they support teachers to ensure students have learnt core concepts before moving on, but in doing so they can save teacher time. Assessments and exams can also generate insights nationally, helping the Department for Education (DfE) to, for example, understand specific topics that students struggle with and adapt curricula and policies accordingly.

Without good assessment, there is no sure-fire way to know whether learning has taken place. The medium through which assessment takes place can also have an impact; currently we develop the handwriting skills of students and their stamina with using a pen or pencil to help them in exams. Through a move to a more digital exam world, we believe we can drive improvements in the digital skills of young people. As assessment is an important part of the education system, and where AQA has particular expertise, we are interested in the potential for digital exams to drive improvements across education.

Changing the way we design assessments can have huge impacts right across young peoples' education. In the following sections, we explore some of the potential benefits of moving to digital examinations. All points are supported by evidence from a variety of sources: polling data from nationally-representative samples of young people aged 11-18, parents of young people aged 11-18, the general public, and the teaching workforce; academic evidence from other jurisdictions which have moved to digital exams already; an initial analysis of the carbon impacts of digital and paper-based exams; and evidence from pilot studies AQA has run with schools into making digital exams a reality.

The key reasons for moving to digital exams are that digital exams: prepare young people for the digital world; are more inclusive; are more environmentally sustainable; and develop digital skills while also being what young people want.

Digital exams are better preparation for the real world

Digital assessments present the opportunity to provide students with more authentic problems to answer. 'Authenticity' is used to mean that the assessment is close to tasks in the wider world, i.e., the assessment gives an accurate representation of what someone can do 'in the real world.' Digital exams can present challenging problems in different ways from traditional assessments and provide ways to assess complex skills like problem-solving, decision making, and testing hypotheses.

Moving to digital exams presents an opportunity to increase the authenticity of assessment to future work experiences and develop the skills and knowledge that will be required after formal education. Preparing students to enter the world by asking them to demonstrate their skills at handwriting an essay or short-answer question is increasingly inauthentic for the world they will enter. Digital assessment forms can assess skills that humans routinely use computers to perform and that paper-based assessments can struggle to assess reliably. To take essay-writing as an example, people for whom writing is a part of their profession write with help from specific

tools and sources. To write a report, article or story, people research and use the ideas of others and revise drafts. Word processors are used to correct their spelling, punctuation, and grammar. Editing what you have written becomes more straightforward with a word processor and frees up the writer's mind to do other kinds of tasks. Of course, if the assessment was designed to test specific knowledge, or to test grammar, you could disable certain features – digital assessment gives you the flexibility to assess what you truly want to be assessing. In our focus groups with computer science teachers, this was highlighted as a particular benefit for their students.

> "Writing out programming with a pen is a lot harder. This [digital exam] is more reflective"
>
> – Computer Science teacher

> "My students would definitely like to go online, for programming, because this is the reality. You run it and look at errors. On paper that's taken away from you"
>
> – Computer Science teacher

Research has also indicated that traditional pen and paper exams can sometimes struggle to measure complex practical performances or deep conceptual knowledge and thinking, skills and knowledge that are required for problem-solving. A lack of validity can creep into assessments also when students are learning about digital technologies but are assessed using pen and paper – for example manipulating data, creating graphs, or coding. This is not to say that traditional paper and pen exams do not have a place, these exams have a purpose and are good at what they do, but a move towards digital exams can facilitate new question formats.

Digital exams have the potential to unlock new types of questions and provide a more engaging exam experience. Digital assessment can present rich media rather than just text or still images such as videos and audio; these mean that digital exams can be more interactive than traditional paper exams (e.g., providing a video clip as a stimulus to answer questions). New digital assessment types can also assess new sets of skills (e.g. creating a web page which meets a specific set of criteria), digital technologies can elicit and measure multi-faceted skills, sets of knowledge and cognitive processes that have previously been difficult to assess. For example, simulations can simultaneously measure technical computer skills, decision-making and strategy processes as well as subject-specific skills like scientific enquiry. The ability to create and visualise complex data sets and models is also only realistically possible in a digital exam. The potential for more engaging question types was raised by senior leaders in schools in our focus groups.

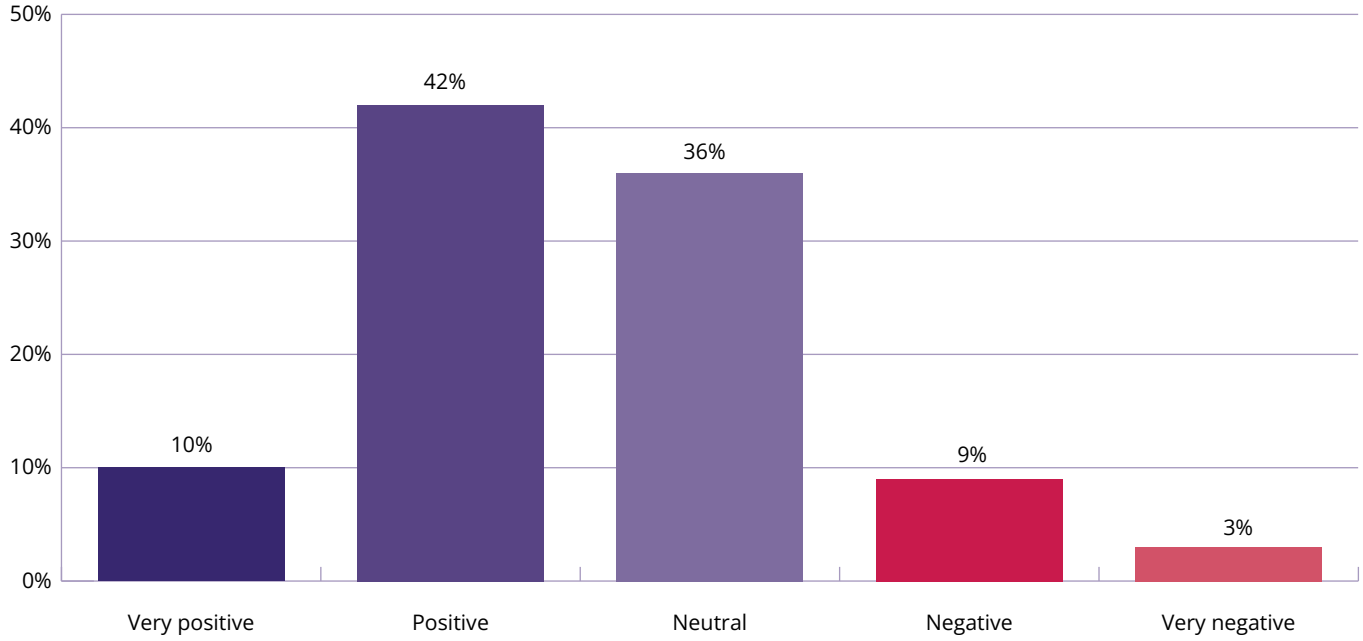
> "It could be, say a 3D diagram rather than flat on paper, which could be more engaging and students could really benefit from that sort of visualisation"
>
> – Senior Leader

> "For [Modern Foreign Languages], it could be interactive, like in a restaurant setting for example. I could see that working in a fun way"
>
> – Senior Leader

While one might assume that digital exams would be less suited to essay-based subjects, feedback from students in our focus groups as part of our pilot programmes revealed the opposite. They liked being able to copy and paste from text sources and edit their responses. In our pilot studies, students reported finding typing more efficient than writing and were glad to not have to worry about the legibility of their handwriting. There are studies which indicate that students' grades can be subject to handwriting bias and digital examinations could be a way to overcome this problem.

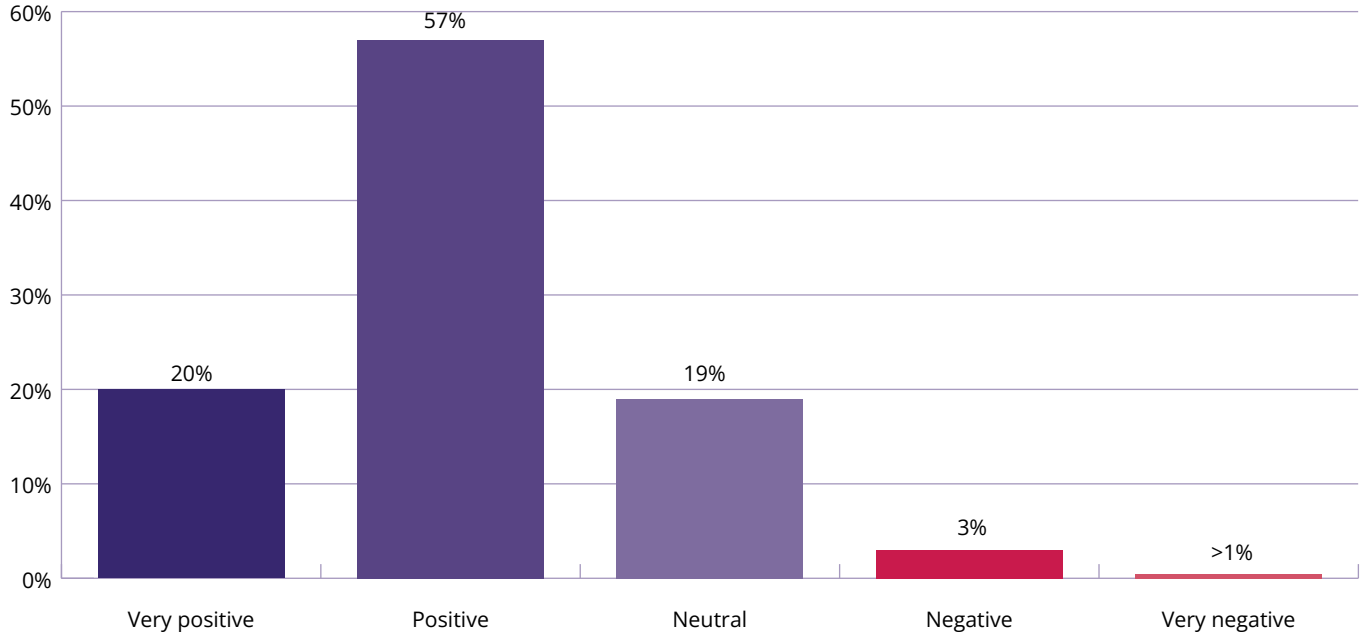
Evidence from AQA's pilot studies of digital exams also found that digital assessments allowed for interactive and accurate assessment of specific knowledge and skills. Students who took part reported that they found digital exams, and typing, more relevant than paper-based assessment. Indeed, when asked about taking a mock digital science exam, over half (52%) reported having an overall positive experience, with only 12% reporting a negative experience.

Figure 5: Students' experience of taking GCSE Science digitally in AQA pilot studies



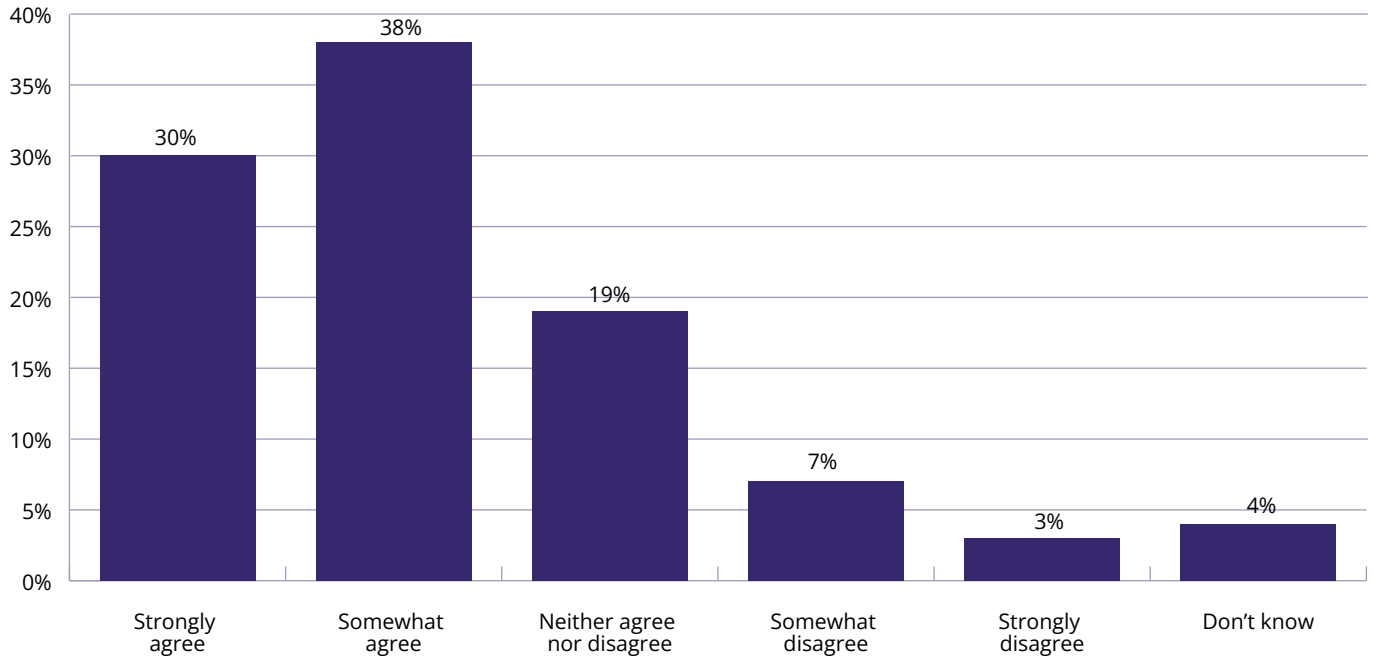
Source: AQA digital on-screen exams pilot studies

Figure 6: Students' experience of taking GCSE Computer Science digitally in AQA pilot studies



Source: AQA digital on-screen exams pilot studies. NB. Results do not add up to 100%, due to rounding

Figure 7: To what extent do you agree or disagree that more digital (on screen) schoolwork and exams (rather than using pen and paper) will better prepare you for the future (e.g. training, university, work)? 11-18 year olds



Students were even more positive about taking GCSE Computer Science digitally on a screen. 77% of students had a very positive or positive experience. 3% of students (7 students in total) reported a negative experience overall, and only one student (0.47%) reported a very negative experience. GCSE Computer Science is obviously a unique case, so the findings below may not be applicable to other subjects.

Students who took part in the Computer Science pilot also expressed positive views in focus groups. Responses were broadly positive, although there were some frustrations with the precise functionality of the coding program used as illustrated by the following quotes.

> "Typing it just makes a lot more sense. It's computer science. It's all based around computers, why wouldn't we do it on one."
>
> (Student 2, School C)

> "Yeah, I'd agree that it also feels easier, because when I'm doing it on paper it feels a bit more stressful because it feels like it's more permanent when I write it down, whereas with the keyboard it's less stress."
>
> (Student 6, School B)

Figure 8: To what extent do you agree or disagree that more digital (on screen) schoolwork and exams (rather than using pen and paper) will better prepare you for the future (e.g. training, university, work)? 11-18 year olds

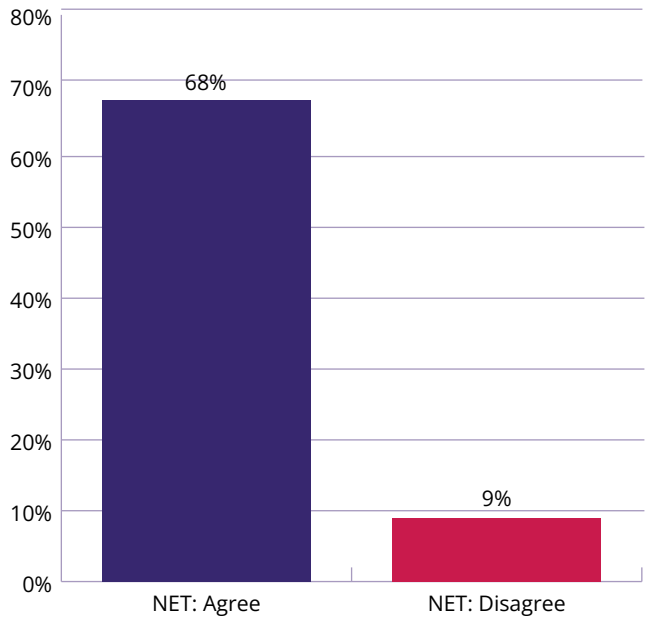


Figure 9: "It is important for the way young people take exams to move with the times" - Parents

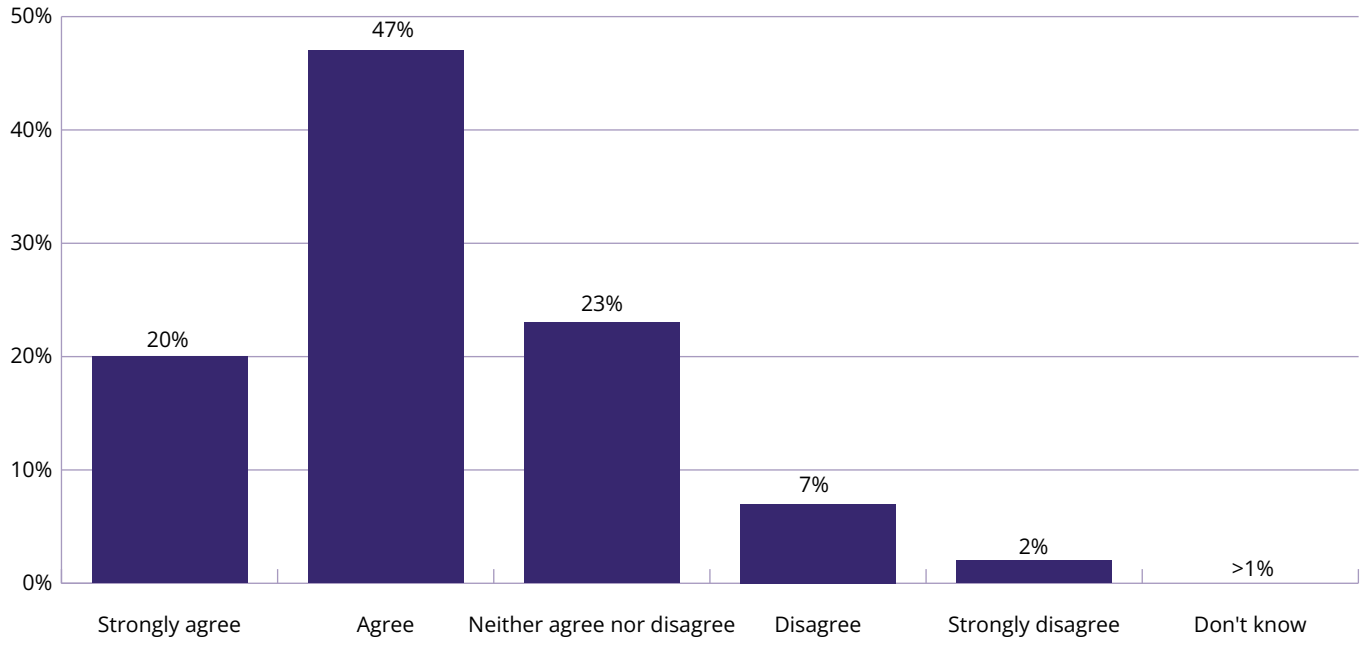


Figure 10: As far as you know, are standard GCSEs and A-levels currently delivered in a more traditional (with pen and paper) or digital (on-screen) way? - Parents

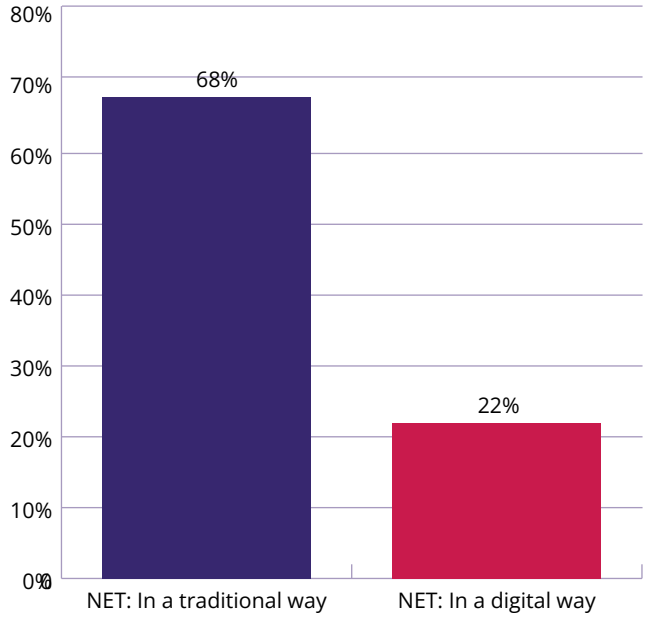
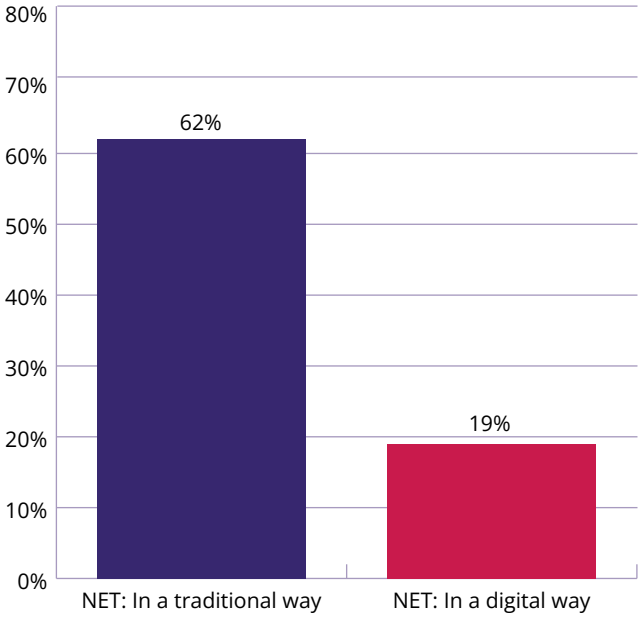


Figure 11: As far as you know, are standard GCSEs and A-levels currently delivered in a more traditional (with pen and paper) or digital (on-screen) way? - General population



In our survey of young people, there was a strong agreement that increasingly digital exams would be better preparation for their future in work, education, or training. Over two-thirds (68%) of young people surveyed agreed that digital exams would be better preparation, with less than one-in-ten (9%) disagreeing. People aged 11-13 were more likely to agree that more digital schoolwork and exams will better prepare them for the future than those age 14-16 and 17-18 (74% vs 66% vs 62%). This potentially represents an understandable hesitancy on the part of older school children who are more used to sitting traditional exams, so may not want a style of exam they are not used to.

Similarly, in our survey of parents, respondents agreed that exams should move with the times and be delivered increasingly digitally. Over two-thirds (67%) agreed with the statement "It is important for the way young people take exams to move with the times", with only 9% disagreeing.

Most surprisingly from our survey, a sizable minority of parents (22%) surveyed already believe that GCSE and A-levels are currently delivered digitally, at least in part. In fact, the actual number of summative examinations which use a digital on-screen assessment is very small, with the overwhelming majority being examined using the traditional pen and paper method. Results were similar for the general population, where nearly one-in-five (19%) of the general population thought exams were delivered digitally, at least in part. It is possible that these respondents were thinking more generally about how GCSEs and A-levels are taken, with homework and coursework being set and completed digitally, although they could also indicate that many think that exams are already digital.

In our focus groups with the school workforce about their attitudes towards digital exams, many teachers had positive feelings towards digital exams. Teachers and senior leaders were positive about the potential for digital exams to be closer to the worlds of work and further study, saying that digital exams could better prepare students.

> "It's the modern world, we are preparing for their futures, for jobs, which mostly use computers where everything is online, even at university"
>
> – Citizenship teacher

> "Learning post-16 is about going into the workforce. It's teaching you the skills you will use for life"
>
> – Philosophy teacher

> "[Digital exams are] happening abroad, and in universities, so we should follow"
>
> – Media studies teacher

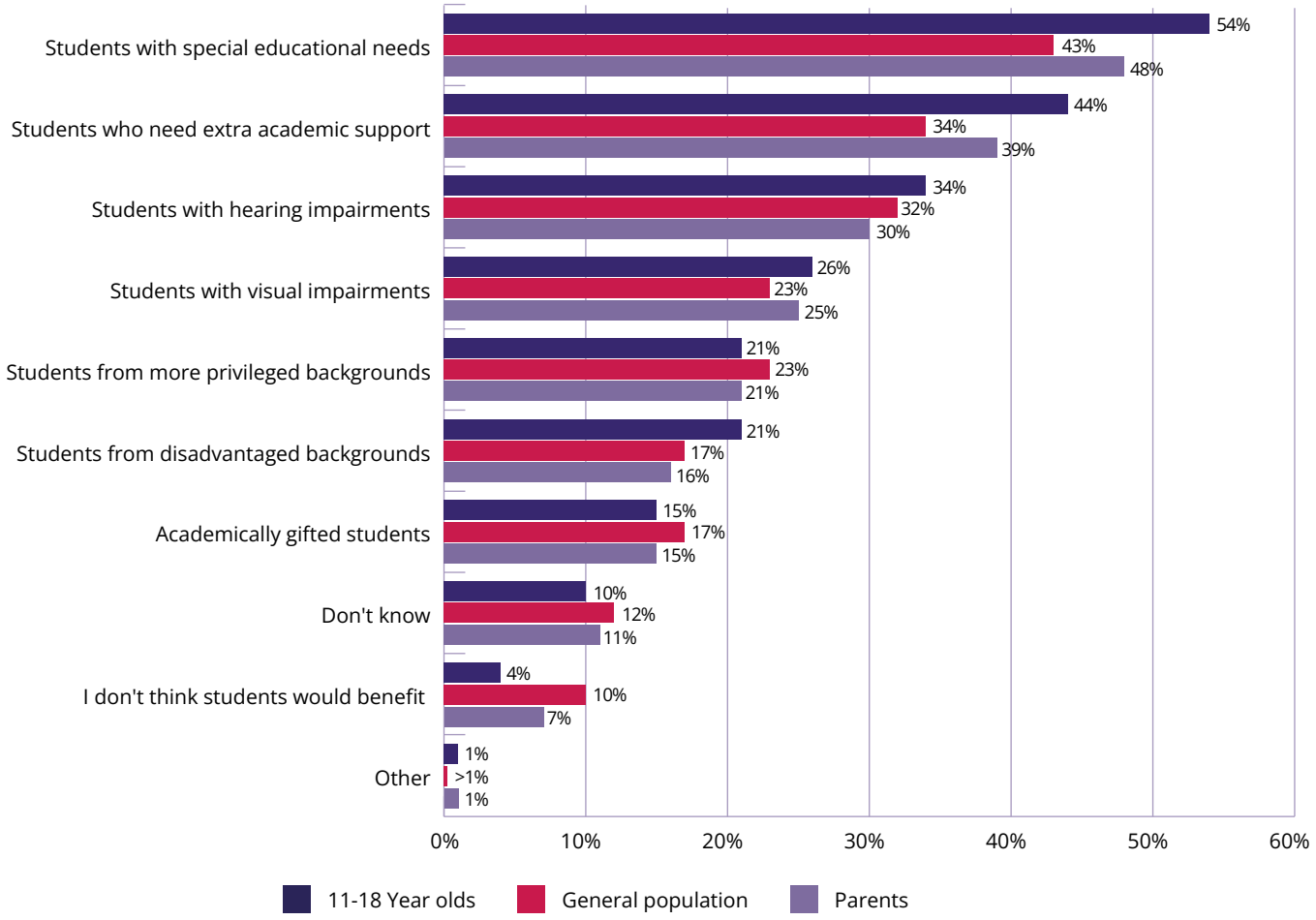
International jurisdictions which have already made the move to digital exams also show the potential for digital exams to enable new types of more authentic assessments. Egypt moved to large-scale national digital exams for upper secondary school in 2019/20, which allowed for new digital questions to be designed and included in assessments which could better target higher-order thinking. The Norwegian move to digital exams enabled programming and advanced mathematical functions to be incorporated into maths exams in a way that was not feasible for paper-based assessments. The ability to incorporate multimedia resources into item construction also has been beneficial in Norway with simulations, videos and audio used to engage students during the assessments. In more literary subjects also, digitisation allowed for new types of digital texts and interactions in Norwegian and other language exams.

Digital exams are more inclusive

Digital exams are already used in assessments to help students with additional needs with assistive technology. 'Assistive technology' is a general, catch-all term for any device, software or system that is designed to help an individual who has a disability or impairment of some kind. Laptops and e-readers are already available for students who need them and new technological advances can provide innovative alternatives to improve inclusion in learning and assessment. Access arrangements and assistive technologies have been growing over the last few years, with over 114,000 computer readers or readers being approved in GCSEs, AS-levels, and A-levels in 2021-22 academic year. Moving to digital exams for all students means that assistive technologies can be turned on for more students who need extra support or similar accommodations.

In our surveys, all groups surveyed (teachers, 11–18-year-olds, parents, and the general population) agreed that students with special educational needs and disabilities (SEND), students who needed extra support, and students with hearing or visual impairments were most likely to benefit from digital exams. Many respondents felt that digital exams could improve inclusion for students with SEND, or with hearing or visual impairments. Across all groups surveyed, only a small number thought students from disadvantaged backgrounds would benefit most from digital exams. However, 11-to-18-year-olds felt that students from privileged backgrounds (21%) would benefit from digital exams as much as disadvantaged students (21%). Parents felt that privileged students (21%) would benefit more than disadvantaged students (16%). There was only a small difference (6 percentage points) in the difference reported by the general public.

Figure 12: Which group of students would benefit most from on-screen exams?



All groups worried that disadvantaged students may be negatively impacted by a move towards digital exams. A third of 11–18-year-old respondents (36%) believed that students from disadvantaged backgrounds may be negatively impacted by digital exams, compared to two in five (41%) parents, and over two in five general population respondents (43%).

Interestingly though, when comparing preference for on-screen digital exams or pen and paper exams by socio-economic group, higher social group young people (ABC1, 24%) were more likely to prefer pen and paper than lower social group young people (C2DE, 19%). Correspondingly, lower social group young people (C2DE, 64%) were also more likely to prefer the potential to sit an exam digitally than their more affluent peers (ABC1, 59%).

In our focus groups with teachers and senior leaders, accessibility was also highlighted as a potential benefit of moving to digital exams. While not every focus group mentioned it, accessibility was at the forefront of some teachers' minds.

> "Certain kids struggle with writing now like, maybe if you're dyslexic, for example... if you're dyslexic, [digital exams] will work really well"
>
> – Member of Senior Leadership Team

> "[Digital exams] could improve accessibility – you can more easily change font sizes etc."
>
> – Computer Science teacher

In AQA interview research with Special Educational Needs Co-ordinators (SENCOs) there was also enthusiasm for the potential introduction of onscreen exams for learners with SEND, with student independence viewed as a key benefit.

> "Being able to do online assessments that don't need to have that scribe or that reader, it does give them [student] independence not having to rely on an adult to help them with those parts of their exam."
>
> Interview H - SENCO

However, there was also awareness from SENCOs that meeting the needs of all learners is a difficult task. While accessibility can be increased for many learners by introducing digital modes of assessment, this may not be universal, and we need to be mindful of that.

Figure 13: Which group of students would benefit most from on-screen exams? - Teachers

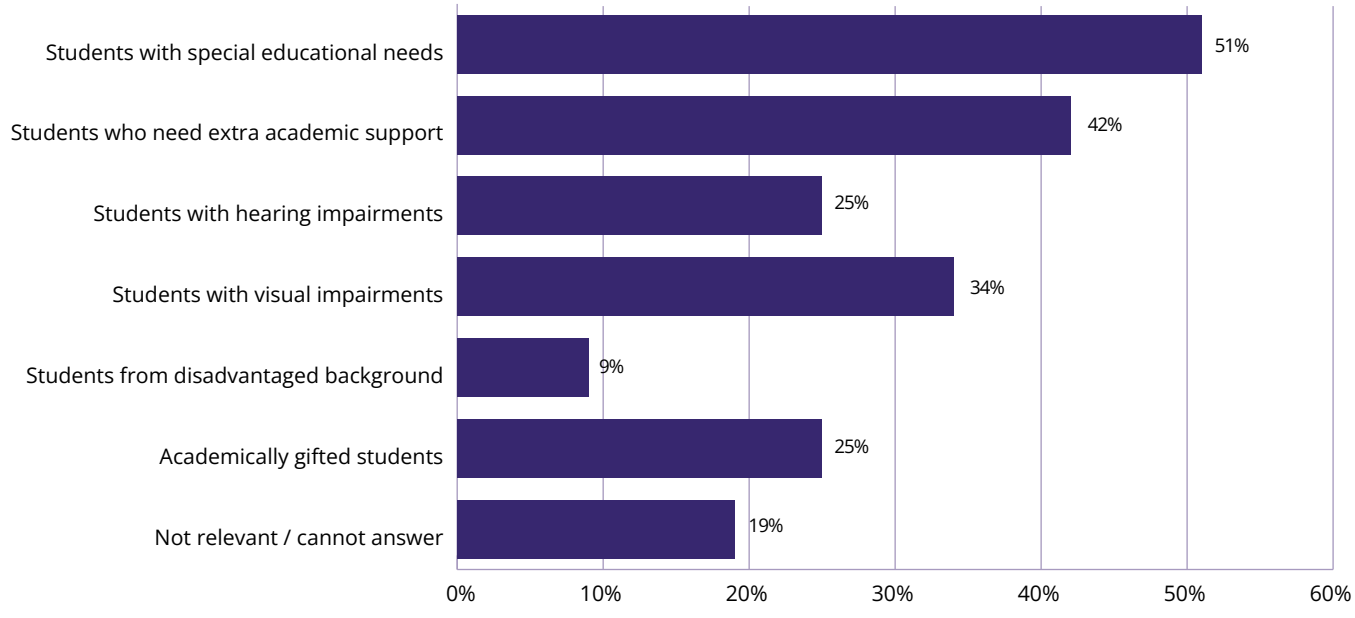
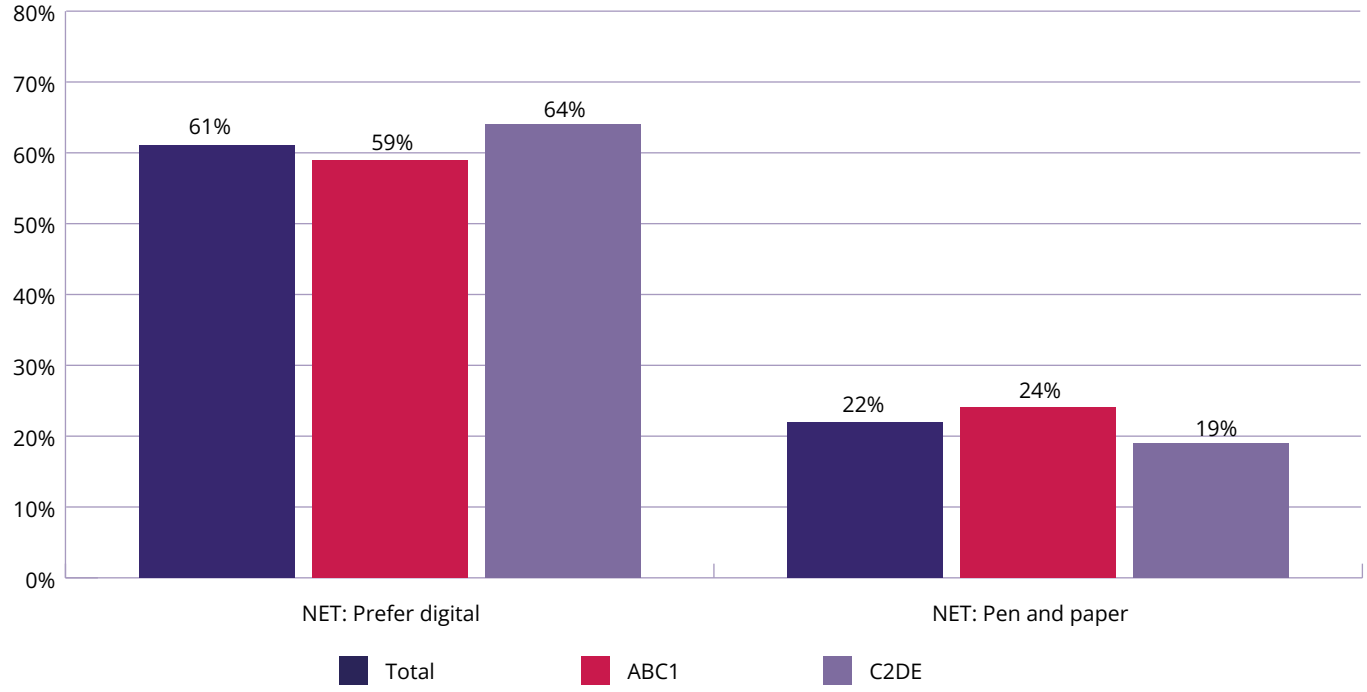


Figure 14: Would you prefer to sit an exam using pen and paper, or on-screen digitally? – 11-18 year olds by socio-economic status



> "I think the problem with it is trying to produce something that is suitable for everybody, but the problem with special education needs is they're so individualised that it can be really difficult."
>
> Interview F – SENCO

In Israel, digitisation has helped improve digital literacy amongst traditionally deprived areas, as well as allowing less well-resourced schools better access to advanced technology. Further, digital assessment has allowed the use of technology which have benefits for SEND students (e.g. video signing of questions).

In Scotland, the introduction of Digital Question Papers (DQPs) allowed for greater inclusivity in assessment. Students who sit DPQs can have the paper tailored to their needs, and can complete their exams independently, without a scribe, an interlocutor or having to be in a separate enclosed space.

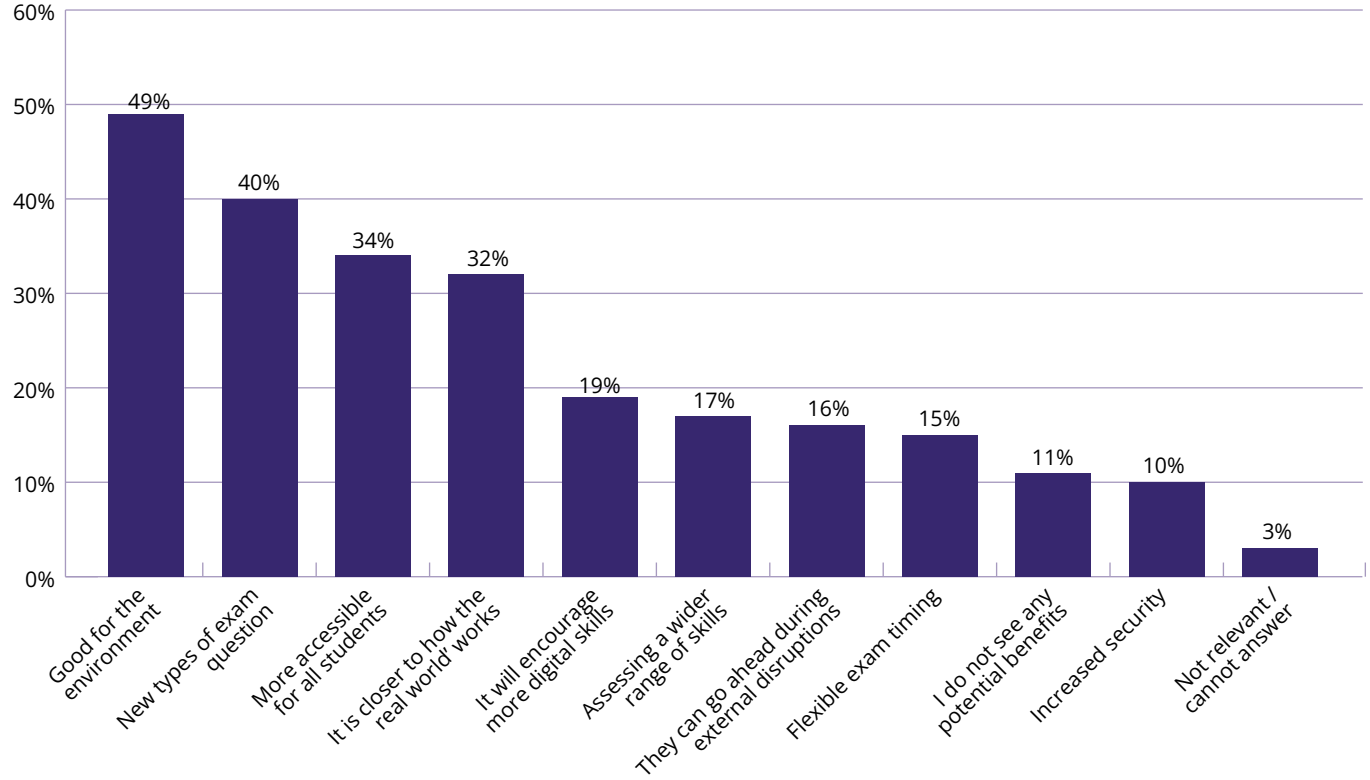
In England, we already allow for digital accommodations for students with additional needs. The use of laptops and e-readers are already in English exam halls for students with specific SEND. A move to digital assessment for all could allow for greater inclusion for students who would benefit from additional technology.

Digital exams are more environmentally sustainable

One of the most important reasons for shifting to digital exams is the environmental benefits. We work hard to ensure that current paper-based exams are sustainable, but making exams more digital can make them even more so. Each year, around 1.2 million young people sit multiple GCSE and A-level papers. Each of these exams is currently made of paper which needs manufacturing and transporting to thousands of schools, colleges, and exam centres. Completed exam papers then need transporting to a scanning facility where they are digitised before being electronically marked. We work hard to ensure that current paper-based exams are sustainable, but making exams more digital can make them even more so. With electricity coming from increasingly renewable sources, the potential for a greener examination future is near.

Many people agree that digital exams could be more environmentally sustainable. In our polling, teachers, young people, parents, and the general public all selected 'good for the environment' as the most chosen benefit of moving to digital exams. Around half of all teachers (49%) thought the environmental benefits were one of the

Figure 15: Which three of the following do you see as the biggest potential benefits of on-screen exams? - Teachers



top three benefits for digital exams. Two-fifths (40%) of young people, 40% of the general public and 36% of parents selected 'good for the environment' as one of their top three benefits of digital exams.

To understand in more detail the impact digital exams can have on the long-term environmental sustainability of the examination system, AQA commissioned Blue Marble to undertake an initial life cycle analysis of exams in both traditional pen and paper mode and in a new digital mode. Blue Marble is an environmental consultancy which specialises in managing the carbon impacts of businesses, their supply chains, and products. By conducting a detailed analysis of all stages of digital and paper-based exams processes[5], we can analyse the inputs of resource consumption, and outputs of environmental emissions at each stage of the exams process, to explore the environmental impact of a product.

The limitations of this analysis and caveats must be noted and a table of inclusions and exclusions is provided at the end of this report in the appendix. The analysis is not a full life cycle assessment to ISO standards and is not peer reviewed so all claims made below should be treated as indicative at most. Much more information and data on digital exams is required to make more meaningful judgements on overall impacts but this analysis provides a useful and informative illustration provides a useful and informative illustration of the potential sustainability benefits that digital exams can provide.

For the paper-based process the raw material inputs comprise the examination paper, plastic inner packaging, and cardboard outer packaging. These paper exams then need transporting to the exam centre, and then returning to AQA's scanning facility; this is usually done through secure couriers, using vans and lorries on roads. After the scripts have been scanned and stored for eight months, they are destroyed. All these elements consume energy, with associated carbon emissions. In the table below, energy

5 Blue Marble compared the 2022 English Language GCSE as the reference examination, with a notional on-screen digital examination event equivalent to the 2022 English Language GCSE. The 2022 English Language GCSE was a two-paper examination. Each paper requires an average of two hours to complete, therefore a total of four hours for the full GCSE (hereafter "examination event"). The on-screen process uses primary data which was collected from a pilot run by AQA between May-April 2022, with an English Language examination lasting 45 minutes. The on-screen process as described in this study has been updated for comparability with the paper-based process, consequently all data related to the on-screen process is considered representative of a notional two-paper GCSE English Language examination.

consumption from scanning is accounted for on the basis of scanner power consumption and throughput. Transportation between AQA offices and warehousing facilities are accounted for. Energy consumption from physical storage is accounted for on the basis of allocation of electricity consumption of the warehouse to the completed scripts. Digital storage is accounted for on the basis of cloud storage of a digital file for twelve-months.

For digital exams, the process is more complicated as certain assumptions need to be made about the energy usage of the digital device (full details of the assumptions can be found in the appendix). For our initial analysis of the amount of carbon used for a single exam, we assumed the laptop is used for a total of 4 hours during the examination event and that no additional ICT required purchasing. While the laptop would be used for more than just the single exam, we have only calculated the carbon that would be associated with a single examination event to allow for clearer comparisons between paper-based and digital exams.

From analysing all the different steps involved in the delivery of paper-based exams and comparing them to digital exams, an estimated carbon impact of the paper-based process and a digital exam is calculated. As shown in the table below, there is an estimated **reduction of 9% in the amount of carbon emitted per exam** (as measured in kg of CO2 per exam event) by moving from paper to digital. With the average student taking around eight GCSEs, with many courses requiring multiple exams, over the average lifespan of an ICT device[6], this reduction could compound into a considerable difference.

As mentioned, there are several different assumptions underpinning the analysis, some of which have a level of uncertainty inherent within them. Tweaking some of these underlying assumptions can have substantial impacts on the overall level of carbon usage per digital exam. Some of these assumptions will now be discussed in more detail, with further information in the appendix.

For example, we wanted to model the difference that different ICT equipment could make; tablets tend to use less energy that laptops, so this was modelled. As ICT equipment can last for some time, we modelled an increase in the average lifespan of the ICT equipment from 5 to 6 years. With an increasingly digital world, ICT devices are increasingly being used more frequently, so we modelled an increased daily use of 6 hours, compared to 4 hours in the baseline. As the main carbon impact of ICT is in the manufacturing, and many centres have at least some ICT equipment, we also modelled the impact of any brand-new ICT equipment only (assuming a 30% uplift in ICT equipment required). The results are as follows:

- Blend of ICT Equipment - 50% Laptops / 50% Tablets - 34% decrease
- Average years of lifetime use increasing from 5 to 6 years - 19% decrease
- Average hours of daily use increasing from 4 to 6 hours - 29% decrease
- Attribution to new ICT equipment only (assume 30% uplift in technological access required) - 51% decrease

Our baseline assessment of a 9% reduction in carbon emissions per exam, therefore, only represents the tip of the iceberg in potential green improvements to exams. With a blend of ICT equipment, used effectively throughout the school day, over several years, the exam system's impact on the environment could be lessened even further – potentially dramatically so.

All groups we polled mentioned the environment as an important benefit for digital exams, so people are clearly passionate about sustainability. By comparing a typical paper-based GCSE examination event with a potential digital on-screen exam, we can say that digital exams are more environmentally sustainable than paper-based exams. Digital exams will therefore play an important part in helping build a more environmentally sustainable education system.

6 For the purposes of the initial baseline analysis, an average lifespan of 5 years was assumed per device.

Figure 17: Sensitivity analysis - Carbon Impacts (kg C02e per exam process)

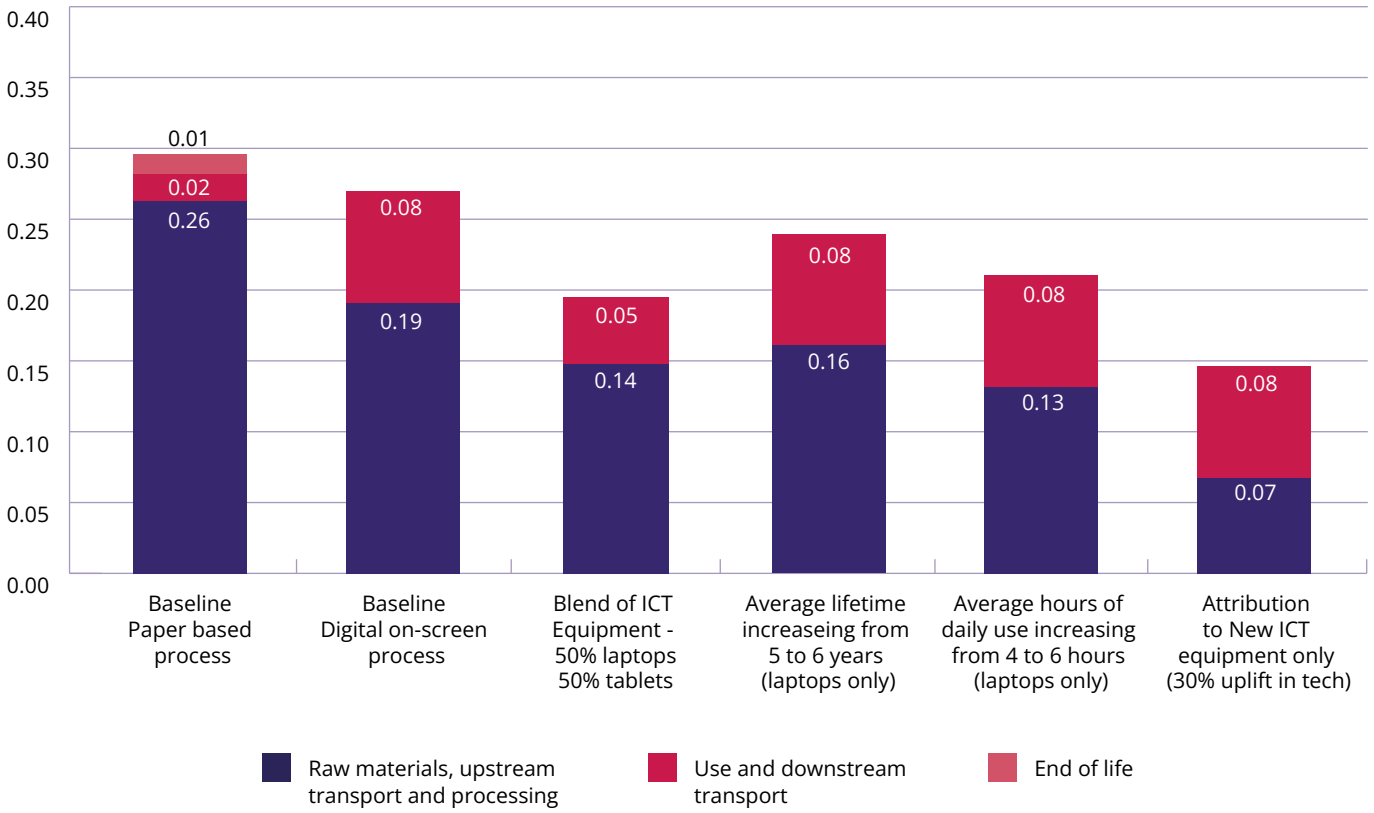
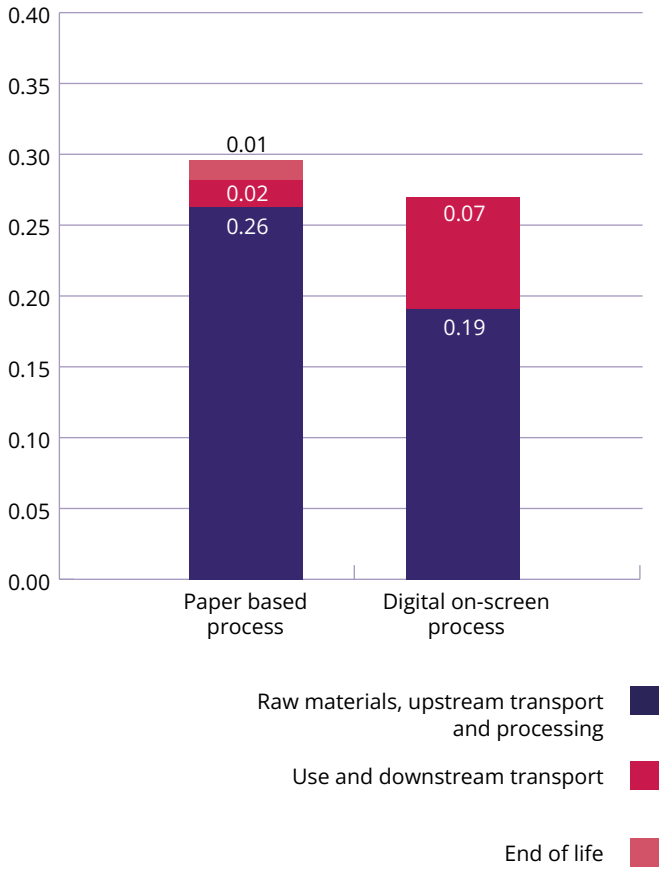


Figure 16: Carbon Impacts (kg CO_2e per process)



Digital exams improve the digital skills of students, and it's what they want

Requiring students to sit digital exams on electronic devices means they will need to develop their digital skills to effectively sit their exams. This would mean they are more equipped to be a part of our digitally connected world and bring assessment more in line with our digital society. There is an assumption that the new generation are 'digital natives' as they can use a smartphone. Yes, maybe they can screen-capture themselves playing video games while talking to their friends on Discord, or nail the latest TikTok dance, but that does not necessarily mean they are 'digitally fluent.' By bringing digital technology into examinations, we can develop the digital skills and knowledge of young people further.

In our survey of parents, respondents felt that young people lacked digital skills and should develop their them in greater depth, to help them prepare for adult life. Two-thirds (64%) felt that young people today are less skilled at typing on a computer than older generations, and nearly three-in-five (58%) felt that it was more important for students to practice digital skills (like typing and using a computer) than more traditional skills (like using a pen).

Young people aged 11-18 reported being more comfortable using a computer or electronic device for longer than if using a pen and paper. 63% of young people felt comfortable using a computer for longer than an hour, whereas only 36% felt comfortable using a pen and paper for longer than one hour. As many GCSE exams can last over an hour, and most students take several exams over their GCSE exam season, a move towards having exams more digitally delivered could mean students feel more comfortable taking them.

The advantages of digital over handwritten exams was also raised in our focus groups with teachers and senior leaders. Some respondents felt that their students found writing for extended periods difficult, or that students would be worried about their handwriting rather than focusing on giving the best answers they could. The following quotes illustrate these points.

Figure 18: Would you prefer to sit an exam using pen and paper, or on-screen digitally? - 11-18 year olds

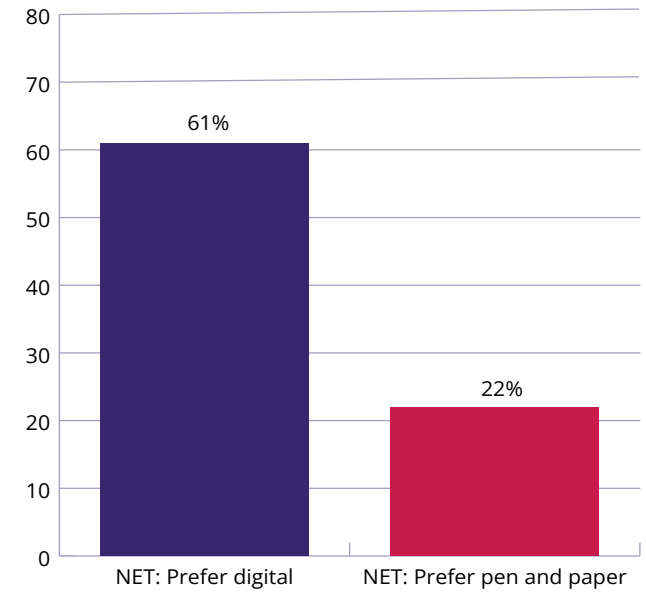


Figure 19: Comfortable using for longer 1 hour or longer Computers vs. Pen and Paper - 11-18 year olds

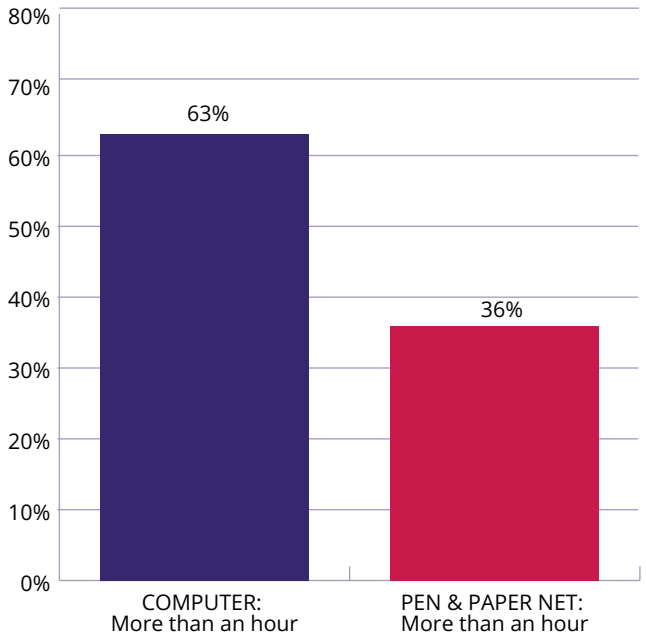


Figure 20: For how long do you feel comfortable typing on a computer - 11-18 year olds by socio-economic group

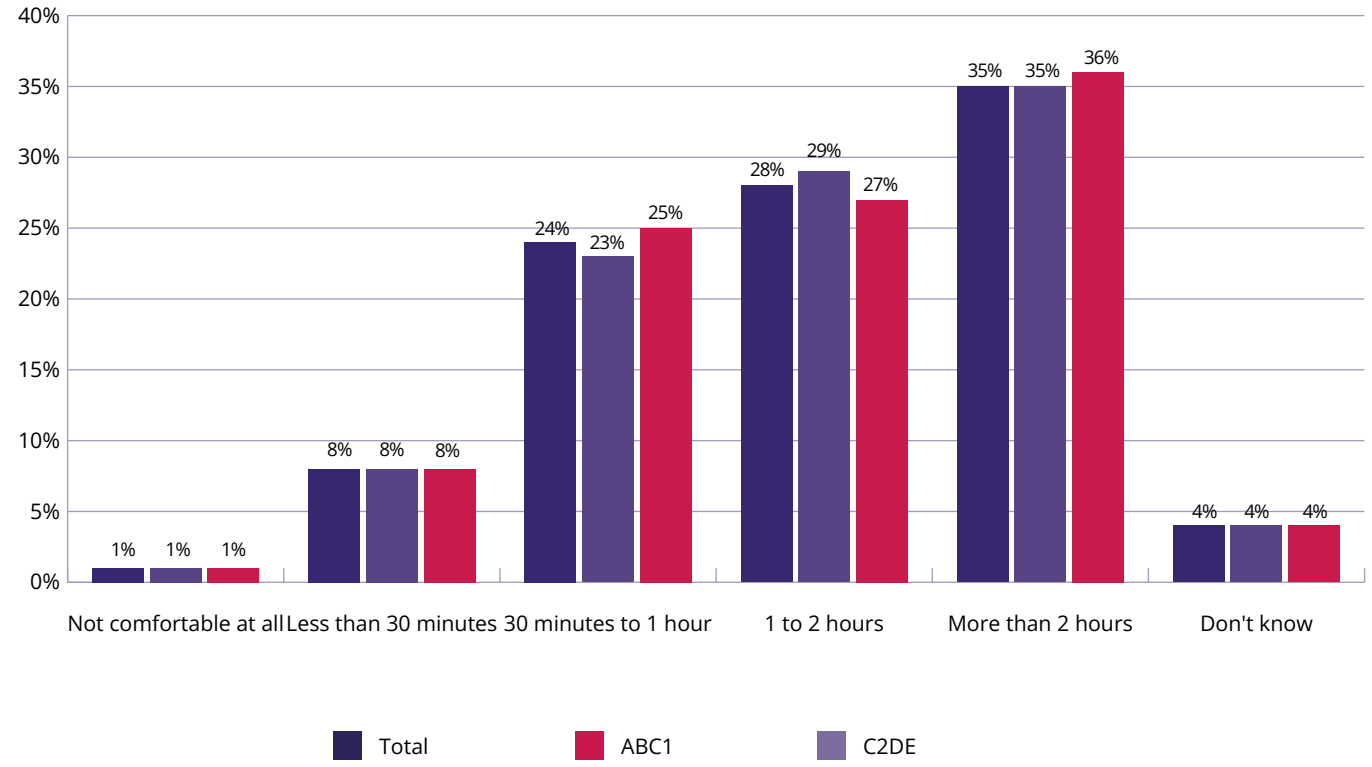


Figure 21: For how long do you feel comfortable typing on a computer - 11-18 year olds by socio-economic group

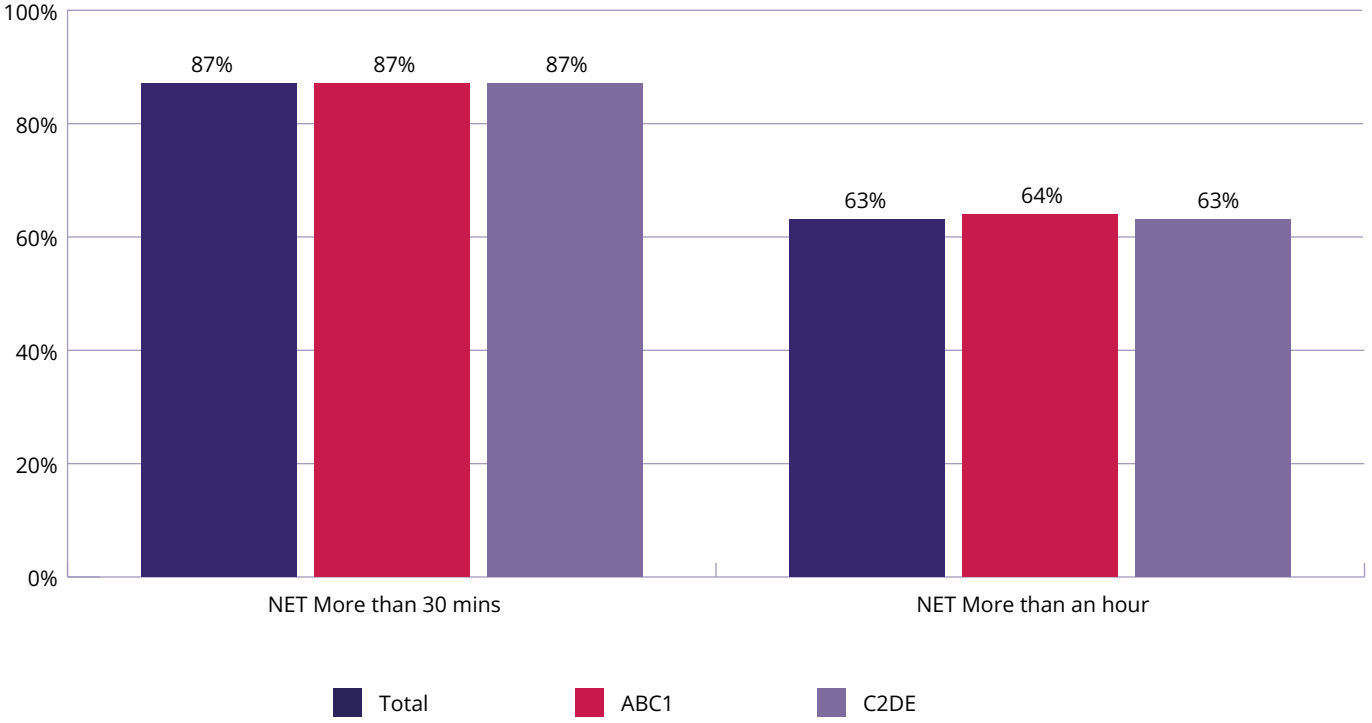


Figure 22: It is more important for students to practice digital skills fit for the present and future (like typing and using a computer) than more traditional skills (like using a pen) - Parents

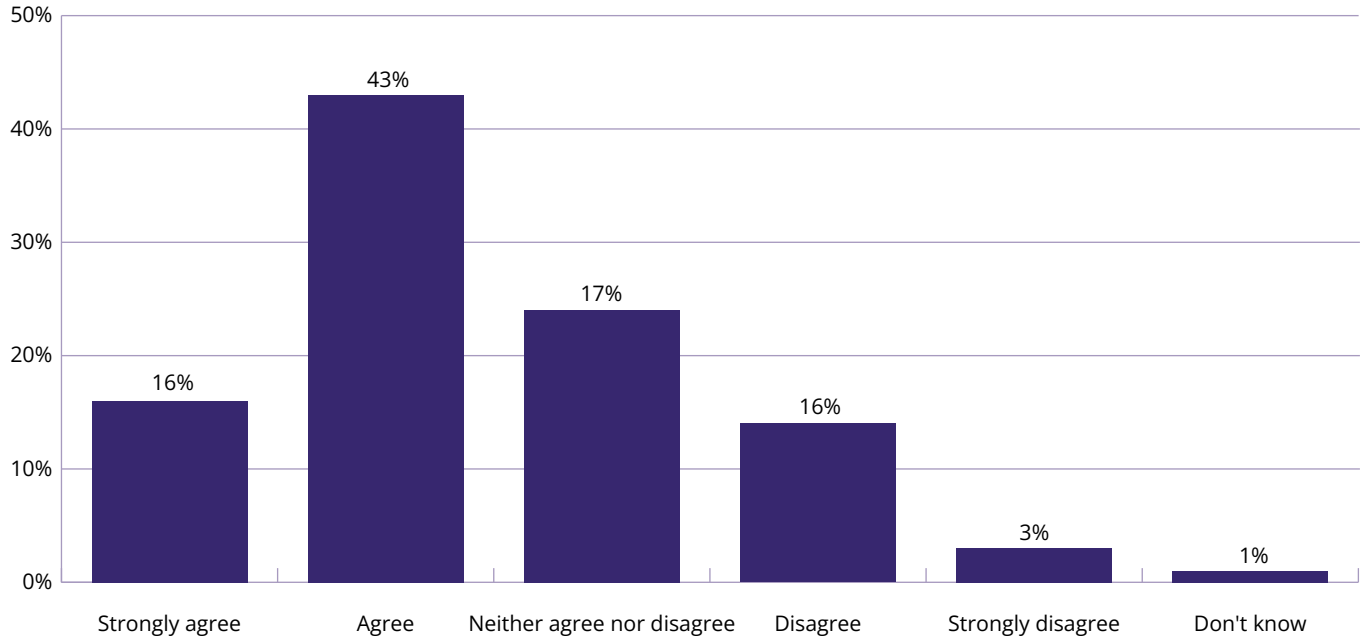


Figure 23: As smartphones have become more common, today's young people are less skilled at typing on a computer than the generation before them - Parents

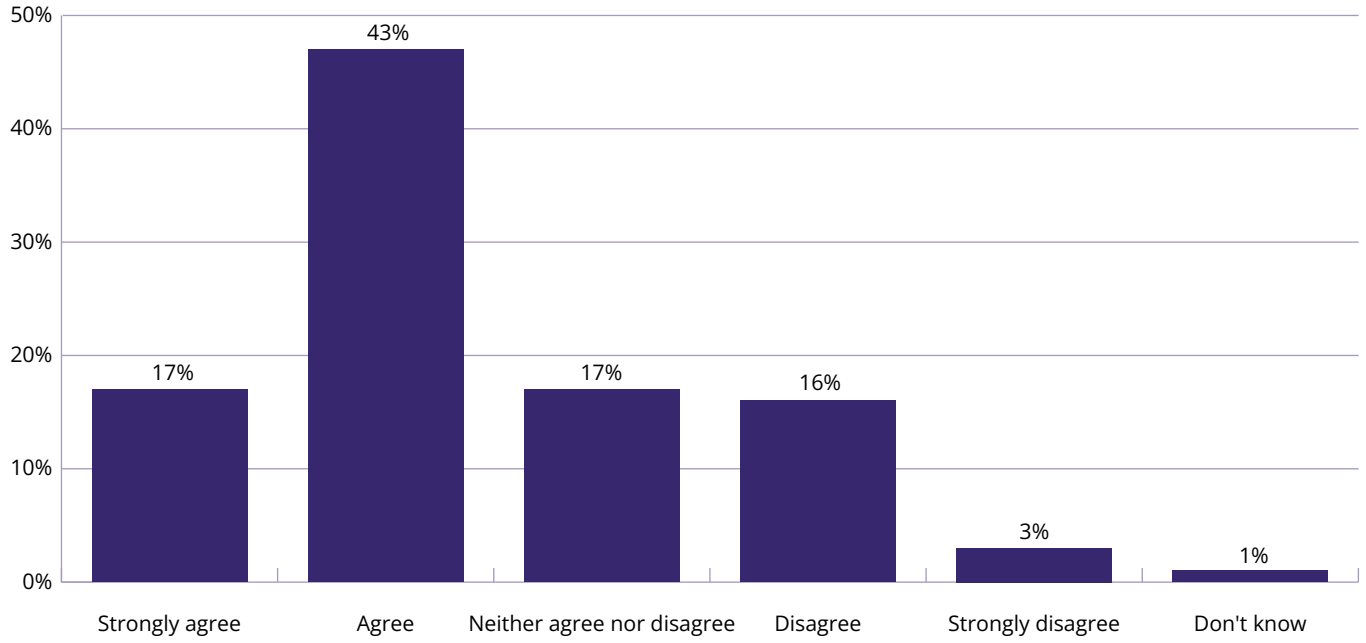


Figure 24: For how long do you feel comfortable typing on a computer? 11-18 year olds

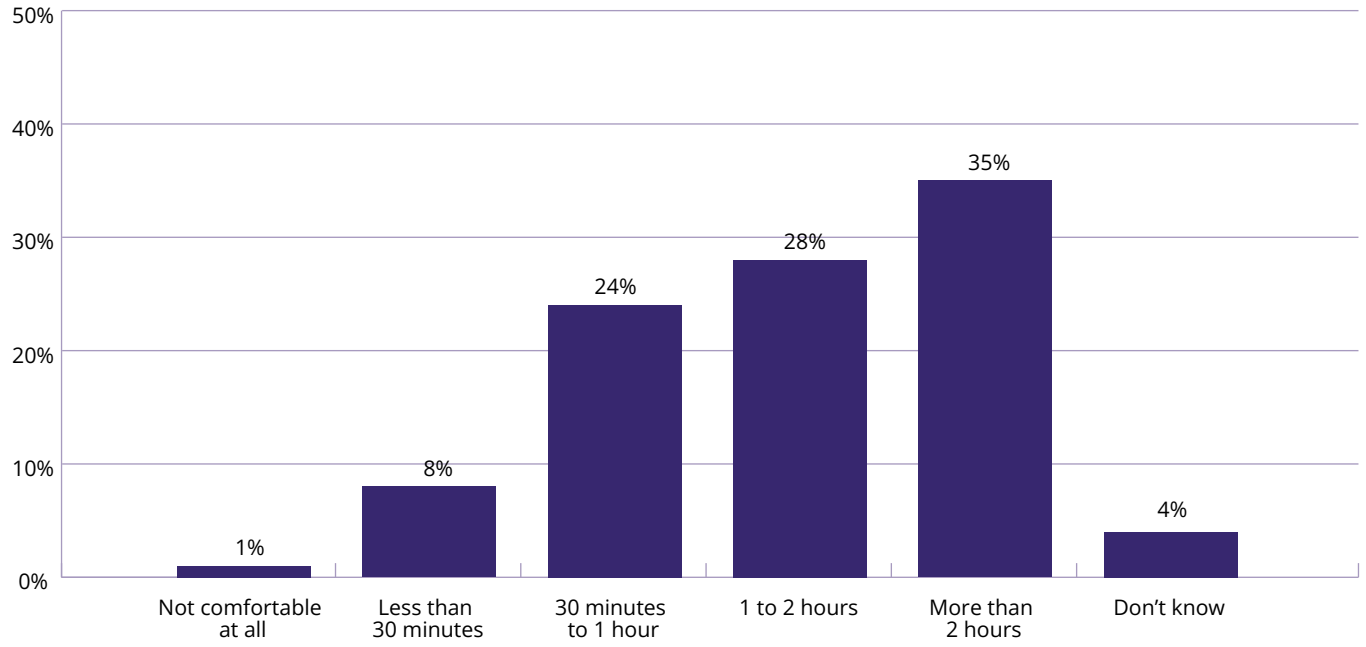
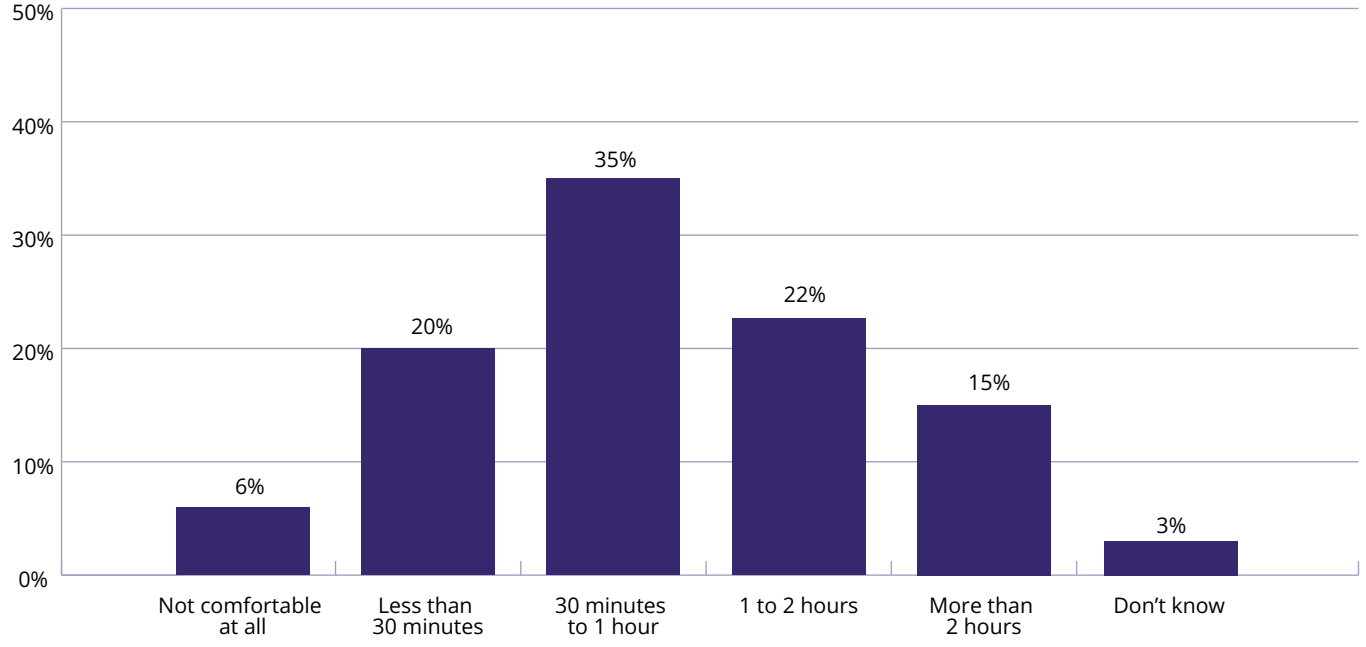


Figure 25: For how long do you feel comfortable writing with a pen and paper? 11-18 year olds



> "Students aren't used to writing for long periods, their wrists ache so this could help"
>
> – Citizenship teacher

> "Lots of students get a lot across with typing compared to writing"
>
> – Citizenship teacher

> "It takes handwriting out of the equation – some students spend so long trying to make sure their handwriting is neat. It wastes time"
>
> – Citizenship teacher

When examining comfort using a computer by socio-economic group, there was no substantial differences between socio-economic groups. When looking at which groups felt comfortable typing on a computer for over an hour, 64% of the higher social group (defined as being in ABC1 social grades) were comfortable, compared to 63% of the lower social group (C2DE).

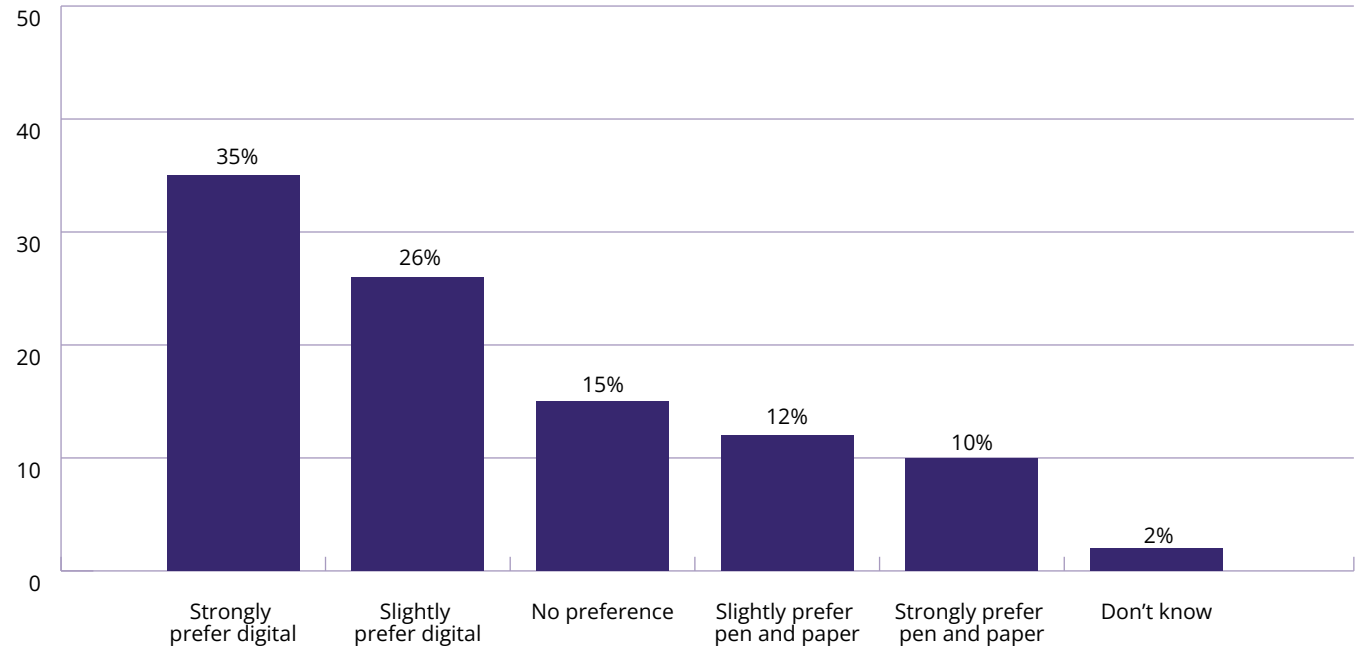
Indeed, when we asked young people whether they would prefer to sit a digital exam on a screen, or with a pen and paper, the clear majority (61%) expressed a preference for a digital exam.

Young people who had taken part in our pilots of on-screen digital examinations were positive about taking exams digitally. The following quote from one of our focus groups with young people is illustrative of this:

> "I feel like it's quicker to type my responses rather than write which gives me more time to develop more ideas."
>
> – Student who took part in AQA's pilots of on-screen digital exams.

Improved digital skills stemming from a move to digital exams is already happening in some areas. In Wales, for example, increased digital assessment has encouraged the use of digital technology in the classroom; this has enhanced learning, improved engagement, and stimulated reflective learning. In the United States, the

Figure 26: Would you prefer to sit an exam using pen and paper, or on-screen digitally? - 11-18 year olds



significant increase in funding for technological resources across the state of Massachusetts has improved levels of digital literacy for all students. At least 10 million dollars per year of state funding has been earmarked for increasing technological access in schools state-wide. While this uptick in funding was initiated by the transition to digital exams in the MCAS (Massachusetts Comprehensive Assessment System), funding is not solely used for MCAS purposes and is also used to drive innovation in teaching and learning more generally.

In Norway, the International Computer and Information Literacy Study (ICILS) has shown that digital literacy levels have improved for teachers and for students since implementation of educational reform focusing on use of technology in schools. Success in digital exams has generated a washback effect into classrooms where consistent, focused use of digital technology is increasingly common.

Moving to digital exams is a way of embedding digital skills in our education system in a lasting way. Young people are growing up in a digital world and the world of work has changed to mean that digital skills and knowledge are required as the norm in many places. Digital exams have the potential to bake in these skills, preparing our young people for the digital world in which they will live their adult lives.

Moving to digital exams is a way of embedding digital skills in our education system in a lasting way.

Longer-term benefits

The benefits of digital exams outlined above can be realised in a relatively short amount of time. Beyond the immediate benefits, there is a suite of longer-term benefits which can be realised through a move towards digital exams. These potential improvements are further into the future, and some would require wider changes to the way we currently run exams. We outline these now to show indications of what the future could hold.

These longer-term benefits are adaptive, flexible assessments tailored to the student; increased efficiency of assessment, with a reduction to teachers' workloads; and increased resilience. These longer-term benefits are examined in more detail in the following sections.

Adaptive, flexible assessments tailored to the student

Traditional assessments tend to be uniform for all students, with every student completing the same tasks and answering the same questions regardless of their prior knowledge, experiences, and confidence. In this way, they are unable to adapt to the knowledge and backgrounds of participants.

With the advent of fully digital assessments, adaptive assessments could come to the fore. A student sitting an adaptive digital assessment would find that a correctly answered question leads to the candidate answering a more complex question next and vice versa. While they are not suitable for all subjects, computerised adaptive testing can create a tailored experience for students.

This adaptive assessment – only possible through digital means – allows students to receive an accurate grade while answering questions that are not too challenging, or too easy, but to grapple with 'just right' questions. This has benefits for the student as they will move more swiftly through the assessment, rather than being frustrated with questions that are either too taxing for them, or not taxing enough.

"It could take away all the fear, anxiety, worry, not all of it but minimise it"

– Senior Leader

The current system of tiering faces many criticisms, with some arguing they unfairly disadvantage students and take up teacher time and resources. In 2019 - the last exam series unaffected by Covid-19[7] – just under 4,500 students were ungraded on higher tier combined science, out of a total entry of over 140,000; while this is a small fraction overall, it is a significant problem if you are one of those students. Grade restrictions on foundation and intermediate tiers mean that students' attainments are capped, with repercussions for their future trajectories. Tiering can also lead to inequalities in the curriculum – the foundation tier can offer a restricted curriculum and limit some students' learning. The other issue is how decisions are made about which students should be entered into which tier; this is a challenging task, which takes a lot of time and effort on the part of teachers and one which can be impacted by unconscious bias.

A move towards digital exams, with adaptive assessment practices, could help to address this problem with the current system, at least in part. With computerised adaptive testing, students would be able to answer questions at their own pace, with the exam adapting to their progress – answering a question correctly would prompt a more challenging question, an incorrect answer would be followed by a less demanding question. Attainment would be accurately measured quickly, removing the artificial ceiling from a lower-tier student so they can achieve higher marks and reducing the risk of a poor performance on a higher tier leading to an ungraded paper. This may sound like science fiction and there are potential issues with ensuring computer algorithms can command public confidence, but the example of adaptive assessments shows the potential of what is possible with a move towards digital exams.

Senior leaders who took part in focus groups recognised the potential benefits of adaptive assessment. For example, they raised that adaptive testing could offer a less stressful and fairer form of assessment to students of all, but especially lower, attainment levels.

> "It will eliminate the exam pressures. It might not feel quite so like an exam"
>
> – Senior Leader

> "It could take away all the fear, anxiety, worry, not all of it but minimise it"
>
> – Senior Leader

Traditional assessment practices often take discrete snapshots of performance on a particular day at a particular time. This has advantages for centres and the system as it provides a level of dependability and administrative consistency when assessing a whole cohort. It can, however, have downsides for the individual learner as they may have an off-day for a variety of reasons – they could be ill, have slept poorly, not eaten properly, or be suffering from seasonal allergies.

An increased use of adaptive assessments which are more tailored to the individual can also allow for flexibility in when students take their exam. Learners progress at different speeds and may not be ready to sit an important examination all at the same time. Higher attaining students who are confident and proficient may want to take the exam earlier, so they can proceed with further study, while lower attaining students may want to spend more time mastering the fundamentals before they sit their exam. Digital assessments hold the potential for offering on-demand assessments when the candidate is ready, so that students can sit them at the best time for them.

An assessment that is digital and on-demand could be accessed anywhere, mitigating the adverse effect of physical presence on achievement, unlike traditional pen and paper exams. There are still questions to be answered and practicalities to work out and we will be thinking carefully about how to make this beneficial and practical to implement.

7 Teacher assessed grades were used in 2020 and 2021, meaning that tiers were not used in the same way. In 2022 and 2023, while the exam series went ahead, different grade boundaries than usual were used to calculate grades, so data from these years make for difficult comparisons.

Increased efficiency and reduced teacher workloads

Digital exams have the potential to improve the efficiency of an exam series. Without the need to courier and scan physical exam scripts before sending them to markers, this could speed up the time between exams being sat and results being awarded. It would also mean a reduced need for secure storage space in schools and colleges.

Further, in the formative assessment space, digital assessment could help teachers use their time and resources better, particularly in data management and marking, moderating, and storing information. In the formative assessment arena, adaptive assessment can provide valuable insights to teachers about their students' progress. Students will answer questions at an appropriate level, without getting demotivated and distressed by questions which they struggle with; this in turn will flag where gaps are in students' knowledge and understanding. These new opportunities for adaptive testing enable sophisticated automated marking to be implemented, providing useful data for teachers. Teachers can use these insights to target interventions and teaching.

Digital assessments, used in the formative space, have tremendous potential to help reduce teacher workload. Students could sit assessments on digital devices which can then mark the work automatically and provide visualised data and insights. In the DfE's 'Working lives of teachers and leaders' survey, two-thirds of teachers (66%) reported that they spent over half of their working time on tasks other than teaching. Teachers reported that they spend too much time on data recording, inputting, and analysis (53%) and marking (46%).

Teachers and school leaders who took part in AQA's focus groups noted that digital exams would allow for easier feedback both for individual students and for whole-class cohorts, as it was quicker and more direct. The teachers also liked the ability to generate whole class reports from the digital pilot exams. The below quotes illustrate these views.

> "There might be benefits in marking. Short answers could easily be pre marked"
>
> – Philosophy teacher

> "[Digital exams would be] quicker, easier, alleviate marking, and save on recruitment"
>
> – Computer Science teacher

> "You get the stats, a quicker turnaround"
>
> – Citizenship teacher

With more digital formative assessment, including auto-marking of certain questions, students' progress can be tracked accurately and even offer insights into their approach to answering questions. Using digital assessments, various aspects can be monitored, such as students' completion time for each question. This item-level analysis might help to identify issues with question design, or where students are particularly struggling with a concept or knowledge. Across numerous different jurisdictions, teachers have reported that digital assessments and marking practices have reduced their workload and provided fresh insights. Digital exams and marking allow for prompt results, meaning that the administrative burden of marking, logging results and analysing data can be slashed. Moving to more digital assessments means that this workload could hopefully be reduced, meaning that teachers could focus on other tasks.

Computer-based assessment provides educational benefits such as timely feedback to inform future teaching and learning. In Wales, onscreen tests reduced teacher workload as they allowed for accurate automatic marking, removing this time-consuming task for teachers and providing results faster than with paper tests. Welsh students in Years 2 to 9 who take the personalised assessments in reading and numeracy are provided with instant feedback after their tests, allowing their teachers to target their support quickly. In Hong Kong, digital marking of scripts has allowed for more detailed analysis of candidates' performance, at greater speed and efficiency. This enables students to receive their marks faster, and for teachers it has allowed prompt data on trends among their students.

Improved resilience

We are all well-aware of the disruptions to exam seasons caused by the Covid pandemic. In England, we rapidly moved to a system of teacher assessed grades which had significant drawbacks and will have impacts for years to come on university places, training course entrants, and employment. Moving to a more digital exam system could offer greater resilience to shocks.

Digital exams may allow for a choice in approach, format, and timing of assessment for students in future. Students would be able to access assessments at a time and place of their own choosing, with fewer constraints due to time or location. Rather than having the exam schedule dictated by organisational requirements, students would be able to sit their exams when they were ready and reschedule with minimal fuss if there are problems or disruptions.

Digital exams also offer improved security, though they also introduce different types of security challenge. With everything being stored securely and digitally in one place, there are no papers to transport, reducing the likelihood of losing exam papers. Electronic examinations reduce, and in many cases completely remove, the need for paper handling and as a result can be more secure. Digital exams can help flag up plagiarism cases more easily, as is often done in university essay submissions.

Obviously, digital systems are vulnerable to hacking attempts in a way that physical systems are not. Also, there is the need for robust and secure IT infrastructure to ensure stability and reliability. We are acutely aware of these issues and are working to build high levels of digital security and mitigate against disruptions. These are issues that all organisations and wider society are grappling with, and improvements to security are being developed continuously. With strong mitigations in place, the potential for a more secure digital exam system is a real potential benefit.

Indeed, in Hong Kong – which moved towards digital exams and marking from 2007 – there have been substantial increases to security, efficiency, and accuracy in marking of exams. Digital marking was found to improve the secure storage of scripts and helped to reduce manual errors in marking, cataloguing and calculation of grades.

Electronic examinations reduce, and in many cases completely remove, the need for paper handling and as a result are usually far more efficient

Implementation Considerations and Mitigations

There are substantial benefits to moving to digital exams, as have been outlined above, but we are acutely aware there are practical implementation issues to consider. We want to ensure that this move to digital is a success and that we successfully mitigate risks and implement digital exams in a sensible, pragmatic way. Of course, any change in the education system needs to be done in collaboration with schools, colleges, and other centres.

There are many practical considerations that will need to be addressed, but there are reasons to be optimistic. We can learn from other jurisdictions which have made the move to digital exams, building on their successes, and learning from the issues they faced. We should also be clear that digital exams are already here, in England, now. Digital assessment are widely used in professional and vocational qualifications. One component of A-level Computer Science has already been moved to be digitally assessed by AQA successfully. Indeed, a survey of current A-level Computer Science teachers found that over two-thirds said that delivering digital exams for A-level Computer Science has not been difficult or challenging and that they were confident in the feasibility of introducing digital exams for smaller, optional GCSEs (86%); although the figure was lower for larger optional (28%) or compulsory subjects (18%). At A-level, sentiment towards introducing more digital on-screen exams was also positive, with just under two-thirds agreeing or strongly agreeing that it was feasible (65%) for A-levels other than Computer Science; only 19% disagreed.

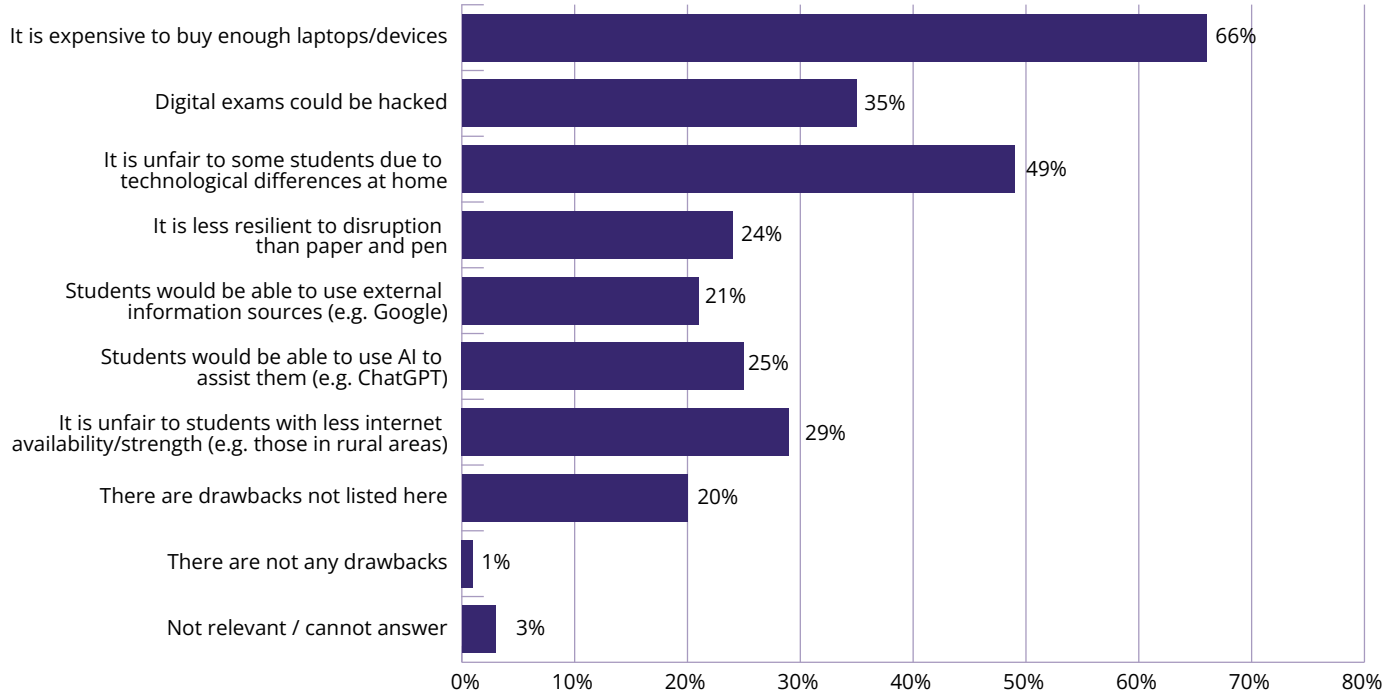
AQA's researchers have analysed feedback from teachers and students around the challenges of moving to digital exams and this is informing our approach to implementing digital exams and the mitigations we will be putting in place. There are legitimate concerns about moving towards digital exams, which must be engaged with and mitigated against.

Equity

One of the greatest concerns is to ensure digital exams are not disadvantaging any group. As mentioned above, respondents to our surveys felt that digital exams could be beneficial to those students with SEND and additional needs, but concerns were also raised about how disadvantaged students may be negatively impacted. In our survey of teachers, we asked them what they thought the three biggest drawbacks of digital exams could be, around half (49%) of teachers felt that digital exams could be unfair to some students because of differences in access to technology in the home; among teachers in schools in the most deprived areas, this increased to more than half (55%). Notably, however, it was not their largest concern, which was the cost of technology (66%).

In our interviews with SENCOs, there was also awareness that meeting the needs of all learners is a difficult task. While accessibility can be increased for many learners by introducing digital modes of assessment, this may not be universal, and we need to be mindful of that.

Figure 27: Which three of the following do you see as the biggest drawback to on-screen exams? - Teachers



> "I think the problem with it is it's trying to produce something that is suitable for everybody, but the problem with special education needs is they're so individualised that it can be really difficult."
>
> Interview F - SENCO

In the USA, the introduction of on screen exams in 2017 resulted in state-wide statistical analyses being conducted to analyse potential mode effects which may result in inequitable outcomes for different groups of students. Current findings suggest that:

- Students with certain demographic characteristics (e.g. low socio-economic status, ethnicity, gender, geographical location) were identified as being more negatively impacted by digital exams than other students.
- Consequently, statistical modelling has been introduced in Massachusetts to explore the relationship between mode effect and demographic characteristics.
- These intersectional factors continue to be carefully monitored and research is ongoing, particularly due to the disruption in data collection caused by the pandemic.

These concerns that a move to digital exams could lead to some groups being advantaged and others disadvantaged are a genuine issue to consider. The attainment gap stems from a multiplicity of factors and it is difficult to isolate the impact of digital exams alone on any changes in the attainment gap. Further research is required to determine how digital exams may impact the attainment gap, and AQA will be monitoring international developments to learn lessons from other jurisdictions.

There are clear potential benefits to moving towards digital exams, but we are mindful of the potential difficulties some students could have with increasing use of technology. From the very first principles, accessibility needs to be a key point in the development of digital exams. We are working hard to ensure that digital exams will not disadvantage any group unfairly, and we are confident our implementation will be effective in this regard.

In Israel, digitalisation has helped improve digital literacy amongst traditionally deprived areas, as well as allowing less well-resourced schools better access to advanced technology. Further, digital assessment has allowed the use of technology which benefit for SEND students (e.g., video signing of questions).

In Scotland, the introduction of Digital Question Papers allowed for greater inclusivity in assessment. Students who sit DPQs can have the paper tailored to their needs, and can complete their exams independently, without a scribe, an interlocutor or having to be in a separate enclosed space.

In England, we already allow for digital accommodations for students with additional needs. The use of laptops and e-readers are already in English exam halls for students with specific SEND, a move to digital assessment for all could allow for greater inclusion for students who would benefit from additional technology.

Providing sufficient training for the education sector will be crucial to ensuring that digital exams do not disadvantage students. Our research has shown that while digital exams have tremendous potential for improving accessibility, we need to have a level of caution to ensure this is a success and that access arrangements can be mapped onto a new digital medium. As England's largest exam board, we are acutely aware of our role in exams and qualifications and will work to ensure that students and teachers are well-supported throughout the move towards digital exams. We are also committed to moving towards digital exams in a collaborative, evolutionary way, working with the education system.

However, we must also recognise that the current exam system already has a disadvantage gap and exams often simply reflect the wider world of advantage and disadvantage. Currently, students have various levels of confidence and competence with pen and pencil. Some students are better at writing quickly, some people write pages and pages in an essay, and some write half a page. In this way, concerns about the digital divide are not a new consideration. This is not to disregard the importance of disadvantage. AQA is researching the mode effects of different forms of assessment, to ensure that our move to digital exams will be done in the fairest possible way.

"I think the problem with it is it's trying to produce something that is suitable for everybody, but the problem with special education needs is they're so individualised that it can be really difficult."

Interview F - SENCO

Cost

One of the clearest issues to overcome for digital exams to be a success is the digital infrastructure required to make it work, and the capital investment in digital devices required. Without digital devices, digital exams cannot take place. Responses to our polling questions were clear that teachers feel a strong need for sufficient digital devices in schools to run digital on-screen exams. When we asked teachers to choose their top three responses to the question "What would you need to change in your school to ensure students are ready for on-screen exams?" the top response was about sufficient technological devices (79%), followed by typing training for pupils (60%). Interestingly from this survey, only a minority of teachers responded that they wanted training for themselves (21%) or their colleagues (25%).

Our research has highlighted that preparation is key for a successful transition to digital exams, and that this should involve developing keyboard skills. For many students, the speed and the legibility of typing responses can be an advantage, but those with lower levels of laptop use or access in the home can be less confident at using a keyboard. We will be using this research and our polling results to inform the development of our digital exam programme, to ensure it is successful.

We are acutely aware of the digital divide in access to technology in the home, and it is something we are considering when we move to digital exams. We asked teachers in our polling about how many of their students lacked internet-connected devices at home. In their responses, a sizable number of teachers felt some of their students lacked technology at home. While an overall two-thirds (67%) of teachers thought that 5 or less students did not have access to devices at home, there were significant differences depending on whether the teachers taught in a school in an affluent or deprived area. Of those who taught in the most deprived schools, 5% thought more than half of their students did not have access to devices at home. These results were replicated in our other surveys as well, almost half of young people we surveyed (48%) believed that digital on-screen exams could be unfair to some students due to technological differences at home.

Figure 28: Which of the following electronic devices, if any, do you own and/or use at home? - 11-18 year olds

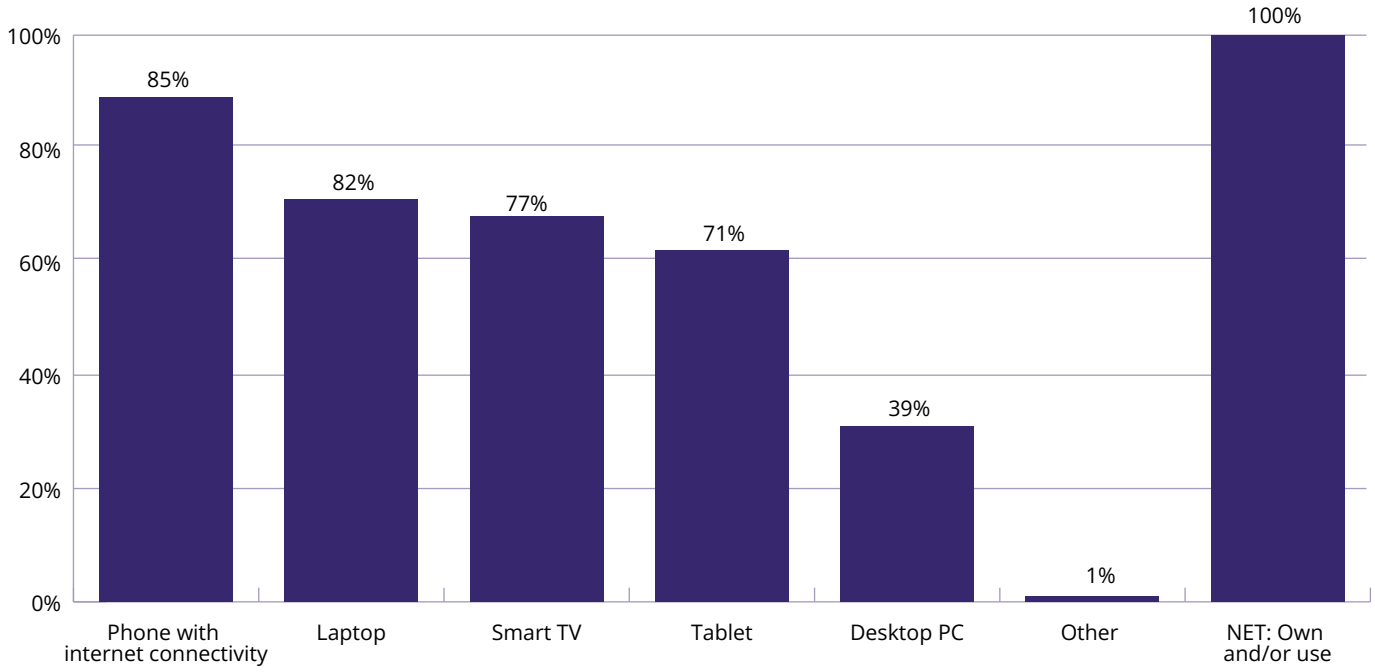


Figure 29: What would you need to change in your school to ensure students are ready for on-screen exams? - Teachers

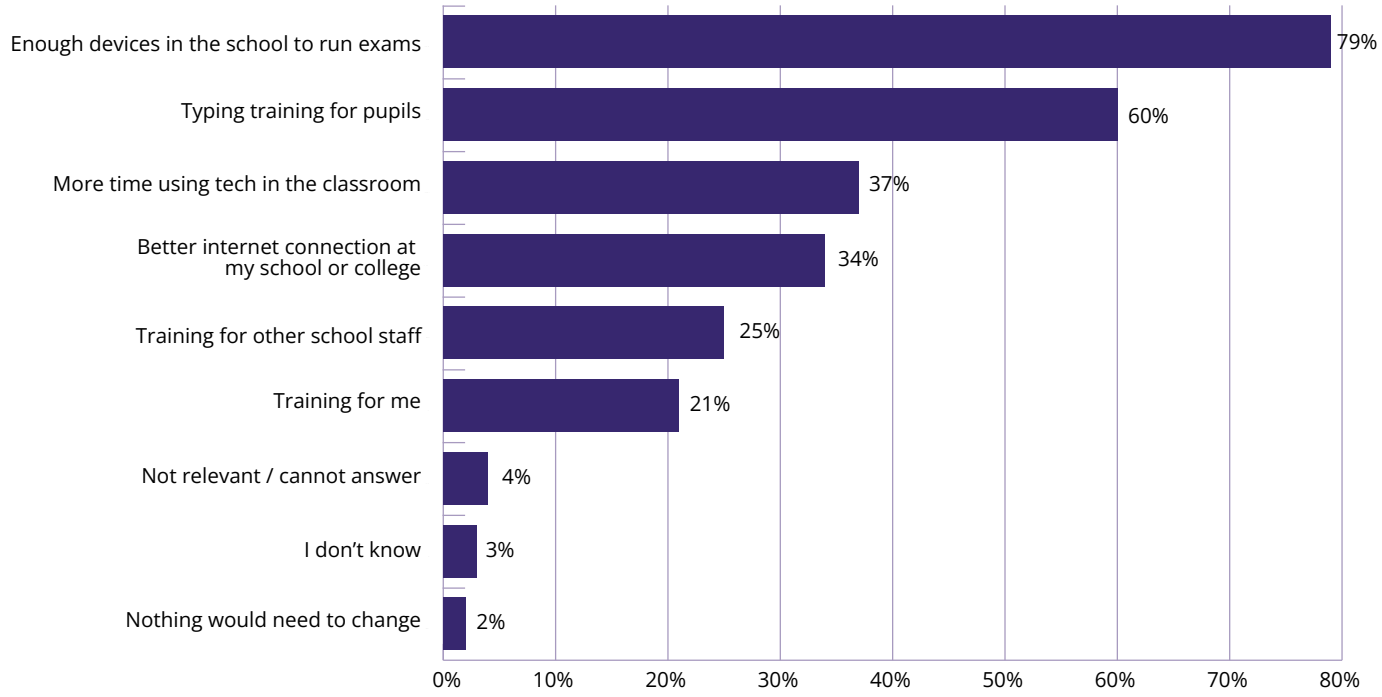
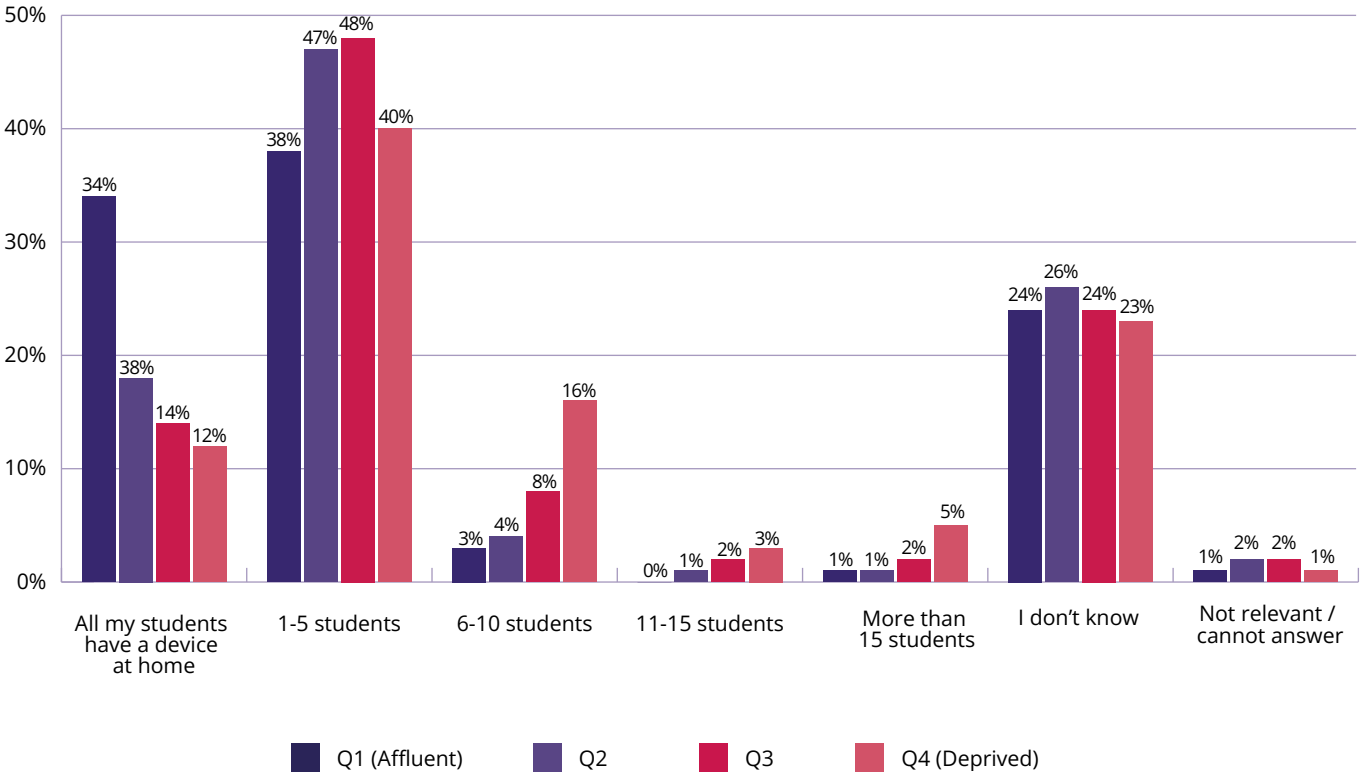


Figure 30: Thinking of the last class you taught, approximately how many students DO NOT have access to an internet-connected device at home? - Teachers



In our survey of young people, all respondents (100%) reported that they had some kind of electronic device at home. Similarly, Ofcom's Children and Parents: Media Use and Attitudes found that the overwhelming majority of homes with children aged 0-18 (97%) had access to the internet in 2022, significantly higher than the average for all households (93%).

This apparent discrepancy is interesting. It may be down to the methodology of our polling and Ofqual's survey which were both conducted online-only. It is also possible that teachers may under-estimate the digital devices students have in their homes. We cannot comment further from the data we currently have available but will be exploring this in more detail as we progress our work towards digital exams.

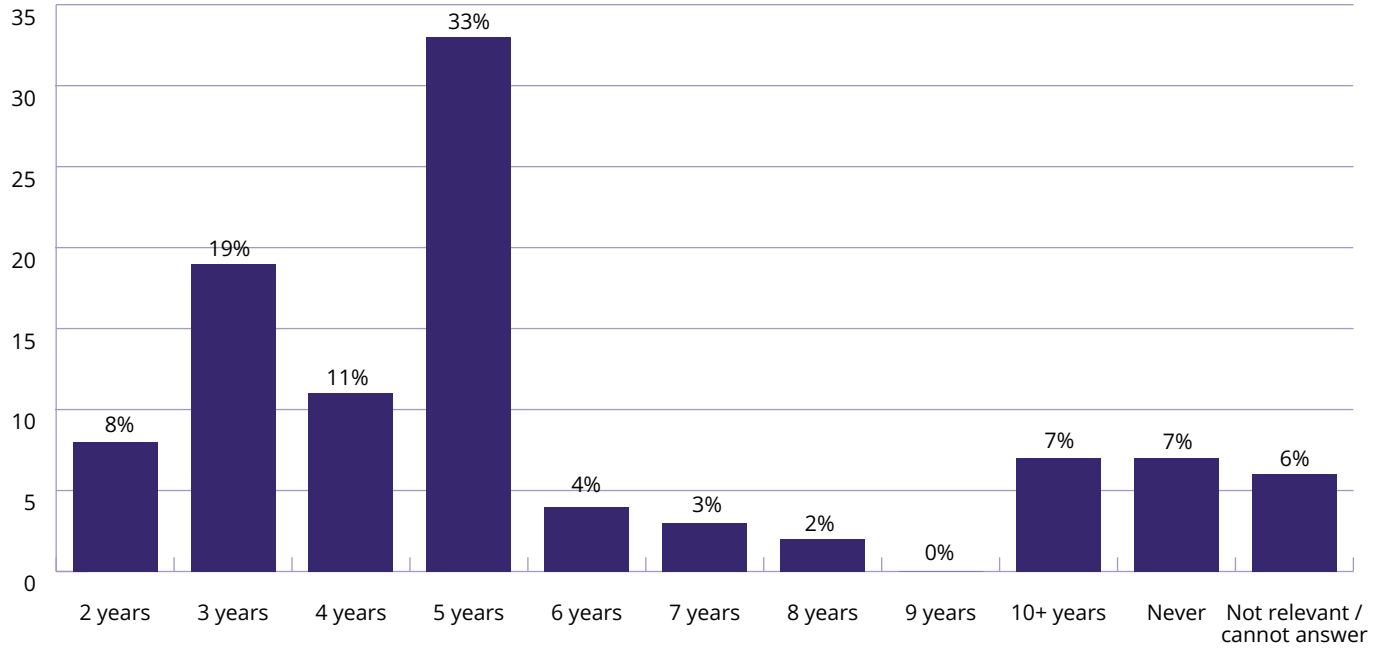
In our pilots into on-screen digital exams, students were also acutely aware of potential inequalities stemming from different facilities and digital access in schools and at home. We are mindful of this issue, which is why AQA is taking an evidence-based approach to digital exams, working in an evolutionary manner with the education system. We will engage teachers on what support could be most helpful, to ensure that the implementation of digital exams is as smooth as possible.

Preparation

Another consideration is the need for adequate lead-in time so that schools, colleges, centres, and learners can prepare for digital exams. We want digital exams to be a success and to benefit learners and teachers for the reasons outlined in earlier sections of this report. AQA is committed to moving gradually towards more digital exams, in a measured, evidence-based manner. This is the reason for announcing our intention now, ahead of a period of engagement with key stakeholders across the education sector.

We are not assuming that students will seamlessly transition from paper-based to digital assessments. Overall, students and teachers who took part in our pilots of on-screen digital exams were positive about the pilot experience, which is good news. Some students, however, reported having difficulties when faced with the unfamiliar layout of a digital exam paper; this could be a very disconcerting experience in a high stakes exam setting, which is why we are taking this measured approach and learning from the experience. We want candidates to focus on giving the best answer they can, rather than being perplexed by the question. Students in our digital exam pilots agreed that the transition from paper-based to digital exams is necessary and were enthusiastic about some of the potential benefits that digital exams can have. We are pleased and positive about this but remain conscious that there must be time to prepare.

Figure 31: What would you consider a sensible lead time for the introduction of the first digital examinations at GCSE or A level? - Teachers

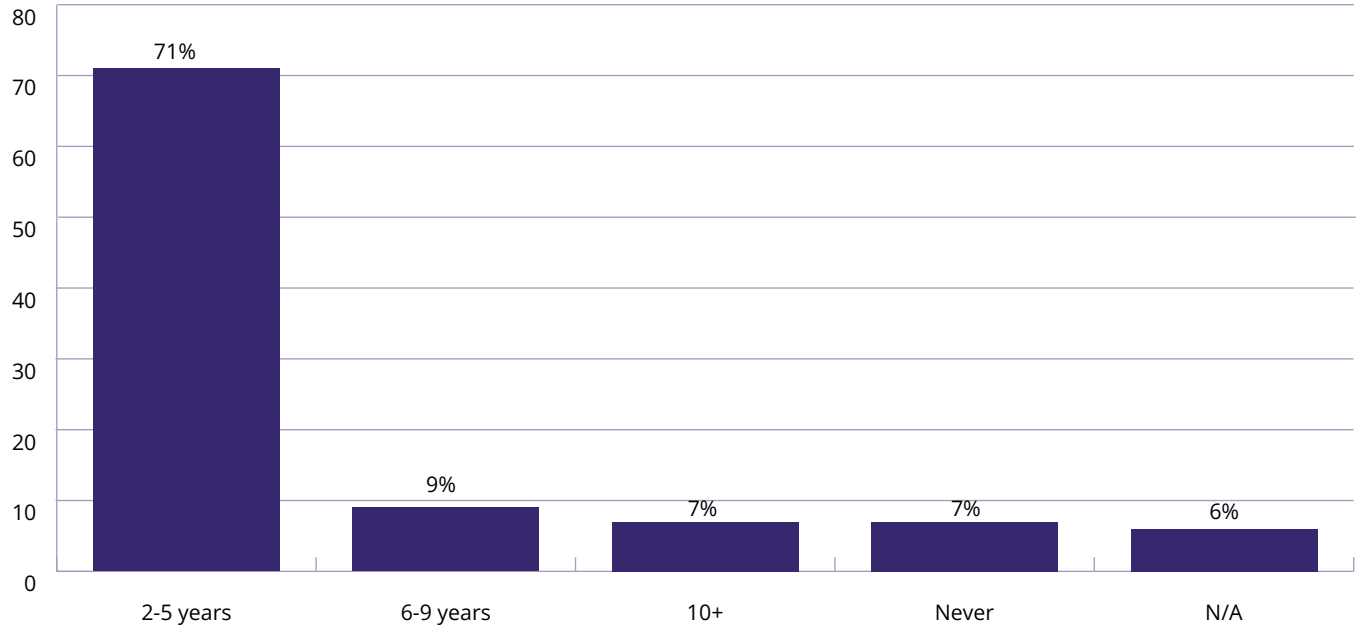


In our polling, we asked teachers and school leaders what sort of lead in time they thought would be sensible, to gain an understanding of what sort of timeframe we should begin moving to more digital exams. The most popular timescale chosen by teachers and school leaders was five years (33%) for a suitable timeframe for implementation, with many suggesting a shorter timeframe. Grouping the responses, over 71% of teachers and school leaders felt that 2-5 years would be a suitable timeframe, with only 16% thinking a longer timeframe would be suitable, and only a small minority (7%) responding that they thought it should never happen. These findings are informing AQA's approach as we think of how best to make a move towards digital exams, and we will continue engaging with the sector as we develop our plans.

Evidence from New Zealand shows that making digital exams a success is linked to several factors: a gradual approach to implementation; support for students; as well as increased use of digital learning systems in the classroom. Disruptions in Norway's 2023 exam series demonstrate the need for strong and resilient digital infrastructure, which is why we will be taking a gradual, iterative approach to rolling out digital exams, starting slowly and learning each time we bring a new component into the digital era. We are monitoring how other jurisdictions are handling their transitions to digital exams, to learn from their experiences.

We want to ensure sufficient familiarisation time with any new form of exam, so students are all able to access and make the best use of their knowledge and skills through digital exams.

Figure 32: What would you consider a sensible lead time for the introduction of the first digital examinations at GCSE or A level? - Teachers



Conclusion

Now is the right time to begin moving towards digital exams in England. We owe it to the students of today to prepare them for tomorrow in the best way possible.

The current system of exams has been around for more than a century and we are doing a disservice to young people if we do not move our exam system to be more in line with the increasingly digital world young people are growing up in. Technological change has always played a part in our world, and moving to digital exams is the next step in the evolution of our education system.

The potential for digital tools to improve our exam system is clear. As we have set out in this report, digital exams have the potential to provide assessments that are more suited to the modern candidates' needs, to use novel assessment techniques to engage learners, be more sustainable, and be more tailored to individual learners. Ultimately, they are what young people say they want. These benefits are already being realised in other jurisdictions which have moved to a more digital examination system, and we at AQA are excited to begin moving towards digital exams here in England. We will be learning from other countries' good examples and improving where they could have done better to make a success of digital exams here in England.

This is why AQA is excited to make the first steps towards a more digital exam system, announcing our proposals that the first components to move to digital exams for mocks in 2025 and exams in 2026 will be:

- GCSE Italian, Reading and Listening
- GCSE Polish, Reading and Listening

AQA is also aiming to continue introducing further components in other subjects at GCSE and A-level. Our ambition is to implement a digital exam component in a major subject by 2030.

We want to reassure the sector that we will be moving forward in a measured, sensible way and that we will provide teachers and candidates with as much detail as we can as early as we can. Throughout implementation, we will be working with teachers, schools, colleges, and centres, to support them through this change.

This report explored the benefits of digital exams and announced our high-level plans for moving to digital exams. We will be beginning an intense period of engagement to gather insights and feedback from across the education sector to inform our work going forward. Following this period of engagement, we will announce more detailed proposals in 2024 around which further

subjects will begin moving to digital exams and when the change will take place.

All AQA's work is underpinned by our expert assessment researchers who study new developments in assessment and identify potential challenges for teachers and students. This is why we are setting out the benefits of a fully digital exam system now, to make the case for why this move is important and necessary. The approach AQA is taking is an open, honest, and collaborative dialogue with the sector. We are excited for the next steps and the benefits of a digital exam system, and look forward to continuing in an open, honest, and collaborative manner throughout the whole process.

Moving to a fully digital exam system is right for students and right for the education system. As the nation's leading exam board, we are acutely aware of the immense responsibility that comes with making digital exams a success for the candidates, their teachers, and the education system. We look forward to taking the next step in evolving our examination system and will be working closely teachers and students to make it a success.

The future of digital exams is bright. And the future of digital exams is here.

Appendix A: Detail of carbon analysis conducted by Blue Marble

AQA commissioned Blue Marble to undertake an initial life cycle analysis of exams in both traditional pen and paper mode and in a new digital mode.

For the paper-based process the raw material inputs comprise the examination paper, plastic inner packaging, cardboard outer packaging. These paper exams then need transporting to the exam centre, and then returning to AQA's scanning facility; this is usually done through secure couriers, using vans and lorries on roads. After the scripts have been scanned and stored for eight months, they are destroyed. All these elements consume energy, with associated carbon emissions. In the table below, energy consumption from scanning is accounted for on the basis of scanner power consumption and throughput. Transportation between AQA offices and warehousing facilities are accounted for. Energy consumption from physical storage is accounted for on the basis of allocation of electricity consumption of the warehouse to the completed scripts. Digital storage is accounted for on the basis of cloud storage of a digital file for twelve-months

For digital exams, the process is more complicated as certain assumptions need to be made about the energy usage of the digital device (full details of the assumptions can be found in the appendix). For our analysis, we assumed the laptop is used for a total of 4 hours during the examination event. The examination event lasts for four hours which are allocated to the laptop based on 4 hours over a 3900-hour reference service life. It was assumed that a typical laptop computer owned by an examination centre is in use for four hours per day during term time only (195 days per year), and that it is used for five (5) years before being replaced and disposed of, this equates to 3900 hours of use (the reference service life). It is important to note that this study assumes that no additional ICT equipment is required to be purchased to run examination events and that centres have access to equipment necessary to run examination events for 131 candidates concurrently. Access to ICT equipment is one of the major barriers to adoption of digital on-screen exams, however, lack of complete data on current levels of access to ICT equipment meant that its availability has been assumed for the purpose of this assessment.

From analysing all the different steps involved in the delivery of paper-based exams and comparing them to digital exams, an estimated carbon impact of the paper-based process and a digital exam is calculated. There is an estimated reduction of 9% carbon emissions overall per exam by moving from paper to digital. As ICT equipment can be used many times to sit different exams, this figure is substantial when considered over an exam season as the average student takes around eight GCSEs, with many courses requiring multiple exams. Over the average lifespan of an ICT device , this reduction could compound into a considerable difference.

In the digital process assessment, only laptops were considered as attributable ICT equipment. However, the eventual ICT equipment used may be a blend of technologies. A scenario was considered where the ICT equipment comprises 50% laptops and 50% tablets. It should be noted

that the operational use phase was also changed to reflect the lower power consumption of most tablets, in this case the model used was an Apple iPad (12W). All other variables, years of use etc. remain the same.

The largest impact for the digital process is the ICT Equipment attributed to the examination event in the Raw Materials stage (65%). The second largest impact for the digital process is the operation of the laptop during the examination event (29%). The downloading of software and storage of digital files has a minor impact (5% and >0.01% respectively). The largest impact from the paper-based process is comes from the paper production, transport & printing for the examination papers (73%). The plastic inner packaging contributes 12% to the overall carbon impacts in the paper-based process.

To test the effects of different parameters on the carbon output of digital exams, difference scenarios were modelled. For one, a scenario was created whereby the lifetime use of laptops was increased from 5 to 6 years.

While most Centres operate term-time only (195 days per year), it is not known for how many hours per day laptops are typically used. Therefore, a scenario was created increasing the assumed daily hours of use from 4 to 6 hours on the basis that the average school day is at least 6.5 hours.

A further model assumed that Centres would require a 30% uplift in technology to allow 131 students to sit exams in parallel. The 30% uplift would require 30% more new ICT equipment to be purchased. In this scenario, the current ICT equipment used by Centres (70%) is assumed to be accounted for as attributable to regular daily use only, and only the 30% uplift attributable to the digital exam process, it is also assumed that the 30% uplift is also subject to regular daily use at the current rate.

The limitations of this analysis and caveats must be noted and a table of inclusions and exclusions is provided at the end of this report in the next appendix. The analysis is not a full life cycle assessment to ISO standards and is not peer reviewed so all claims made below are indicative and should be treated as indicative at most. Much more information and data on digital exams is required to make more meaningful judgements on overall impacts but the information provided below provides a useful and informative illustration of the potential sustainability benefits that digital exams can provide.

Appendix B: Summary of Inclusions and Exclusions in the Life Cycle Analysis of paper-based exams and digital exams

Lifecycle Stage	Inclusions	Exclusions
Materials	Extraction, production, and delivery of raw materials. ICT equipment used in the on-screen process. Transportation of raw materials.	Software development activities (examination software is considered a capital good). Activities associated with development of questions (internal AQA meetings etc.) - considered to be equivalent for both paper-based and on-screen processes.
Processing	Processing of plastics. Printing of papers.	Physical infrastructure requirements for capital goods (factories, machinery, transportation equipment, etc.)
Transport	Shipping (by road) the examination papers + packaging.	Upkeep of roads and ports involved in the transportation of products. Transport of AQA employees and staff to and from work.
Use	Electricity required for operation of ICT equipment during an examination event. Electricity required for digitization (scanning) of physical papers. Digital storage (via data centres)	Examination re-sits. Examination awarding and certification. Script marking on-screen.
End of Life	Municipal waste disposal of recyclable and non-recyclable materials.	Process outputs from recycling of components. Avoided impacts from the provision of recyclates

For any further information please contact us at:

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