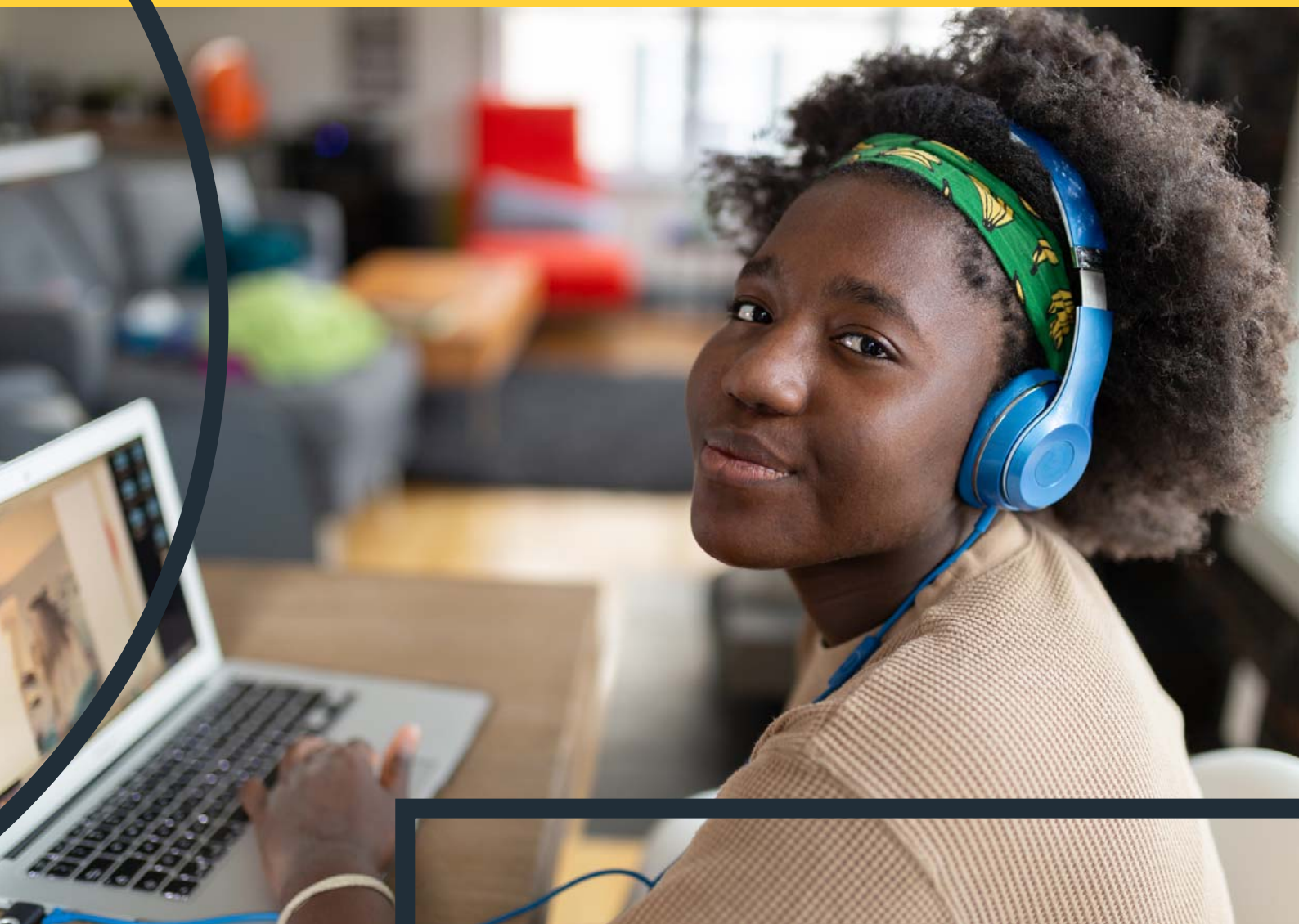
Nuffield Foundation

Report focus
Report from an independent evaluation of Nuffield Future Researchers, undertaken by CFE Research.

Authors
Lindsey Bowes
Sarah Tazzyman
Alex Stutz
Guy Birkin

Evaluation of Nuffield Future Researchers



About this report

In 2020, the Nuffield Foundation adapted Nuffield Research Placements in response to COVID-19. An alternative offer - Nuffield Future Researchers – was developed which comprised a series of online modules designed to develop students' professional, research, analytical and reporting skills. CFE Research was commissioned to undertake an independent evaluation of the new delivery model. The evaluation assessed how effectively Nuffield Future Researchers achieved its objectives through consultation with students, supervisors and co-ordinators. This report identifies aspects of the programme that worked well and areas for improvement as well as scope to integrate elements of the online delivery model into Nuffield Research Placements in the future.

Authors

Lindsey Bowes, Research Director; Dr Sarah Tazzyman, Associate Director; Alex Stutz, Research Manager and Dr Guy Birkin, Senior Research Executive, CFE Research.

Established since 1997, CFE Research is an independent not-for-profit company specialising in research and evaluation in the fields of education, well-being and the economy.

Recommended citation

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About the Nuffield Foundation

The Nuffield Foundation is an independent charitable trust with a mission to advance educational opportunity and social well-being in the UK. We improve understanding of the issues affecting people's chances in life and identify ways to address disadvantage and inequality.

We fund research that informs social policy and has an impact on people's lives, primarily in Education, Welfare and Justice. Our student programmes provide opportunities for young people to develop skills and confidence in science and research.

We are the founder and co-funder of the Nuffield Council on Bioethics, the Nuffield Family Justice Observatory and the Ada Lovelace Institute.

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CFE research

Foreword

In 2021 our Nuffield Research Placement programme celebrates its 25th year. Placements provide practical learning opportunities for talented Year 12 (or equivalent) students from across the UK. Students gain valuable skills and experience through engaging in high quality real-life research projects, working with experts in a range of organisations across many fields and industries. The projects are set within a meaningful and professional context and take place during a 4–6-week placement in the summer holidays. Since 1996, more than 20,000 students have benefited.

Nuffield Research Placements began as an initiative to encourage young people to study natural sciences at university but has expanded over the years to support the development of research skills across all STEM disciplines as well as data sciences and quantitative social sciences. Our network of Q-Step Centres has been valuable in enabling this expansion into social sciences, with many Centres providing placements. Crucially, we have also developed the programme to exclusively focus on aspirational students from disadvantaged backgrounds, including those from low-income households, families with no history of higher education, or those in local authority care. For these groups, the experience can be particularly transformational in their education and career plans.

The past year has been pivotal for the programme. As the significant impact of COVID-19 become apparent in spring 2020, we and our partner organisations were determined that students should not miss out on the benefits of Nuffield Research Placements on top of the other challenges they were facing. Our response was to develop an alternative virtual programme, Nuffield Future Researchers, which was not reliant on in-person placements.

Over the 2020 summer holidays, 797 students took part in Nuffield Future Researchers. Our aim was to provide as many of the opportunities and benefits of face-to-face placements as possible, including the development of essential research skills through collaboration with experts working on projects based on real-life research questions. The research project element of the programme was complemented by online modules designed to enhance students' data analysis skills through a range of tasks and assignments delivered via a virtual learning environment. In short, the alternative programme combined familiar elements of Nuffield Research Placements with innovative approaches and new activities.

In line with our commitment to robust evaluation of all our activities, we commissioned an independent evaluation of Nuffield Future Researchers, the findings from which are presented in this report. We wanted to explore the extent to which this alternative delivery model could provide the benefits of Nuffield Research Placements, whether there were any new strengths or advantages to this different approach, and whether there were lessons for enhancing Nuffield Research Placements in the future. This report helps to answer those questions and complements the wider six-year longitudinal evaluation we have been undertaking since 2016 to assess the impact of Nuffield Research Placements and the experiences and outcomes of participating students.

There are important aspects of in-person placements that could never be replicated in an online environment, and it is unlikely that the virtual experience would be as transformative for most students. But during an extremely unusual year we are convinced that developing Nuffield Future

Researchers as an alternative was the right thing to do, and it is clear that the benefits for students have been significant.

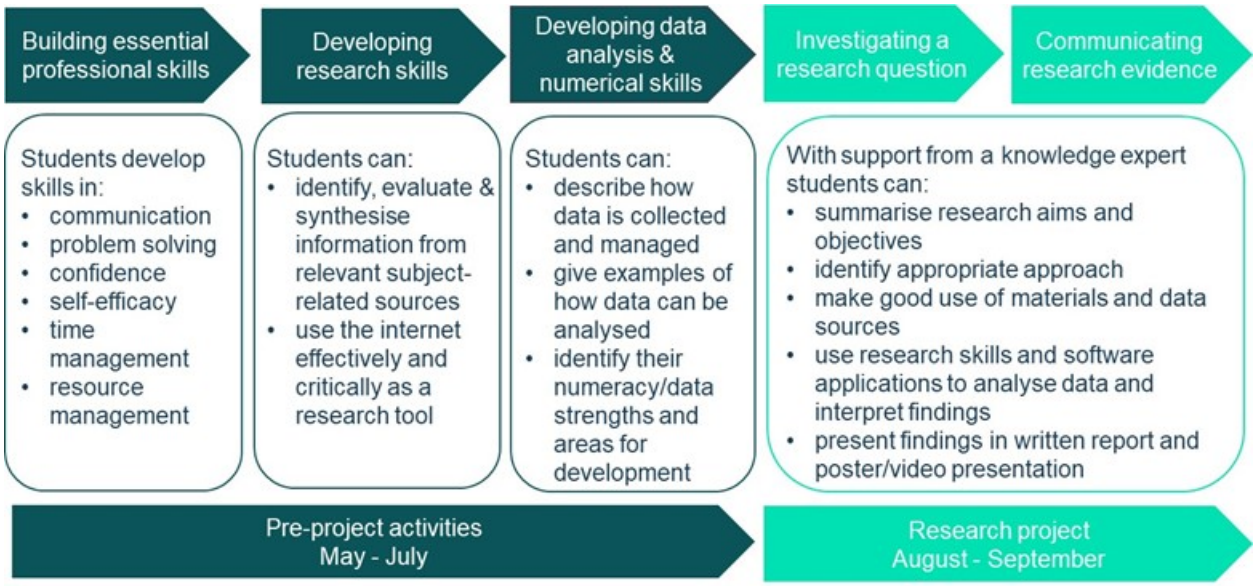
We are grateful to all those who helped in the development and implementation of Nuffield Future Researchers, including our co-funders, Wellcome and UKRI, our network of regional co-ordinators, and the teachers and employers who provided support and placements. But most of all we would like to thank the students themselves who worked so productively, often in the most difficult of circumstances.

We look forward to sharing further findings of the longitudinal evaluation in the future, but meanwhile we hope you will find this report on the alternative programme we delivered in 2020 both interesting and insightful.

Josh Hillman
Director of Education, Nuffield Foundation

Executive summary

The Nuffield Foundation has been delivering its UK-wide programme, Nuffield Research Placements, for almost 25 years. Over this period, the programme has evolved and since 2019 has targeted students from socially and economically disadvantaged backgrounds who meet at least one of four eligibility criteria.[1] The aim is to provide students with an opportunity to develop skills and gain research experience in a STEM-related setting, thus contributing to the achievement of the Nuffield Foundation's mission to enhance educational outcomes for young people across the UK. In 2020, in the context of COVID-19, it was not possible to deliver Nuffield Research Placements in the usual way. An alternative offer – Nuffield Future Researchers – was rapidly developed, designed to be delivered entirely online. The revised programme comprises a series of online activities to develop students' professional, research, analytical and reporting skills. The placement is replaced by a research project which students complete with support from a knowledge expert working in a relevant field (see figure below).



CFE Research was commissioned to undertake an independent evaluation of the new delivery model. The evaluation assesses how effectively Nuffield Future Researchers achieved its objectives and identifies scope to integrate elements of the online model into Nuffield Research Placements in the future. Participants in the 2020 programme were consulted along with supervisors, co-ordinators and members of the development team to explore what worked (and what didn't) in terms of delivery and with the perceived benefits of taking part. The Nuffield Foundation provided anonymised data from the 2019 post-placement survey to enable a comparison of the outcomes achieved by students in 2020 with those who took part in the traditional face-to-face model the previous year.

[1] To be eligible, students must come from a family with a household income of less that £30k per year; have been entitled to free school meals within the last 6 years; be care-experienced and/or have parents/carers with no experience of higher education.

Key findings

- **Students, supervisors and co-ordinators are broadly satisfied with their overall experience of Nuffield Future Researchers and the majority would recommend the experience to others.** This is despite some initial disappointment that students would not be able to complete a physical placement, and some supervisor's concerns about their ability to deliver an effective placement experience online**.**

- **Students, on the whole, find the pre-project activities enjoyable, but some are perceived to be less relevant and useful for preparing students to undertake their research project.** 'Developing research skills' effectively equips students with the skills and confidence they need to complete the research project. In contrast, 'building essential professional skills' and 'developing data analysis and numerical skills' are perceived to be less useful, particularly by students with strong existing numeracy skills.

- **The opportunity to complete an authentic STEM research project is the element of the programme that students most value.** With support from a knowledge expert, students developed a range of research skills along with an appreciation of different approaches and how and where to apply them. Working as part of a team, both with other researchers and their peers, is perceived to be particularly beneficial by students, although a substantial proportion did not have an opportunity to do this via the online approach.

- **A comparison of the outcomes achieved by Nuffield Future Researchers students with those achieved by last year's cohort of Nuffield Research Placements students reveals that whilst there are some nuanced differences in the specific effects of the two approaches, the online model is perceived to deliver several similar outcomes to the face-to-face model, including the development of certain generic skills and attributes.** Students' perceptions of their skills levels decreased slightly in most cases after they took part in the programme. However, this is likely to be the result of a common cognitive bias whereby individuals overestimate their skills at the outset of a programme. Nuffield Future Researchers helps to recalibrate students' perceptions of their skills and abilities and supports them to identify areas for development. Report-writing is the exception, with most students perceiving that their skills improved. The online approach is an effective way to achieve this outcome. Supervisors perceive that the programme also has a positive impact on students' ability to work independently and their project management skills.

- **The comparative analysis suggests that an immersive experience in a physical setting has a greater impact on students' intentions and decision making than an online approach.** Although most students are confident that they know what they want to do when they finish their current qualifications before they apply to Nuffield Future Researchers, and very few change their plans as a result of the programme, the experience can reassure students that they have made the right decision and can help others to choose between options under consideration.

- **Nuffield Future Researchers helps students to develop their understanding of the opportunities in STEM and roles available within and outside of research**. Student perceptions of the likely importance of STEM in their future careers increases as a result of their involvement in the programme. Students have a strong interest in STEM before they apply

and most agree that STEM industries offer interesting job opportunities. Comparative analysis suggests that the online approach is an effective way to maintain their commitment to STEM and encourage them to pursue STEM higher education and careers.

- **Supervisors, including early career researchers, develop their coaching and mentoring skills through their involvement in Nuffield Future Researchers.** The programme also enables supervisors to gain a fuller understanding of young people's needs and the best ways to support them. Involvement in the programme also supports organisations / institutions to achieve wider strategic objectives, including corporate social responsibility and widening participation obligations. Insights from students' research outputs can also help to inform operational planning and delivery of host organisations / institutions.

- **Although the rapid shift to an online approach presented a number of practical and logistical challenges, co-ordinators perceive that it helped to enhance aspects of delivery** by extending the geographical reach of the programme, widening access to a broader range of students and supervisors and facilitating communication between co-ordinators, students and supervisors.

The programme would be enhanced in the future by:

- Maintaining the online induction and communication platform for students and supervisors.

- Assessing students' knowledge and skills, particularly numeracy skills, and signposting students to pre-project activities that address identified gaps.

- Providing supervisors with more information on students' knowledge, skills and research interests and on the pre-project module content, including what students are expected to know and be able to do once they have completed the modules.

- Increasing opportunities for students to collect primary data, learn how to use computer software packages (where appropriate) and work as part of a team.

1. Introduction

This report has been produced by CFE Research for the Nuffield Foundation. It presents the findings from an independent evaluation of Nuffield Future Researchers conducted between July 2020 and January 2021.

Background and context

The UK has been in the midst of a global health crisis since March 2020. Unprecedented measures to control the spread of a new coronavirus disease, COVID-19, and its impact on health, wellbeing and the wider economy have been implemented by the UK Government and the devolved administrations. Education has been particularly adversely affected by these measures which have included whole and ongoing partial school closures. As a consequence, many organisations have had to adapt the ways in which they deliver their programmes to the sector.

For almost 25 years the Nuffield Foundation has been delivering its UK-wide programme, Nuffield Research Placements, to high achieving Year 12/S5 students studying at least one STEM subject. Over this period, the programme has evolved and since 2019 has been targeted at students from socially and economically disadvantaged backgrounds who meet at least one of four eligibility criteria.[2] The aim is to provide students with an opportunity to develop skills and gain work experience in a STEM research setting, thus contributing to the achievement of the Nuffield Foundation's mission to enhance educational outcomes for young people across the UK.

In the context of COVID-19, it was not possible to deliver Nuffield Research Placements, which includes a 4 to 6 week placement, in the usual way. To ensure the 2020 cohort of applicants could still take part, an alternative offer – Nuffield Future Researchers – was rapidly developed with support from existing partners, The Skills Builder Partnership and Q-Step Centres. The new offer was delivered entirely online. It comprised a series of online activities designed to develop students' professional, research, analytical and reporting skills, including a live research project with guidance and supervision from a knowledge expert working in a relevant field (Figure 1 overleaf). Many of the supervisors who participated in 2020 had hosted Nuffield Research Placements students in the past. However, the new online approach helped to attract a number of new organisations with the potential to extend the scope and reach of the programme across the UK.

The evaluation

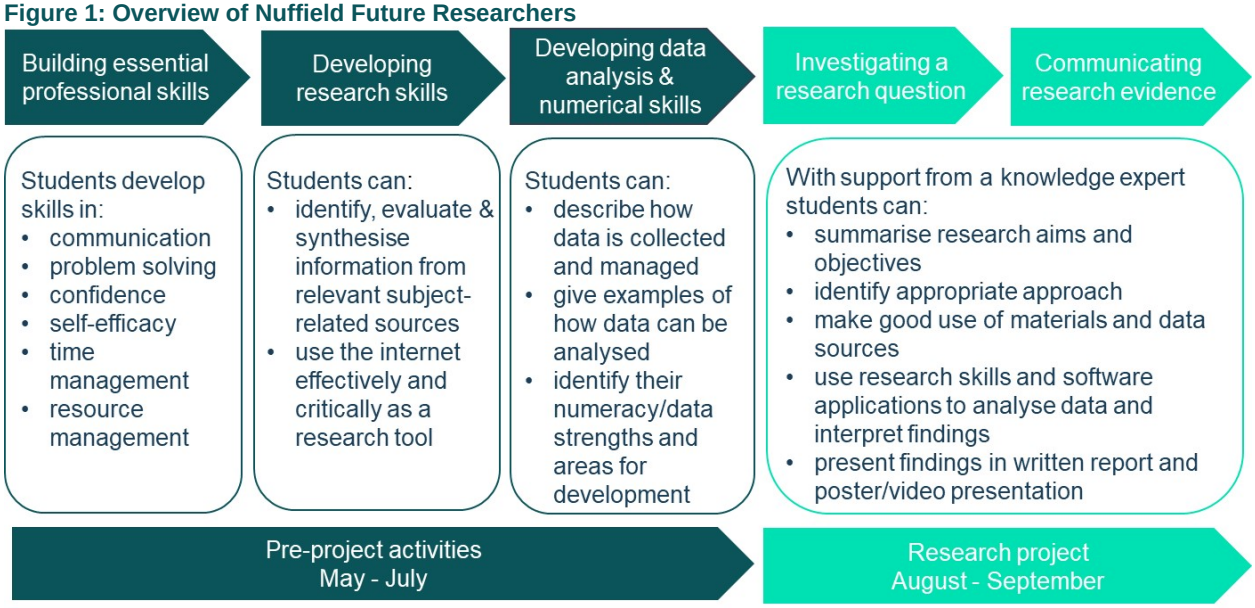
In 2016, Frontier Economics in partnership with CFE Research were commissioned to evaluate the impact of Nuffield Research Placements. CFE led a process evaluation which involved in-depth qualitative research with co-ordinators, placement supervisors, school staff and students, and a longitudinal survey of the 2016 cohort of applicants. The analysis explored how well the programme worked for the different stakeholders along with the benefits of participation. This included the perceived impact on students' knowledge, skills and attributes as well as their

[2] To be eligible, students must come from a family with a household income of less that £30k per year; have been entitled to free school meals within the last 6 years; be care-experienced and/or have parents/carers with no experience of higher education.

propensity to study STEM in HE and apply to a 'Top 30' university. The findings (Cilauro & Paull, 2019) helped to inform the development of the programme, as well as the impact evaluation led by Frontier Economics which concludes in 2022.

The current evaluation builds on this earlier work to explore whether Nuffield Future Researchers delivers the same outcomes for students as the traditional approach. It examines the effectiveness of the online delivery model, including its strengths and limitations, and identifies those elements that could usefully enhance Nuffield Research Placements in the future. It also explores the benefits of the programme, as perceived by students, supervisors and programme co-ordinators.

Figure 1: Overview of Nuffield Future Researchers



This report

Following this introduction, the report is presented in six chapters. **Chapter 2** describes the evaluation aims and objectives and outlines the methodological approach, together with the overarching sample characteristics. **Chapter 3** examines students', supervisors' and co-ordinators' perceptions of the application and induction process and their experience of the pre-project modules. In **Chapter 4,** we explore perceptions and experiences of the research project and presenting research findings. **Chapter 5** focuses on student and supervisor outcomes and the benefits of participating in the programme. It also considers the extent to which the programme contributes to the development of the skills and attributes students need for future STEM destinations, alongside the perceived influence of the programme on student decision-making. **Chapter 6** explores the advantages and limitations of an online approach from a range of stakeholder viewpoints. The report concludes in **Chapter 7** by synthesising the key findings and identifying recommendations to inform future delivery and evaluation.

2. Method

This chapter provides further details of the methodological approach and the characteristics of the samples that provide the basis for the analysis.

Evaluation aims and objectives

The evaluation was designed to address two principle aims:

- to measure the effectiveness of the new online approach against the programme's objectives, and
- to identify the potential scope to integrate elements of the new approach into Nuffield Research Placements in the future.

In addressing these aims, the evaluation sought to answer four research questions:

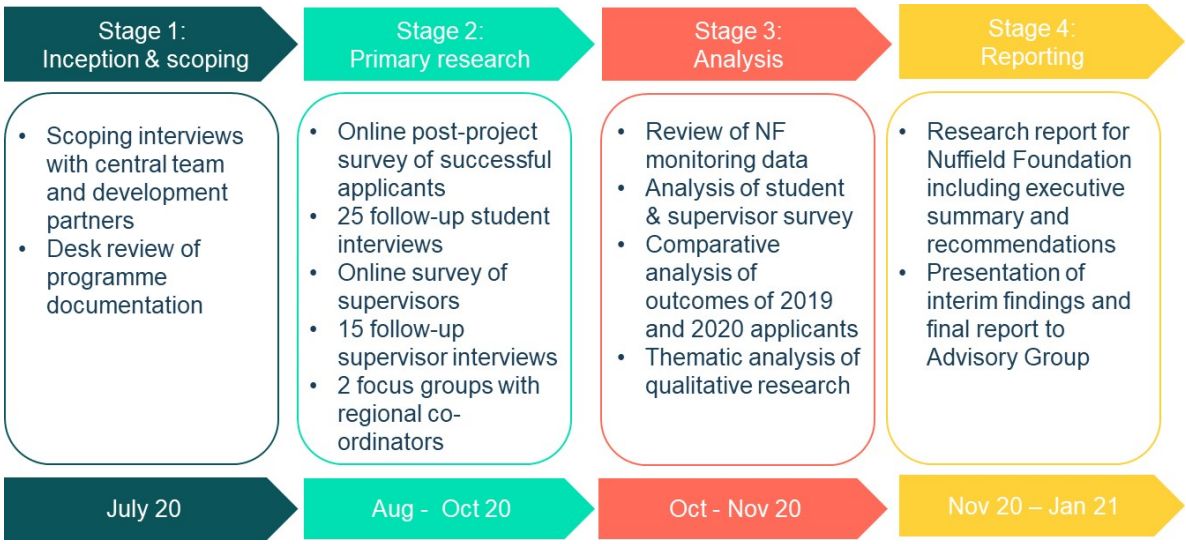
- What are the characteristics of applicants and project participants?
- What are the experiences of students and project supervisors?
- Does participation in pre-project activities support the research project experience, and if so, how?
- How does participation in the programme influence student decision-making, aspirations, and views about STEM and STEM-related subjects and career plans?

The evaluation, therefore, had a dual focus: a *formative* element to establish what works, what doesn't and why in terms of process and delivery; and a *summative* element to establish the outcomes achieved as a result of the programme, including the perceived impact of participation on knowledge, skills, aspirations and intentions.

Approach

The evaluation was delivered through a mixed-methods approach which combined data generated from online surveys, management information and previous evaluations, with qualitative information derived from interviews and focus groups. The evaluation was delivered in four main stages between July 2020 and January 2021, as summarised in Figure 2 overleaf). During stage 1, the CFE research team consulted with two members of the Nuffield Foundation's central team who were responsible for adapting the placement programme and three representatives from The Skills Builder Partnership and Q-Step Centres, who were responsible for developing key elements of the pre-project activities designed to enhance students' professional, numeracy and data skills.

Figure 2: Summary of approach



Consultation with students

Primary research

During stage 2, CFE designed an online survey which was distributed by the Nuffield Foundation via email to all participating students shortly after they had submitted their project report / presentation. The survey explored students' perceptions and experiences of the new delivery model. It contained key questions from the post-application survey administered by the Nuffield Foundation to enable change in knowledge and skill levels to be measured.

Of the 797 students who completed Nuffield Future Researchers, 784 responded to the survey, representing a 98% response rate. As such the characteristics of the sample reflects the cohort as a whole: two-thirds (66%) of the sample are Female; just over three-fifths (62%) are from a Black, Asian or Minority Ethnic background and approximately three-quarters (76%) are from a family with no prior experience of higher education (HE). A total of 669 respondents (85%) gave their permission for CFE to link their survey responses to data held by the Nuffield Foundation, including their post-application survey responses. This sample provides the basis for the analysis of the change in students' knowledge and skills pre- to post-intervention.

Twenty-five students were selected from the sub-sample of respondents who agreed to a follow-up interview to discuss their experience of Nuffield Future Researchers in more depth. Students were selected to ensure the characteristics of the sample broadly reflect the cohort as a whole.

Secondary data analysis

The Nuffield Foundation provided anonymised data from the 2019 post-placement survey to enable CFE to compare the outcomes achieved by students in 2020 with those who took part in the traditional face-to-face model the previous year. Comparative analysis enabled differences in perceived impacts between the two cohorts to be explored, offering insights into the extent to which the online programme was able to support students as intended. Selecting the 2019 cohort for the analysis was considered appropriate due to the close

alignment and of student and programme characteristics between the two cohorts. It was not possible to account for all student and programme characteristics in the comparative analysis. This includes differences in student motivation to engage in the face-to-face and online models and contextual differences in the programme delivery. In particular, the COVID-19 pandemic has resulted in significant disruption and uncertainty for many students. In contrast, the novelty of an online model may have resulted in 'halo' effects that might not be experienced in future online delivery, due to this becoming a more common educational experience.

Regression analysis using ordinary least squares (OLS) and logit models was carried out to compare the 2019 (base = 636) and 2020 (base = 506) programmes across a range of student outcomes including:

- Total skills and attributes
- Individual skills domains (e.g. motivation, confidence)
- Perceptions about the importance STEM
- Perceptions of the extent to which changes in skills and attributes are attributed to the programme
- Impact of the programme on students' future plans.

A stepwise method was used to estimate the relationship between one or more independent variables and the dependent (outcome) variable. No controls were included in step 1 in order to estimate the raw differences in the outcomes. Student demographic characteristics were included at step 2 and science and cultural capital factors were included at step 3. These variables, listed in Appendix 1, were included in the model so that their influence on the outcomes achieved can be accounted for in the analysis.

Consultation with supervisors and co-ordinators

The Nuffield Foundation routinely surveys the supervisors who host students to explore their perceptions and experiences of the programme and their role. CFE developed some additional questions pertaining to the new delivery model which were inserted into this existing survey. The survey was disseminated by co-ordinators to the supervisors in their region and achieved 163 responses – a 21% response rate overall.

The approach to survey administration and the subsequent response rate varied between regions, ranging from 14% to 58% in those that participated.[3] Supervisors from academic institutions are slightly under-represented in the sample (70%, compared with 78% in the population as a whole). Just over a quarter of respondents (28%) are early career researchers and just over three-fifths (61%) are 'first time' supervisors. While the survey findings are not therefore representative, they are indicative of supervisors' views and

[3] Supervisors from two regions are not represented in the survey results: North East, Yorkshire and Humberside and the West Midlands

provide valuable insights into the supervisory experience and the benefits for learners from the supervisors' perspective.

Supervisors were also invited to take part in a follow-up interview. A sample of 15 was selected comprising a similar proportion of academic and industry-based supervisors from a range of disciplines located across the UK. The sample included two early-career researchers and nine first-time supervisors.

Co-ordinators were invited to share their views on the effectiveness of programme delivery and its impacts. A total of 12 co-ordinators took part in two focus groups and one individual interview representing eight of the ten regions.[4] The discussions examined how well-equipped co-ordinators felt to rollout the new model, the benefits and challenges of working with students and supervisors remotely, and ways in which the programme could be improved in the future, including through a more blended approach.

For the purposes of this report, the analysis of the survey and secondary data has been combined with the qualitative research findings to provide detailed insights into each stage of the programme from the point of view of the three key stakeholder groups: students, supervisors and co-ordinators.

[4] The two regions not represented are the North East, Yorkshire and Humberside and the West Midlands.

3. Experience of the pre-project activities

This chapter examines perceptions and experiences of the different aspects of the online delivery model from the application and induction process through the pre-project activities. We identify what works as well as aspects that could be improved to enhance the experience for students and supervisors in the future. Perceptions of the research project and presentation of the research findings are then explored in Chapter 4.

Key findings

- Satisfaction with Nuffield Future Researchers is high; students who took part in 2020 are equally as satisfied as those who participated in Nuffield Research Placements in 2019.
- Students', supervisors' and co-ordinators' perceptions of the virtual induction process are largely positive; the online format is regarded as an effective and efficient way to deliver the induction and helps to enhance accessibility and engagement.
- Most students had access to the necessary technology and space to work in at home. A minority experienced challenges balancing their research project with their school/college work.
- The majority of students completed all of the pre-project activities and associated assignments and found them enjoyable. A lack of time was the main barrier for those who did not complete all the activities.
- Prior attainment in maths may impact on student perceptions of the relevance and usefulness of 'Developing data analysis and numerical skills'.
- 'Developing research skills' effectively equips students with a range of skills required to successfully complete their research project. However, some students completed the preparatory modules alongside rather than prior to their project which impacted on their level of preparedness and confidence going into their research project.
- The flexibility afforded by the online approach ensured students were well-matched to their project provider. However, supervisors require more information about students' existing knowledge, skills and interests to effectively tailor the projects to students' needs.

Overall satisfaction with Nuffield Future Researchers

The application window for the 2020 programme opened before the pandemic reached the UK. At this stage, the Nuffield Foundation intended to run Nuffield Research Placements in the traditional way and successful applicants were expecting to complete a work placement in a physical setting. Although the majority of students (69%) were disappointed when they found out that they would not be able to do a physical work placement, according to the co-ordinators responsible for recruitment, very few were deterred from taking part by the

change. Furthermore, the shift to an online model does not appear to have diminished overall satisfaction with the programme. The vast majority of students (93%) were satisfied with their experience and were equally as satisfied as students in 2019 who took part in the traditional programme with a physical placement. According to interviewees, the experience of the programme often exceeded expectations and, as a result, most participants (91%) would definitely recommend Nuffield Future Researchers to others and most (71%) would be interested in joining the Nuffield Alumni Network.

These positive sentiments are echoed by supervisors. The majority also report high levels of satisfaction with their experience overall and a willingness to take part again in the future, despite half indicating that they had some concerns about delivering the placement remotely. Many of the co-ordinators have been involved with Nuffield Research Placements for several years and they in particular recognised the scale of the challenge that the central team faced in adapting the programme in such a short period of time. Co-ordinators commended the team on their achievements and for successfully ensuring students could still benefit from a worthwhile experience despite the exceptional circumstances.

Application and induction process

According to the 2020 monitoring data, 3,474 students began the application process and 1,890 completed it.[5] A total of 921 students were subsequently offered a place on Nuffield Future Researchers and 886 started the programme. Of these, 797 (90%) successfully completed[6] with support from 426 supervisors[7] based in HE institutions[8] and other organisations[9] including research centres, charities and private businesses. This compares with 862 students who completed Nuffield Research Placements in 2019, supported by 503 supervisors.

Induction process

The induction process for students and supervisors, as with all other elements of the programme, had to be delivered online in 2020.

The student experience

On average, students agree that the information they received about Nuffield Future Researchers before starting their project told them everything they needed to know (mean = 5.13) and that they understood what was expected of them after the virtual induction (mean

[5] There are a number of reasons why students do not complete their application, but we understand that the principal reason is that they do not meet the eligibility criteria.

[6] Students are classified as completing the programme if they successfully complete the activities 'Investigating a research question in collaboration with a knowledge expert' and 'Communicating your research evidence'.

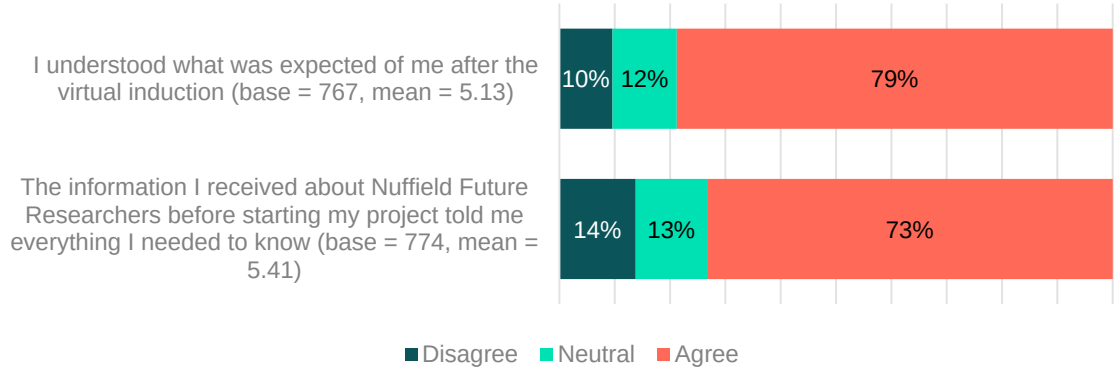
[7] For purposes of comparison this figure was calculated using the same method as the 2019 total and includes main supervisors only. Using Google Classroom data in 2020 we know that in total there were 792 individual members of staff involved in supervising students. This includes, for example, early career researchers whose role will have been supporting main supervisors.

[8] 618 of the 792 supervisors were based in HE institutions.

[9] 174 of the 792 supervisors were based in non-academic organisations.

= 5.41). However, there is a small minority of students who disagree that they were adequately prepared (Figure 3).

Figure 3: Extent to which students agree or disagree with statements about the induction process (All students, variable bases. Rating on a 7-point scale where 1 is strongly disagree and 7 is strongly agree)



Nuffield Future Researchers began rolling out from May 2020. As many schools and colleges were still closed for the majority of students at this time, some of those taking part began completing the programme alongside their school/college work from home. This presented challenges for some students: just over a third (34%) found it difficult to balance their research project with their school/college work and 16% did not have a suitable space to do their work in at home. It also presented challenges for the central team and the regional co-ordinators. A key concern, given the socio-economic characteristics of the student cohort, was ensuring they had access to the necessary technology to enable them to complete the programme activities effectively online.

To help overcome the IT challenge, eligible students were provided with a £400 bursary which could be used to purchase equipment, among other things. According to the survey responses, just over a third of students (35%) used their bursary for this purpose. In addition, the Nuffield Foundation purchased software licences on behalf of students and liaised with schools and colleges to ensure they were providing their students with a laptop where possible. In regions such as the South West, refurbished laptops were sourced that could be purchased by students for £150-£180.

> The support from the co-ordinator worked so well, indeed they loaned the student a laptop which had all the programs installed on it, so there was absolutely everything the student needed to do the work and there are some really good online tutorials which I've used in the past and used this year, which help the student to get to grips with the software.
>
> Supervisor (Private sector – Education)

These measures appear to have been effective, with almost nine out of ten students (89%) agreeing that they had all the technology they needed to access the online activities at the start of the programme. Almost all of the students (94%) subsequently found it easy to access the web-based delivery platforms such as Google Classroom and Kahoot, although a handful of students report that unstable or slow Wi-Fi connections was problematic at times.

In addition, for a minority of student interviewees the specification of their equipment was not sufficiently advanced to enable them to complete some of the technical components of their project.

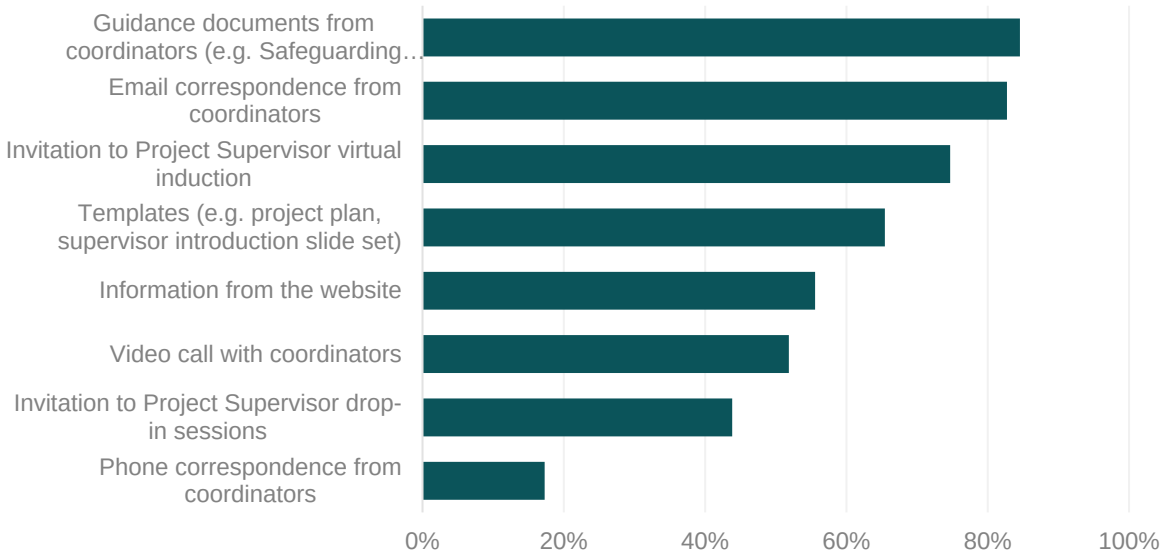
> Working around technology was really difficult. I was supposed to do some data analysis through MATLAB but my computer didn't have the processing power to handle that so I missed out on that component of my project. I feel like if it had been done, like, on campus I would have been able to probably do that part of the programme.
>
> Student (Biology)

Ensuring all students had a suitable workspace was challenging to address in 2020 because access to alternative places to study outside the home was restricted by COVID-19 guidance and legislation. In future, schools and colleges could be encouraged to provide access to study space (and technology) onsite to enable students to complete programme-related activities outside timetabled lessons. A more blended approach for Nuffield Future Researchers, including some time in a physical workplace with access to study space (and technology), could also help to overcome this challenge.

The supervisor experience

The induction process for supervisors involved a range of activities accompanied by materials and resources. In addition to a virtual induction meeting, co-ordinators facilitated drop-in sessions and provided information and support via telephone, video-call and email. Supervisors were signposted to web-based information about the programme and provided with standard templates, guidance, policies and procedures, for example on safeguarding and working in a Virtual Learning Environment (VLE). All the supervisors who responded to the survey accessed at least one form of information and support during the induction phase (Figure 4).

Figure 4: Sources of information and support supervisors were provided with prior to supervising a student (All respondents, base= 162)



Communication

Email correspondence (83%) was the most common mode of communication with co-ordinators, followed by video call (52%). Most supervisors agree that contact with the regional co-ordinating team was effective (91%) and that the administration of the programme ran smoothly (91%) as a result.

> [The co-ordinator] was great. I felt that if I asked her any questions, she came back really quickly. She was really supportive and I thought she was a great face of the Nuffield programme. She was always thanking people for what they were doing and egging people on which was really good.
>
> Supervisor (Higher Education)

Where supervisors experienced a lack of engagement from their student(s), co-ordinators promptly and proactively addressed issues by engaging directly with the student and/or brokering additional meetings between students and supervisors. In one instance, the supervisor considered the support they received from their co-ordinator to be “above and beyond what I would have expected”.

Virtual induction

Three-quarters of respondents to the supervisor survey could recall being invited to a virtual induction. Nine out of ten (90%) of those who subsequently attended found it informative and report that they understood what was expected of them after the meeting.

> It helped me because I didn't really know what to expect. I'd never used Google Classrooms before, [I didn’t know] how the programme would work, what software tools were available, what was expected of us as tutors, front-end supervisors.
>
> Supervisor (Higher Education)

This suggests that the induction is effective for preparing supervisors for their role, but a minority are missing out on the opportunity to attend: a quarter of survey respondents (25%) do not recall being invited to a virtual induction for supervisors. Although based on small numbers, further analysis indicates that most of these were the main[10] supervisor (23 out of 27 who provided a response) and were supervising a student for the first time in 2020 (17 out of 28 who provided a response). It is likely that Nuffield Future Researchers will continue to evolve, incorporating new or existing elements of the activities introduced in 2020 in the future. It is, therefore, important to ensure all supervisors, but particularly those who are hosting students for the first time, are invited to an induction session, so they understand the changes and how that impacts on students and their role as a supervisor.

[10] The ‘main’ supervisor is the person with primary responsibility for setting the research question and supporting the student to complete the project. In some organisations, students also have access to support from other members of staff, including early career researchers.

Co-ordinators view the virtual format as an effective and efficient way to deliver the supervisor induction, given this is often a geographically-dispersed group. A further advantage is that the meeting can be recorded so those who cannot attend in real time can catch up at a later date. Maintaining this approach would help to ensure all supervisors have access to the induction in future.

> They [online inductions] were actually a really good thing. Getting supervisors to come to an in-person induction, it wouldn't happen because of geography and time, but getting them to log in for an hour was easy… We ran them across the whole of the north of England. That was a real positive.
>
> Co-ordinator

A small minority of supervisors (n = 11) did not fully understand what was expected of them following the virtual induction. One way to address this is through subsequent drop-in sessions where supervisors can raise questions and seek clarifications. Although these sessions were offered, less than half of survey respondents could recall being invited to one (44%). Only two of the supervisors interviewed indicate that they had participated in a drop-in session, but several indicate that they would have valued the opportunity to discuss the challenges they encountered with other supervisors.

It would, therefore, be useful to raise supervisors' awareness of these sessions in future to ensure all are fully informed. Just a third of supervisors (33%) report that the VLE is an effective way to collaborate with other supervisors; drop-in sessions could provide an alternative mechanism for enabling supervisors to network and offer 'peer to peer' support. Drop-in sessions could also help to reduce burden on co-ordinators by enabling them to respond to common queries once, rather than in a series of individual emails and calls. The majority of supervisors recalled being provided with guidance documents (85%) and templates (65%) which most also found useful (96% and 85%, respectively).

> There was enough information… I got all the proformas for their report writing, the posters and everything to do with the project… I felt fully informed about the project and what I was trying to do.
>
> Supervisor (Private Sector – Education)

> A lot of the written material was useful... I knew exactly what the aims were, what I was expected to do and what the boundaries of the role were.
>
> Supervisor (Higher Education)

Experience of the programme activities

As illustrated in Figure 1 in the introduction to this report (p.5), Nuffield Future Researchers comprises five modules which involve a series of activities and assignments. Three of the modules, 'Building essential professional skills', 'Developing research skills' and 'Developing data analysis and numerical skills', are designed to prepare students for the final two modules, 'Investigating a research question in collaboration with a knowledge expert' and 'Communicating the research evidence through a report and poster or video presentation'.

As such, it is recommended that students complete the three 'pre-project' modules prior to commencing their research project. However, they are not compulsory, and students can choose which, if any, activities and assignments to undertake.

The majority of students (86%) completed all of the activities and assignments for all of the modules. Of the 64 survey respondents who did not complete all the activities and assignments, the most common reason given is 'lack of time' (n=34). Very few students did not complete the assignments because of a lack of access to the necessary information (n=7) and no one indicates that it was because of lack of support. Some students admit that they were not motivated to complete the assignments because they were not compulsory (n=29), they did not perceive them to be useful (n=14) and/or they did not find them interesting (n=11).

While, on the whole students acknowledge the benefits of completing the modules, some perceive the tasks themselves to be somewhat "dull". Others report that the module tasks were quite generalised and not tailored to their specific subject area. This view is reflected in the feedback from some of the co-ordinators who perceive some of the tasks to be "too much like school" rather than resembling something an individual might do in a professional environment. This, they believe, may have been a turn-off for some students.

Pre-project modules

Time to complete the modules

According to the programme documentation, it is estimated that students should spend one to two hours on 'Building essential professional skills' and 10 to 15 hours on 'Developing research skills' and 'Developing data analysis and numerical skills'. The average amount of time students report that they spent on these activities is broadly in line with these estimates (Figure 5). However, across the cohort, there is considerable variation and, in some cases, the recommended time was exceeded by some margin. For example, almost two-fifths (37%) of students estimate that they spent over 3 hours completing 'Building essential professional skills', up to a maximum of 21 hours.

Figure 5: Average number of hours spent completing each module (All students, trimmed mean)

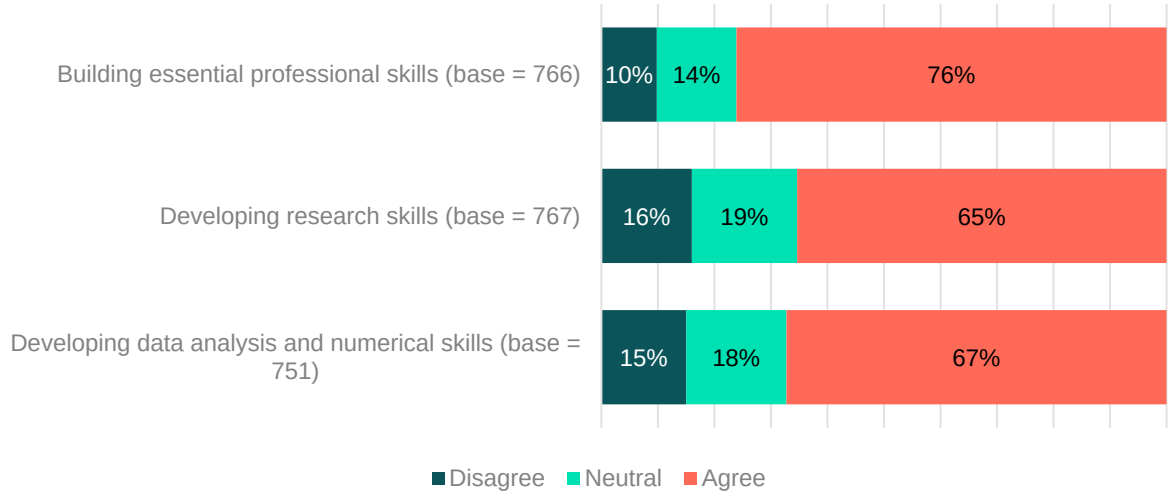
There are a number of reasons why modules may take some students longer to complete than others. Insights from the interviews with students and focus groups with co-ordinators suggest that existing knowledge and skill level is likely to be a factor. For example, interviewees who were studying maths or another subject with a significant element of numeracy found 'Developing data analysis and numerical skills' relatively easy and were able to complete it quickly; others who were less numerate found this module more challenging and therefore more time consuming to complete. A small number of students indicate that module and task instruction could have been clearer. They had to seek further clarification from their co-ordinator which led to delays in completion.

Going forward, this suggests there may be value in students completing some form of skills assessment at the outset of the programme to gauge their existing knowledge and skill levels. Students could then be guided to undertake specific activities from the menu of pre-project tasks and assignments that will be most beneficial for them in terms of addressing knowledge/skill gaps and preparing them to undertake their research project.

Enjoyment of the modules

The vast majority of students (96%) could access the materials on Kahoot easily and just over three-quarters (76%) found these activities enjoyable. Although most also enjoyed the activities for the other pre-project modules, approximately a third did not (Figure 6).

Figure 6: Extent to which students agree or disagree that the pre-project modules were enjoyable (All students)



The extent to which a student perceives that the module content is relevant to their research project appears to impact on their enjoyment of the activity. A minority of interviewees report that the module activities could have been better aligned to their research project. These students did not find the modules as enjoyable as other participants.

> Some of the tasks were unnecessary in my opinion. Maybe giving more options would have been helpful. I don't know if it's necessary for [module completion] to

> be compulsory because some of it doesn't really contribute to the research project.
>
> Student (Biology)

Support to complete the pre-project modules

Co-ordinators report that the level of support provided to students in 2020 overall is considerably higher than in previous years. Helping and encouraging students to complete the pre-project activities accounts for most of this additional time. Co-ordinators generally value the opportunity for more engagement with students and many report that it enhanced their role. However, some found supporting students challenging because of their lack of familiarity the module content and the online platform, and the limits of their own knowledge and skills, particularly in relation to the online technology and research.

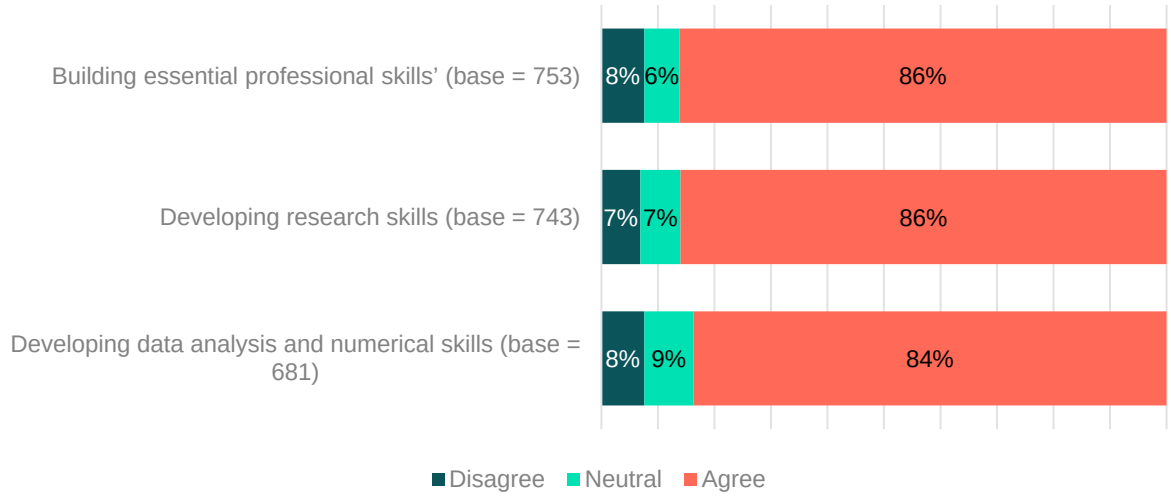
> I found it really difficult. I'm not trained in some of the questions, so I couldn't give students answers, and we know that they were just doing them to get the idea of research, but when they were asking if it was the right answer, I would come to a bit of a halt. I found that quite difficult.
>
> Co-ordinator

Despite the challenges, co-ordinators feel compelled to provide feedback to students on their work, given the time and effort they put into producing it. However, some co-ordinators question whether they really are best placed to provide this feedback and whether supervisors could fulfil a more formal role in future.

> We weren't expected to give feedback on the modules, but I found that quite uncomfortable. The students had put effort in, and we were just marking whether they submitted or not. I think we managed to look at 50% of them, and any students that were struggling, we spent more time on them. That increased the workload a lot.
>
> Co-ordinator

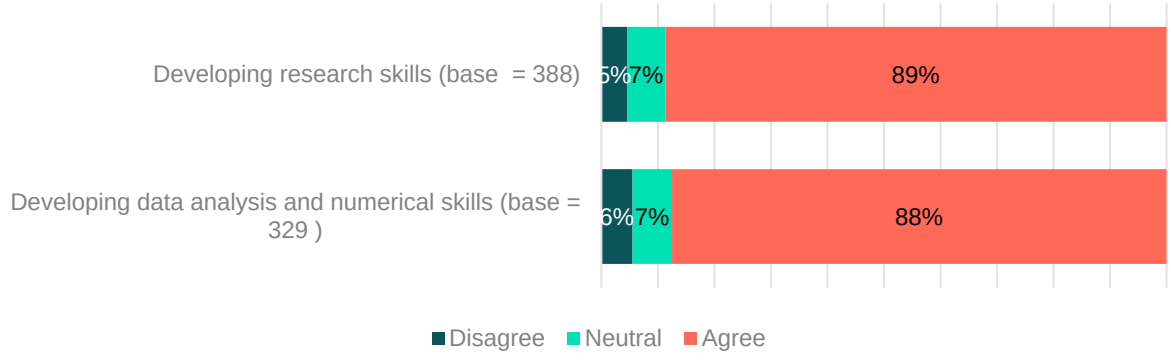
Students, on the whole, recognise and value the support provided by co-ordinators throughout the pre-project phase of Nuffield Future Researchers. As Figure 7 demonstrates, the majority report they got the support they needed from their co-ordinators to complete each of the pre-project modules. Most student interviewees indicate that they valued the speed with which their co-ordinators responded to requests for help. A handful report that they felt overwhelmed at times and suggest that more guidance would have helped. A similar number of students indicate that they found the student drop-in sessions facilitated by co-ordinators helpful in addressing particular issues.

Figure 7: Extent to which students agree or disagree that they got the support they needed to complete the pre-project modules from their co-ordinator (All students)



At present, supervisors are not required to provide feedback on work produced by students at the pre-project stage. Around one in ten supervisors who responded to the survey (12%) recall that they had reviewed some of the assignments that their students had completed during the preparatory modules, most commonly 'Developing research skills'. Feedback from students suggests that a higher proportion of supervisors overall provided feedback at this stage: half of students report that they received input from their supervisor when completing 'Developing research skills' and just over two-fifths when undertaking 'Developing data analysis and numerical skills'. As Figure 8 demonstrates, the majority of these students found this input useful.

Figure 8: Extent to which students agree or disagree that input from the project supervisor was useful during the pre-project modules



This suggests that a more formal role for supervisors in the pre-project phase would help to enhance the programme for students. However, co-ordinators express concern that, if this became a requirement of the role, it would place an additional burden on supervisors which could put some off hosting a student or encourage them to reduce the number of students they are prepared to take.

Few supervisors indicate that they wish to take a more active role in the pre-project stage. However, insight from the interviews suggests that there is appetite among supervisors to learn more about the module content and the activities involved. A better understanding of the skills students are expected to develop during the pre-project activities would enable supervisors to tailor their research projects appropriately. This would help to strengthen the programme by improving the experience for students and maximising the outcomes they achieve.

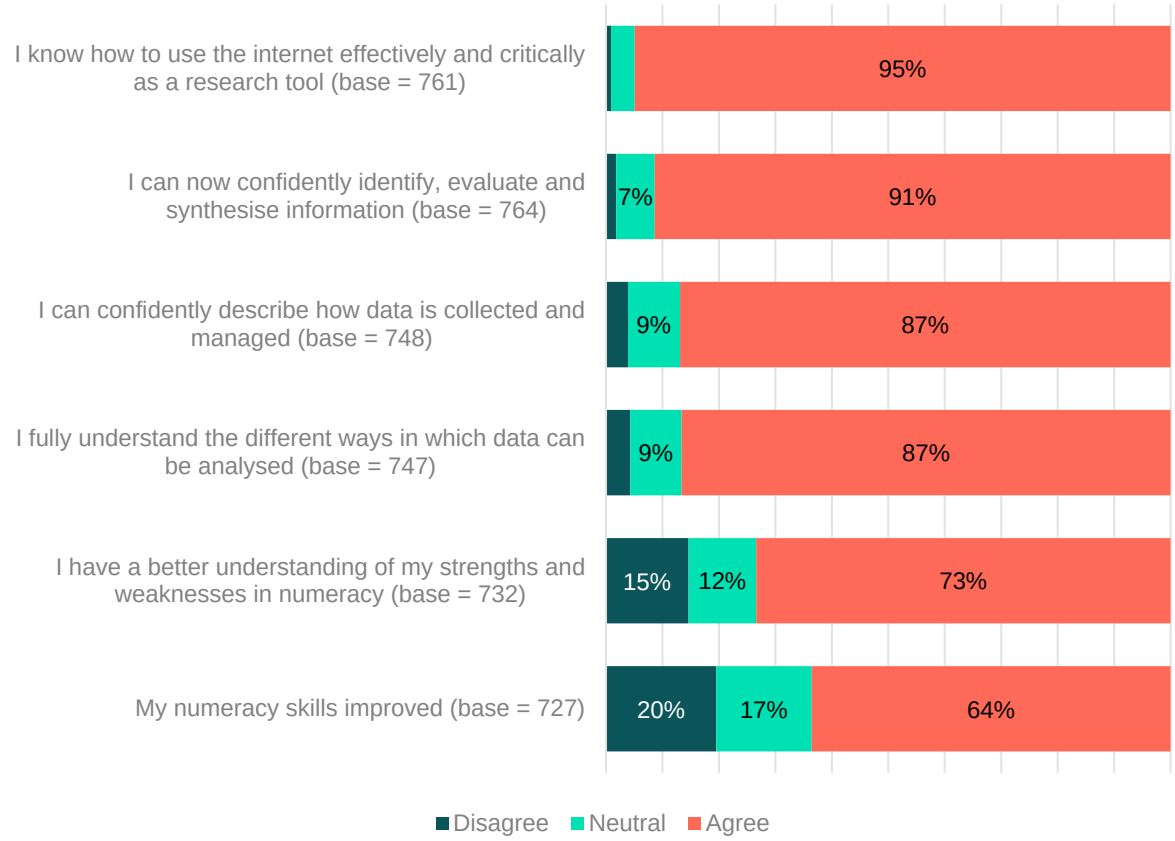
> If I knew what they were being taught I could tailor the project a lot better and I would know also to keep my expectations in line. Have they been taught about this, or is that something I need to spend time explaining? I think that would be useful.
>
> Supervisor (Hospital)

Skills and confidence going into the research project

The purpose of the pre-project activities is to equip students with some of the skills they need to successfully complete their research project with support from a knowledge expert. Overall, the modules appear to effectively achieve this objective for the majority of students.

After completing the ‘Developing research skills’ activities, the majority of students report that they are able to confidently identify, evaluate and synthesise information (91%) and use the internet critically and effectively as a research tool (95%). Most supervisors (89%) also agree that the students they supervised were able to use the internet in this way, at least to some extent. Most students report that they are confident to describe how data is collected and managed (87%) and understand the different ways in which data can be analysed (87%) after completing ‘Developing data analysis and numerical skills’. Almost three-quarters of students (73%) feel they have a better understanding of their strengths and weaknesses in numeracy as a result of taking part in this module; however, 15% disagree with this statement. In addition, a fifth (20%) disagree that their numeracy skills have improved (Figure 9).

Figure 9: Extent to which students agree or disagree with statements about the skills they developed



To be eligible for Nuffield Future Researchers, applicants must have at least 5 GCSEs (or equivalent) at Grade 6 or above, including maths, a science subject and English (or another humanity). According to application data available, just under half of applicants (46.4%) in 2020 can be considered 'very strong' at maths, approximately a third (33.4%) can be considered 'strong' and the remaining fifth (20.2%) 'less strong', relative to the rest of the sample.[11] Similar proportions of students agree that their numeracy skills have improved as a result of completing 'Developing data analysis and numerical skills', irrespective of their 'maths strength'. However, those who disagree with this statement (n = 64) are most likely to be those who are strongest in maths (45%).

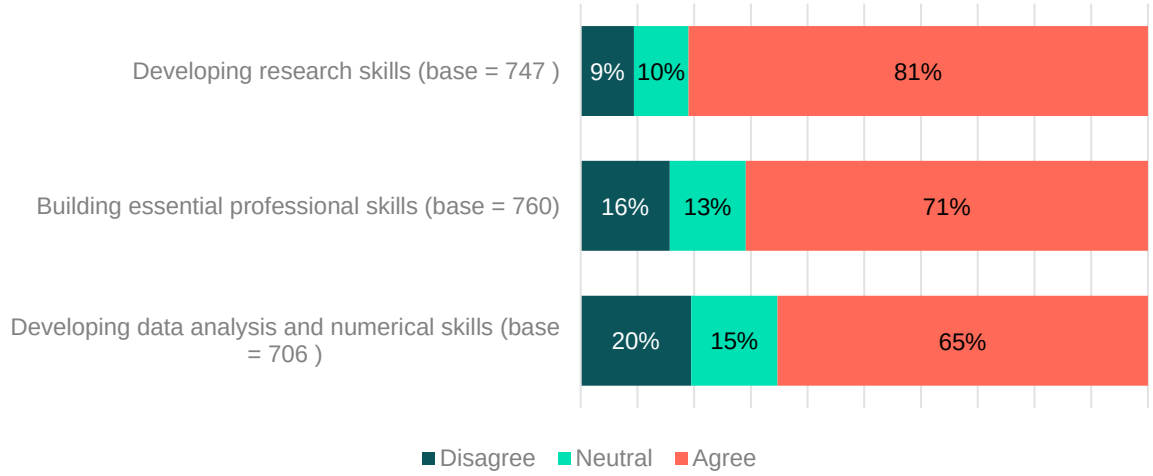
Level of preparedness for the research project

Of the three preparatory modules, students perceive that 'Developing research skills' best prepared them for their research project. More than four-fifths of students (81%) agree that this module helped to prepare them for the research project, compared with 71% who agree

[11] It was possible to calculate 'maths strength' for 55% of the sample of survey respondents (n = 429). There are 199 applicants classified as 'very strong', that is, those who achieved a high grade at Level 2 (7 or above at GCSE or equivalent) and/or achieved further maths and are currently studying maths at Level 3 (A Level or equivalent); 138 classified as 'strong', that is those who achieved a Grade 8 or above at GCSE or equivalent but are not studying maths at Level 3 or achieved a lower grade at GCSE or equivalent but also achieved further maths or are currently studying maths at Level 3; and 92 classified as 'less strong', that is those who achieved the equivalent of a Grade 7 or below at Level 2., do not have further maths and are not currently studying maths at Level 3.

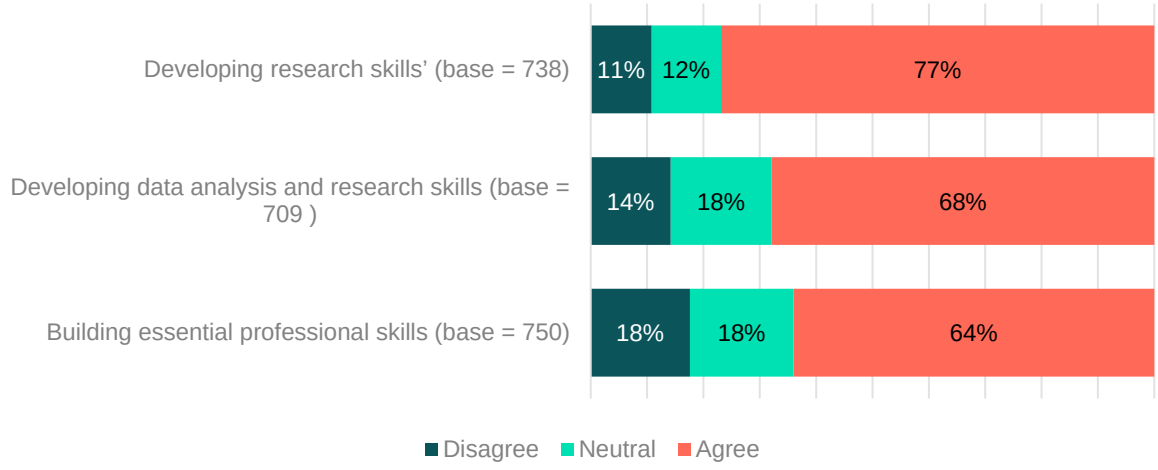
that ‘Building essential professional skills’ and 65% who agree that ‘Developing data analysis and numerical skills’ were helpful in this regard (Figure 10).

Figure 10: Extent to which students agree or disagree that the pre-project modules helped them to prepare for their research project with their supervisor (All students)



Students were also more likely to report that ‘Developing research skills’ boosted their confidence going into their research project than the other two modules (Figure 11).

Figure 11: Extent to which students agree or disagree that they felt confident going into the research project because they had completed the pre-project modules (All students)



Analysis by ‘maths strength’ once again reveals that those with the strongest numeracy skills are most likely to disagree that this module helped to prepare them for their research project with their supervisor. Of the respondents who disagree (n = 61), over two-fifths (44%) are ‘very strong’ at maths. Of those who are considered ‘less strong’ at maths relative to the wider sample, 65% report that they felt confident going into their research project after completing this module, compared with 75% of those who can be considered ‘very strong’ at maths.

Although the analysis of ‘maths strength’ is based on a sub-set of applicants and relatively small numbers, it provides further evidence to suggest that some of those with strong numeracy skills come to Nuffield Future Researchers with the level of skill required to undertake the research project. As such, there may be less need for this group to complete this module, which could be determined by a skills assessment.

The majority of supervisors (82%) agree that their student(s) suitably matched their institution/organisation and the projects on offer; however, most are equivocal about the extent to which the pre-project modules adequately prepared their students to undertake the work. Almost half of survey respondents (46%) neither agree nor disagree that the modules ensure students are well-prepared. However, this is likely to reflect their lack of understanding of the module content, as noted above. A small minority (12%) disagree entirely that the modules adequately prepared students. Interviews revealed that that students had a limited understanding of research methods and scientific principles.

In addition, co-ordinators and supervisors report that, based on their interactions with students, a substantial proportion completed the pre-project activities in parallel, or even after, their research project. The main reason for this appears to be lack of time. Some students experienced difficulties managing the modules alongside school/college work and others took longer than anticipated to complete them. Some students also had a limited timeframe in which to complete the modules before their placement started because of the impact of COVID-19 on the programme schedule. In these instances, there were limited, if any, opportunities for students to apply the learning to their project, and as such the modules did not fulfil their intended function. Modifying the requirements of the pre-project activities and/or extending the lead time would enable students to complete the activities before starting their research project, thus helping to ensure they are well-prepared.

4. Experience of the research project

This chapter examines perceptions and experiences of the research project, including the effectiveness of the supervision and the specific research and data skills students developed. We identify what works as well as aspects that could be improved to enhance the experience for students and supervisors in the future. The perceived benefits and impacts of taking part in Nuffield Future Researchers are then explored in Chapter 5.

Key findings

- Students are well supported by their knowledge expert and most perceive that they contributed to an authentic study in an area of STEM they are interested in. The amount of time dedicated to supervising the research project is perceived to be manageable and comparable to the face-to-face approach.
- Students value the opportunity to work as part of a team with other researchers and their peers. However, not all students had the opportunity to benefit from this part of the experience.
- Engaging in the project supports students to develop an appreciation of the relative merits of different research approaches and the confidence to select an appropriate research approach. While most students develop secondary research skills through the programme, opportunities to collect primary data and learn how to use computer software packages are more limited.
- The research project has a particularly positive impact on students' writing skills, including their ability to structure a report and cite evidence in support of their argument.

Investigating a research question

Despite some students not feeling fully prepared and confident to undertake their placement, the vast majority were satisfied with their experience. Students spent an average of 26 hours completing their project and a similar amount of time writing up and presenting their findings. Most agree that they were well supported and that they had the opportunity to contribute to an authentic STEM study in an area of STEM they are interested in. As noted in the previous chapter, a large proportion of supervisors perceive that there was a good match between the projects and their students. All these factors are likely to have contributed to the high level of student satisfaction with this element of the programme in particular.

Supervision from a knowledge expert

Supervisors spent on average 19 hours supporting[12] their student(s) in 2020. Some spent considerably more than this, up to 96 hours, but these are likely to have hosted multiple students. Those who have hosted a student in the past (n = 60) most commonly report that they spent *about the same* (n = 19), or a *little less* (n = 19) time supervising their student(s) this year; just 4 respondents report that they spent *a lot more* time. Irrespective of the amount of time spent, most (91%) agree that it was manageable. There are some supervisors who spent more time on supervision than anticipated. They reflect that their projects were perhaps too complex given the skill level of the students and the challenges of remote delivery. In future, these supervisors would seek to create simpler, more self-contained projects that could be more easily completed within the timeframe available for this element of the programme.

Most supervisors agree that they were able to effectively support their students remotely (73%). The majority could access the VLE easily (83%) and agree that this provided an effective mechanism for collaborating with their students (71%). Supervisors found it particularly useful during the project set up because it enabled documentation to be shared ahead of meetings and discussions with their student(s). However, a minority did feel they were not able to support their students as effectively online as they could have done face-to-face:

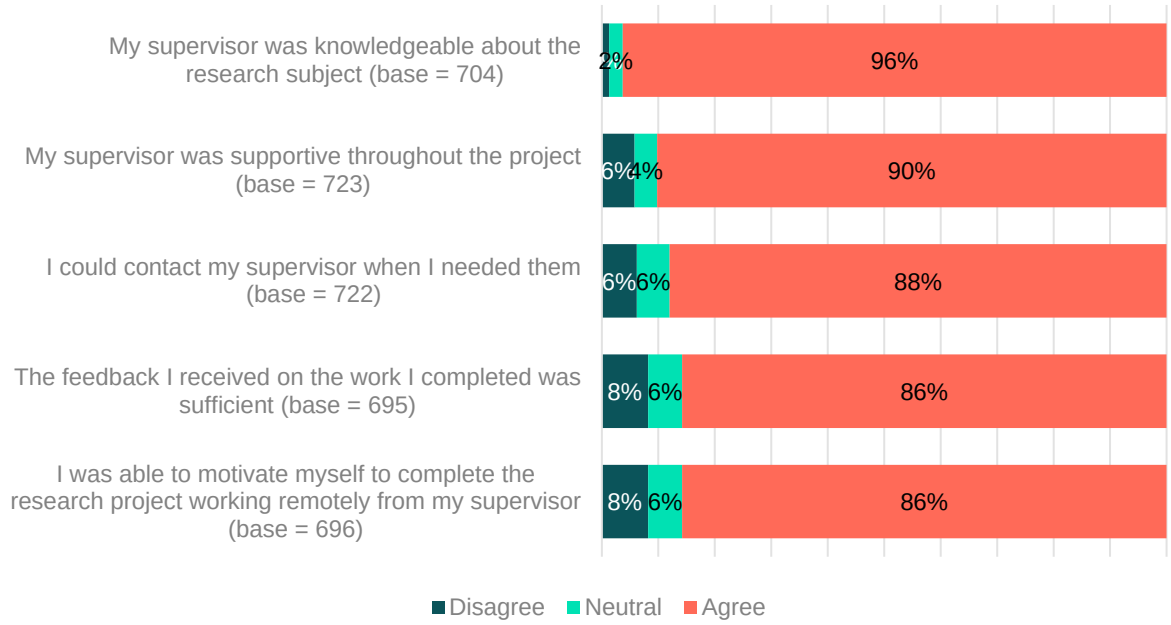
> I don't think as a supervisor you can ever interact as well with someone online as you can in person. It might have been easier for me to know how much work she was actually doing if we'd been there meeting together, rather than talking online. I could have said, 'Well, show me all the notes that you've made from the reading,' you know, but that wasn't really possible online.
>
> Supervisor (Higher Education)

Furthermore, some supervisors found Google Classroom less useful as the project progressed. They report that students preferred to communicate by email and use of the VLE's wider functionality reduced as a result.

The vast majority of students agree that their supervisor was knowledgeable about the research subject they were investigating (96%). Most also agree that their supervisor was supportive throughout (90%) and provided sufficient feedback on the work they completed (86%). Most students also report that they were able to contact their supervisor for help and support when they needed them (88%). As a result, most were able to maintain their motivation and complete their research project, despite working remotely from their supervisor (86%) (Figure 12).

[12] This includes time spent reviewing work completed during the preparatory modules (if appropriate) and time spent supporting students to develop their research skills, complete their research project and write up and present their findings.

Figure 12: Extent to which students agree or disagree with statements about the supervision they received



Wider supervision and support

The majority of the supervisors who responded to the survey were the main supervisor for the student(s) hosted by their organisation/institution. In almost two-fifths of cases (37%) other members of staff were also involved in supporting students, including early career researchers. Across the programme, just under half of students (47%) had the opportunity to work as part of a team with other researchers at their project provider. A similar proportion (45%) had the opportunity to work with other students. Students valued the opportunity to work as part of a team and particularly with other students, because it enabled them to share ideas and discuss their research findings.

> [Engaging with other students was] incredibly useful. I think it gives you an insight into other things that they might have been doing and I find it helps to have different insights, because sometimes you're just looking at things one way and [discussing it with others] can give you a whole different concept.
>
> Student (Computing)

The students that did not have the opportunity to collaborate with their peers would have like to have done so. They suggest that Nuffield Future Researchers would be enhanced if more peer-to-peer learning opportunities were incorporated in future, where possible.

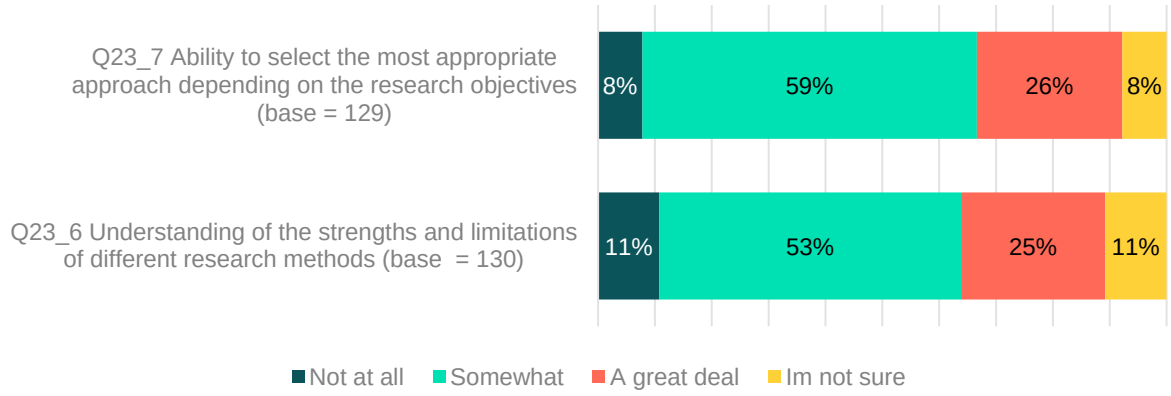
Research skills developed through the project

Most students agree that, as a result of their project, they now understand the relative merits of different research approaches (90%) and are confident in their ability to select an appropriate research approach in the future (90%).

> The research got me to think about methodology and the validity of that because if your methodology isn't clear or isn't reproducible, then your findings are baseless. So that really made me reflect on that […] I had to convince myself before I convinced the audience.
>
> Student (Engineering/Manufacturing)

Most of the supervisors surveyed also perceive that students developed these two key skills during their project, at least to some extent (Figure 13).

Figure 13: Extent to which supervisors feel the student(s) they supervised developed an understanding of the research process (All respondents)

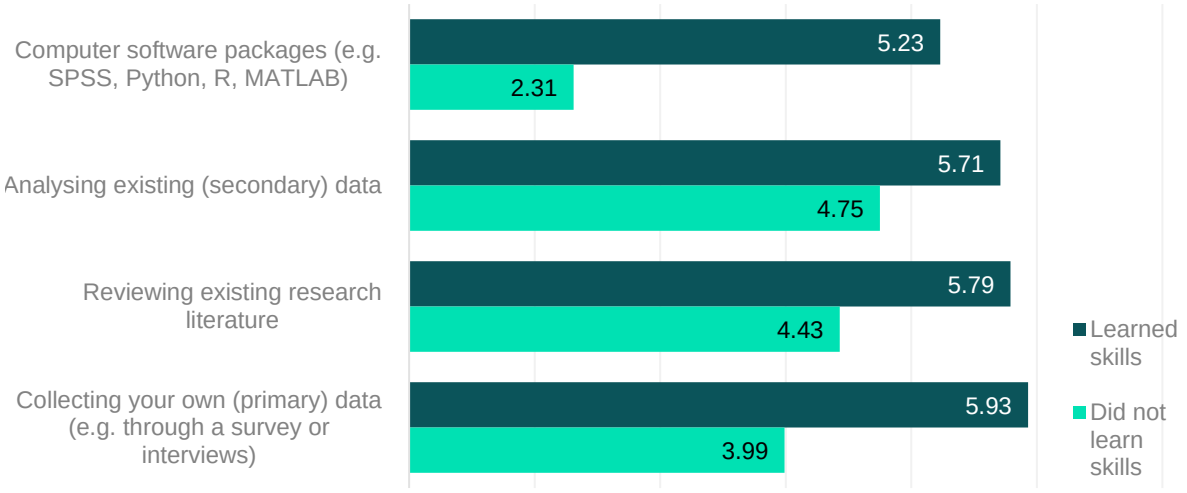


Due to the online delivery method, most projects were desk-based in 2020 and involved students investigating their research question through analysis of existing research literature and secondary data (89% and 87% of students, respectively, used these methods during their research project). Under half of students had the opportunity to collect their own primary data (45%) and just over two-fifths (41%) learned how to use computer software packages such as SPSS, Python, R and MATLAB.

> It would have been nice to have furthered my maths skills or be able to do some interesting statistics stuff but the placement I did wasn't really geared towards that.
>
> Student (Biomedical Sciences)

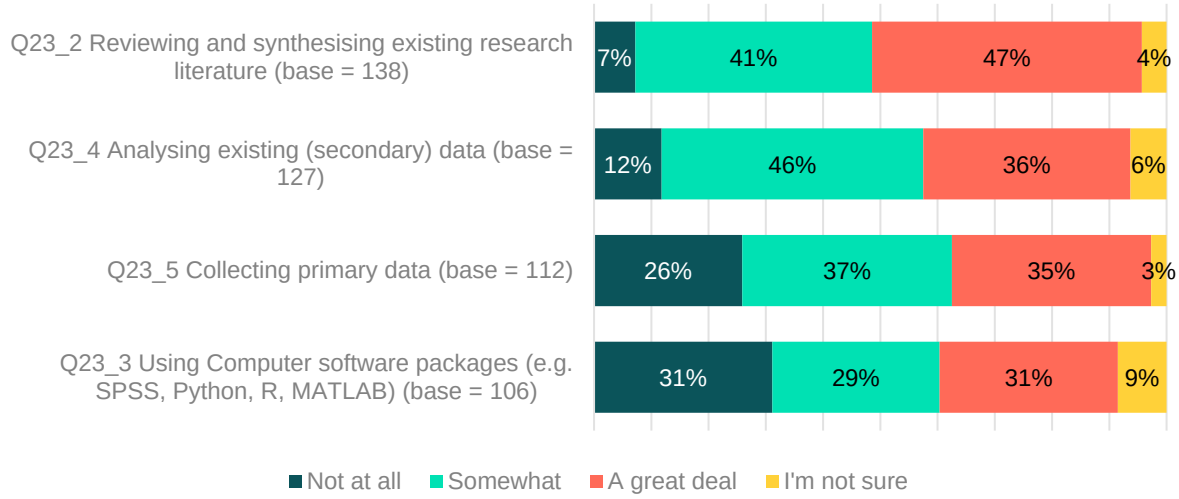
Those students who developed and used a particular skill while undertaking their project are, on average, more confident in their abilities in those skills than those who did not. The difference is particularly pronounced for software skills: those who learned how to use computer software packages during the programme are, on average, 'confident' in their skills (mean = 5.23); by comparison students who did not learn how to use computer software packages while on the programme lack confidence (mean = 2.31) (Figure 14).

Figure 14: Level of confidence in research skills by whether the student used the skill during their project (Variable bases); mean rating on 7-point scale where 1 is not confident at all and 7 is very confident)



Supervisors largely agree that students develop a range of research skills through their project, at least to some extent. A substantial minority do not perceive that students developed primary data collection and computer software skills (Figure 15). However, this is likely to be because these skills were not required on their projects (as illustrated above), rather than a failing on the part of the student or the programme.

Figure 15: Extent to which supervisors perceive that the student(s) they supervised developed research skills as part of the project (All supervisors)



Communicating research evidence

The final stage of Nuffield Future Researchers involves students writing up their research findings and presenting them in a report along with a poster or video presentation. The vast majority of students (92%) report that, following their project, they understood what is required for each section of a research report, how to reference other people's work and

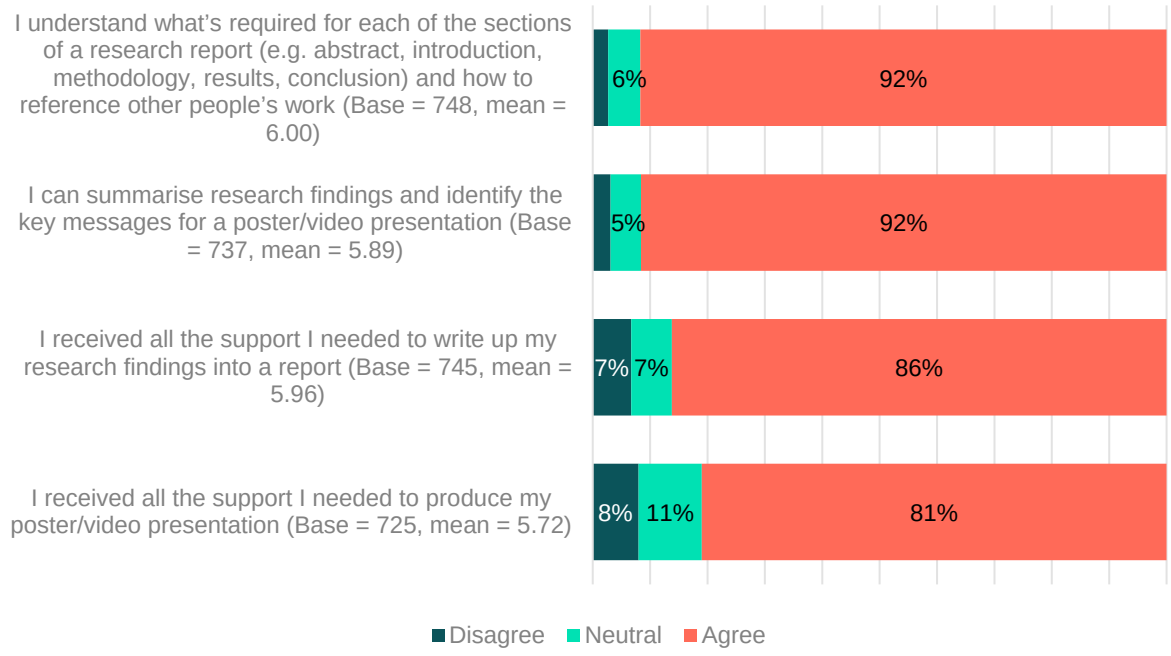
how to summarise the key messages from their research findings in a poster / video presentation (Figure 16). Interviewees highlighted that there are limited, if any, opportunities to write the kind of report they produced for their project in the context of their STEM A-Levels (or equivalent). As such, they recognised the positive impact that the programme had on the development of their writing skills and in particular their ability to structure a report appropriately and cite evidence in support of their argument. Some students indicate that they have been able to apply their skills more broadly, including when drafting their personal statement for their university application.

> At school I'm doing an extended project in which we have to write a report and we don't really get any support for it. So now I know how to structure appropriately and how to reference which is really useful.
>
> Student (Astronomy)

> I've received positive feedback from my teachers when doing school work, how my style is changing, how the tone of my work has changed as well
>
> Student (Computing)

The majority of supervisors (91%) perceived that their students had developed the skills needed to interpret and report on research findings as a result of their involvement in the project, at least to some extent. Interviewees noted improvements in the way their students structured their reports and their ability to effectively convey complex scientific terminology.

Figure 16: Extent to which students agree or disagree with statements about 'Communicating research evidence' (All students)



Most students also agree that they received all the support they needed to write up their research findings (86%) and produce a poster / video presentation (81%) based on their

report. However, there is a small minority of students who would have liked more support or clearer guidance on the processes to follow in this regard.

> I didn't struggle with it but I think some people did in terms of actually structuring posters and the report format. Having some practice, maybe if we'd been given a scientific report to analyse, would have been helpful.
>
> Student (Engineering/Manufacturing)

Finally, supervisors perceive that one of the key benefits of the programme overall is that it equips students with an accurate understanding of what really is involved in a research project.

> [Nuffield Future Researchers] helps in terms of appreciating what would actually be required if they were going to be doing a research project in the future… I think, almost certainly, when they started off, they had a preconceived idea of what was going to be required and they might have been a bit surprised that actually it is quite different.
>
> Supervisor (Private Sector – Research)

5. Outcomes of Nuffield Future Researchers

In this chapter we explore perceptions of the outcomes achieved by students and supervisors as a result of their participation in Nuffield Future Researchers. The outcomes achieved by students in 2020 are compared with those achieved by the 2019 cohort to gain insights into the relative effectiveness of the online and face-to-face programmes.

Key findings

- The online and face-to-face delivery models have a similar effect on the development of students' skills and attributes overall.
- There is a slight dip in students' perceptions of their ability in most skills post-programme. This is likely to be the result of a common cognitive bias rather than a negative impact of the programme.
- Students perceive significant improvements in their report writing skills. This view is shared by supervisors. Supervisors also perceive that the programme enhances students' ability to work independently and their project management skills.
- The online delivery model appears to be more effective for improving students' report writing skills than the face-to-face approach.
- Very few students change their future plans as a result of their experience on the Nuffield Future Researchers, rather it helps to reassure them they have made the right decision or to choose between the options they are considering.
- The online model is less impactful compared with the face-to-face approach on student decision-making about their future plans. This could suggest that the immersive experience of the face-to-face approach is more influential and provides additional insights to inform decisions.
- Supervisors recognise the benefits to them and their organisation of participating in Nuffield Future Researchers. As a result, most would recommend the programme to others and are prepared to supervise students in the future.

A key aim of this evaluation is to ascertain the extent to which Nuffield Future Researchers has an impact on student perceptions of their skills and attributes, and their plans for after their current studies. Students' responses to the post-project survey have therefore been linked to the post-application data collected by the Nuffield Foundation so that changes in perceptions can be measured. In addition, by comparing students' responses in 2020 with those in 2019 pre- and post-project, it is possible to assess whether the online mode of delivery is more, less or equally effective in terms of achieving the programme objectives.

Sample characteristics

Summary statistics for student demographic characteristics show that there are significantly more females, BAME students and students with FSM and bursary entitlement in the 2020 sample compared with the 2019 sample (see Appendix 2, Table 5). Previous evaluation of Nuffield Research Placements indicated that more could be done to engage these groups in support of the Nuffield Foundation's objective to increase the proportion of under-represented groups, including females, in STEM. Analysis of science and cultural capital variables highlights that more students have either engaged in or are planning to participate in STEM-related activities in 2020 than in 2019 (see Appendix 2 for summary statistics).

Development of skills and attributes

Supporting students to develop their skills and attributes is a key objective of Nuffield Future Researchers. The programme has been specifically designed to provide students with the opportunity to develop their STEM knowledge and a range of research, and professional and essential skills that will be advantageous for their future educational pathway.

Total skills

A 'total skills' score was calculated by combining students' ratings of different skills and attributes, including confidence, motivation, problem solving, communication and teamwork. A comparison of average total skills scores in 2019 and 2020 shows that, although the difference is small, post-programme scores are *lower* relative to pre-programme scores. The difference is larger for the 2019 programme compared with 2020, but both are statistically significant (Table 1).

A decrease in student perceptions of their skills after an intervention is not uncommon as it is often difficult to accurately estimate skill level prior to having a full appreciation of what it means to be fully proficient in a skill. This is known as the Dunning-Kruger effect, a well-known cognitive bias that results from people unknowingly overestimating their knowledge or ability and then recalibrating their perceptions based on the understanding they gain as a result of participating in an activity designed to enhance knowledge or a particular skill (Kruger & Dunning, 1999).

Table 1. Descriptives means and SD () for pre-post score differences for students' total skills and attributes scores for the 2019 and 2020 programmes. Note: Significant differences between pre and post values, within a year are indicated as: *** p<.01, ** p<.05, * p<.0.10

	2019 programme	2020 programme	Total
Pre-total skills score	45.80	45.05	45.47
	(6.545)	(6.876)	(6.702)
Post-total skills score	44.51	44.44	44.48
	(6.971)	(7.133)	(7.041)
Difference in pre-post skills score	**-1.294*** **	**-0.614***	-0.990
	(7.927)	**(8.001)**	(7.964)
N	639	515	1154

The first regression model explored total skills and attributes scores to establish the degree to which student perceptions changed post-programme and the extent to which perceptions differed between the 2019 and 2020 cohorts. The findings show that whilst total skills scores decreased post-programme for both cohorts, the difference is not statistically significant and this does not change when demographic, social and cultural capital control variables are included (see Appendix 2, Table 6 for regression output table). The findings indicate that the 2019 and 2020 programmes have had a similar effect on students' skills and attributes overall; as such, the online model is as effective as the face-to-face model in this regard.

Individual skills

Change pre-post

A slightly different pattern emerges when pre-post scores for *individual* skills are considered. For the 2019 cohort, the largest pre-post differences relate to students' perceived motivation, team-working abilities, problem-solving abilities, time management, and report writing skills, which all *decreased*. Significant decreases in pre-post perceptions about time management and team working abilities also emerge for those that participated in the 2020 programme. This is in contrast with significant post-programme *increases* in 2020 students' perceived confidence in their own abilities and report writing skills (Table 2).

Table 2: Descriptive means and SD () for pre-post score differences for student perceptions of individual skills dimensions for the 2019 and 2020 programmes. Note: Significant differences between pre and post values, within a year are indicated as: *** p<.01, ** p<.05, * p<.0.10

2019 programme	Pre-Skill	Post-Skill	Difference pre-post Skill
I am motivated by school/college work	6.119	5.884	**-0.235*** **
	(1.079)	(1.092)	**(1.288)**
I am confident in my own abilities	5.535	5.480	-0.055
	(1.104)	(1.210)	(1.382)
I am good at problem solving	5.859	5.654	**-0.205*** **
	(0.971)	(1.070)	**(1.296)**
I am good at writing reports	5.316	5.133	**-0.183*** **
	(1.160)	(1.288)	**(1.467)**
I am a confident presenter	4.978	4.856	**-0.122** **
	(1.459)	(1.589)	**(1.438)**
I manage my own time well	5.610	5.408	**-0.202*** **
	(1.206)	(1.339)	**(1.428)**
I work well as a member of a team	6.075	5.844	**-0.232*** **
	(1.071)	(1.185)	**(1.252)**
I work well independently	6.310	6.249	-0.061
	(0.986)	(0.913)	(1.149)

2020 programme	Pre-Skill	Post-Skill	Difference pre-post Skill
I am motivated by school/college work	5.984	5.900	-0.084
	(1.208)	(1.150)	(1.456)
I am confident in my own abilities	5.466	5.581	**0.115***
	(1.183)	(1.155)	**(1.346)**
I am good at problem solving	5.746	5.816	0.070
	(1.041)	(0.983)	(1.163)
I am good at writing reports	5.163	5.425	**0.262*****
	(1.216)	(1.075)	**(1.266)**
I am a confident presenter	4.808	4.810	0.002
	(1.484)	(1.614)	(1.464)
I manage my own time well	5.557	5.275	**-0.281*****
	(1.267)	(1.346)	**(1.380)**
I work well as a member of a team	6.057	5.856	**-0.212*****
	(1.056)	(1.016)	**(1.168)**
I work well independently	6.281	6.258	-0.023
	(1.002)	(0.894)	(1.124)

Comparison between the 2019 and 2020 cohorts

Regression models comparing the 2019 and 2020 cohorts controlling for student pre-programme perceptions and student demographics show significant differences between the two programmes for student perceptions of **problem solving, report writing** and **time management**. (See Appendix 2 Tables 7-10 for the regression output tables). There are no significant differences between the two programmes for motivation, confidence in their own abilities, confidence as a presenter, team working and the ability to work independently. This suggests that pre-programme scores, student demographics and science and cultural capital factors influence the outcomes.

Exploring the means for the 2019 and 2020 programmes in relation to the significant regression models shows that student perceptions about their **problem solving** abilities significantly reduce in 2019, but there are no observed pre-post differences in 2020. Student perceptions of their **time management** abilities decrease for both programmes, but significantly more amongst the 2020 cohort. Less than half of supervisors in 2020 (43%) perceive that the programme had ‘a great deal’ of impact on students’ ability to manage their time effectively (Figure 17). It is clear from follow-up interviews with students and supervisors that the remote working arrangements presented some specific challenges in relation to time management. In particular, the online approach impacted on the speed with which supervisors were able to respond to students’ queries which subsequently affected the timeframe students had to complete tasks and deliver their outputs. Supervisors acknowledge that some tasks took longer to complete online than they would have done if they have been undertaken on site.

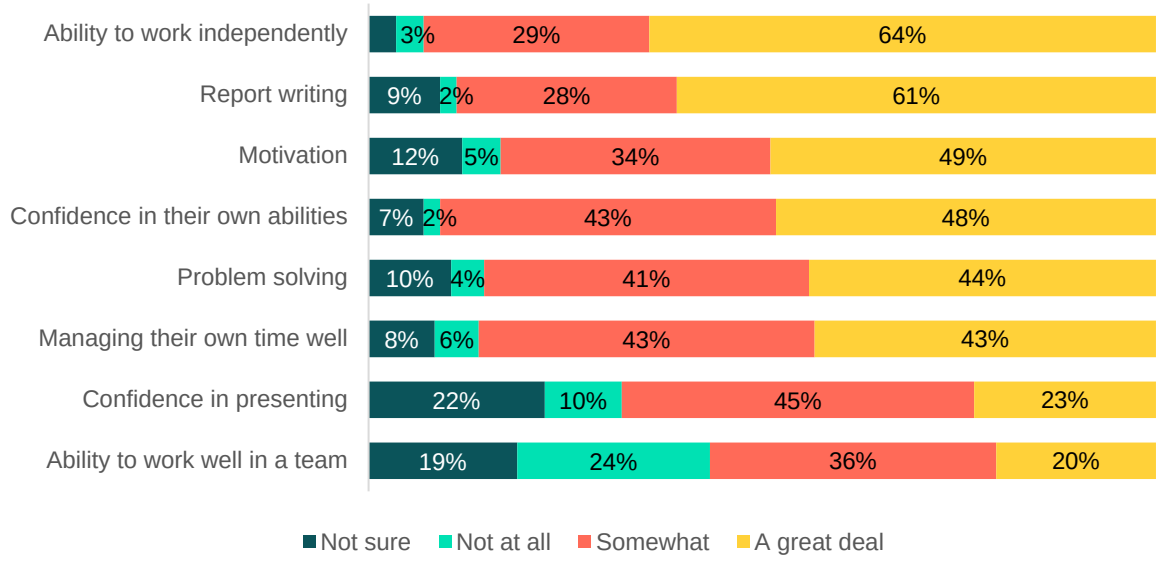
> Sometimes it would take a couple of days to send and receive and exchange emails. There was no quick way for me to tell the supervisor about some problem or the progress that I had made.
>
> — Student (Engineering)

Positively, however, supervisors perceive that as a result of this experience, students developed their project management skills, including how to plan their workload and finish on time.

The most substantial difference between the 2019 and 2020 programmes is in relation to **report writing**. The findings show that whilst perceptions of report writing abilities *decrease* for the 2019 cohort, they significantly *increase* for the 2020 cohort. This suggests that **the online approach could be more effective for developing students' report writing skills than the face-to-face model.** A possible explanation for this could be the increased focus on desk-based activities and written assignments in the 2020 programme.

These findings provide some preliminary evidence that Nuffield Future Researchers is associated with positive changes (or less negative changes) in post-programme perceptions of individual skills and attributes when compared to the 2019 programme. Although 'total skills' scores decrease post-participation, irrespective of the programme engaged in, the magnitude of this decrease is lower for the 2020 programme. **Overall, the findings suggest that the 2020 programme has been as effective as the 2019 programme in achieving its objectives.**

Figure 17: Supervisor perceptions of the impact of Nuffield Future Researchers on students' skills and attributes (base = 143)



Influence of Nuffield Future Researchers on skills and attributes

Students were asked to rate the extent to which taking part in the programme impacted on their skills and attributes. Total post-programme scores[13] demonstrate that both cohorts of students perceive that the programme had a substantial impact on their skills and attributes. However, student perceptions of the impact of the programme are more positive for the 2019 cohort (mean = 20.37, SD = 2.76) compared with 2020 cohort (mean = 18.67, SD = 3.64).

Regression analysis on post-programme impact scores to understand the extent to which there are any significant differences between the 2019 and 2020 programmes reveals that overall, post-programme impact scores are significantly *lower* after participation in the 2020 programme compared with the 2019 programme when all variables are controlled for (see Appendix 2, Table 11 for the regression output table). This is perhaps to be expected as the 2019 programme involved a physical work placement which provided a more immersive and authentic experience than could be achieved online, including opportunities for students to work alongside other researchers and apply a broader range of skills.

Table 3: Summary means and standard deviations () for students' perceptions of post-programme impact scores for individual skills domains (1 = a great deal and 0 = no impact/somewhat/not sure)

Post-programme impact perceptions	2019 programme	2020 programme
I am motivated by school/college work	0.665	0.406
	(0.472)	(0.492)
I am confident in my own abilities	0.598	0.478
	(0.491)	(0.500)
I am good at problem solving	0.599	0.455
	(0.490)	(0.498)
I am good at writing reports	0.496	0.610
	(0.500)	(0.488)
I am a confident presenter	0.356	0.268
	(0.479)	(0.443)
I manage my own time well	0.550	0.470
	(0.498)	(0.500)
I work well as a member of a team	0.685	0.423
	(0.465)	(0.495)
I work well independently	0.833	0.722
	(0.374)	(0.448)

Despite the lower total post-programme impact scores in 2020 compared to 2019, there is evidence in the survey findings and follow up interviews with students and supervisors that the programme is perceived to have a positive impact on a range of outcomes, particularly their ability to **work well independently** (Table 3). Students in 2020 reflect that both the pre-project activities and the research project helped to develop their ability to work

[13] Combined scores from 8 skills dimensions, data skills omitted from comparative analysis as absent from the 2019 dataset, 1 = no impact, 2 = somewhat/not sure, 3 = a great deal. The maximum score is 24.

independently. Most supervisors in 2020 also agree that the programme has at least some impact on the students' ability to work independently (Figure 17).

Conversely, both cohorts of students report that the programme was **least impactful** on the development of the skills needed to become **confident presenters.** Interviewees **i**ndicate that lockdown restrictions limited opportunities to present their research findings. However, over two-thirds of supervisors (68%) perceive that the programme has a positive impact on students' confidence in their ability to present their research findings (Figure 17). They, along with students, also report that students' general communication skills improve as a result of the programme, and in particular, the opportunity to work in a team to deliver the research project:

> [The student] worked not just with [supervisor], but with the team, and she worked with technical staff, as well. I believe her communication skills improved leaps and bounds by the end of the project.
>
> Supervisor (Higher Education)

The extent to which the change in skill levels is perceived to be attributable to the programme does, however, vary between the cohorts. On average, student perceptions of the extent of the impact that is attributable to the programme is lower in 2020 compared with 2019. The only exception is for **report writing skills** (Table 3) where the regression analysis (see Appendix 2, Tables 12–14) demonstrates a higher degree of impact on report writing skills attributable to the programme in 2020 compared with 2019 when all variables are controlled for.

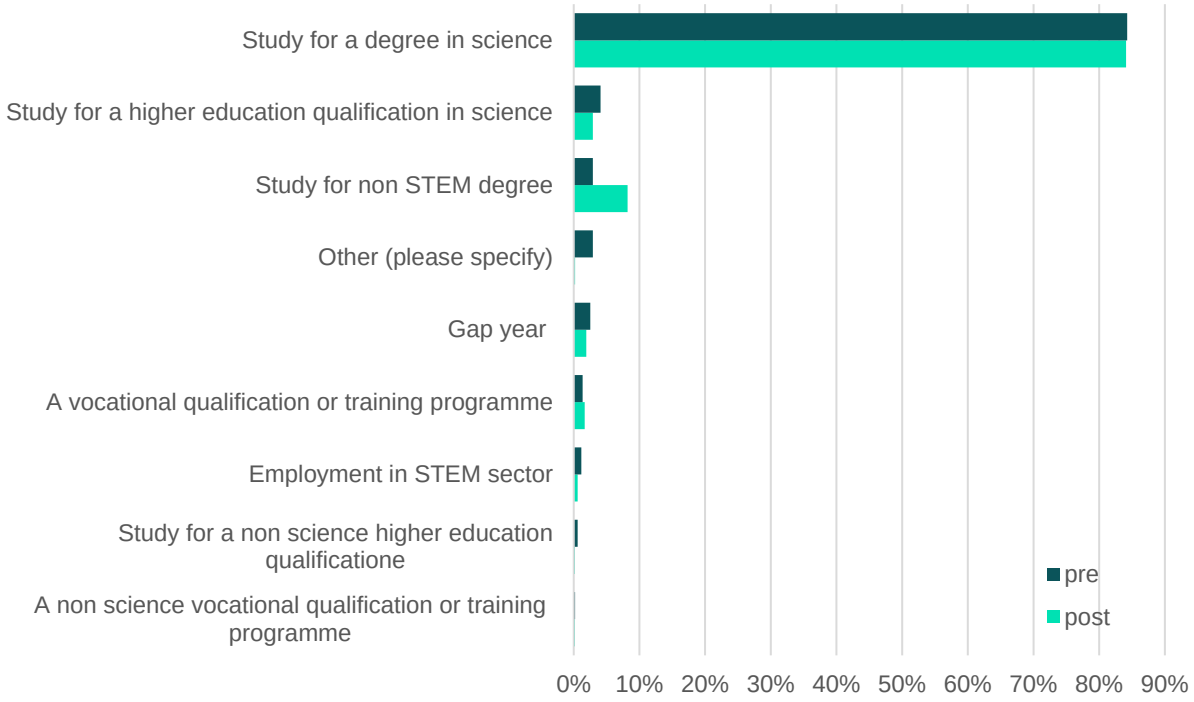
Three-fifths of supervisors (61%) report that Nuffield Future Researchers had 'a great deal' of impact on students' report writing skills in 2020 and a further 28% perceive that it had some impact in this regard (Figure 17, above). A number of interviewees indicate that the initial standard of students' writing was lower than they had expected, and students required substantial support in order to produce the final research report and poster presentation. The quality of many of the final outputs is testament to the improvements that students made during the project with support from their knowledge expert.

Influence of Nuffield Future Researchers on future plans

A further objective of Nuffield Future Researchers is to support and encourage students to study STEM in higher education to enable them to progress to STEM employment in the longer term. Therefore, a key consideration for the programme evaluation has been to ascertain the extent to which the 2020 online programme has positively influenced students' future plans by providing them with an inspiring and authentic STEM research experience.

To be eligible for Nuffield Future Researchers, students must be studying at least one STEM subject at A Level (or equivalent) and have an interest in studying STEM in higher education. As such, many students intend to progress to HE to study a STEM subject before they embark on the programme. Following Nuffield Future Researchers, over four-fifths of students (82%) report that they are intending to study a degree in a STEM subject after completing their current qualifications and a further 7% intend to study a degree in another subject. Just 3% remain undecided after the programme (Figure 18).

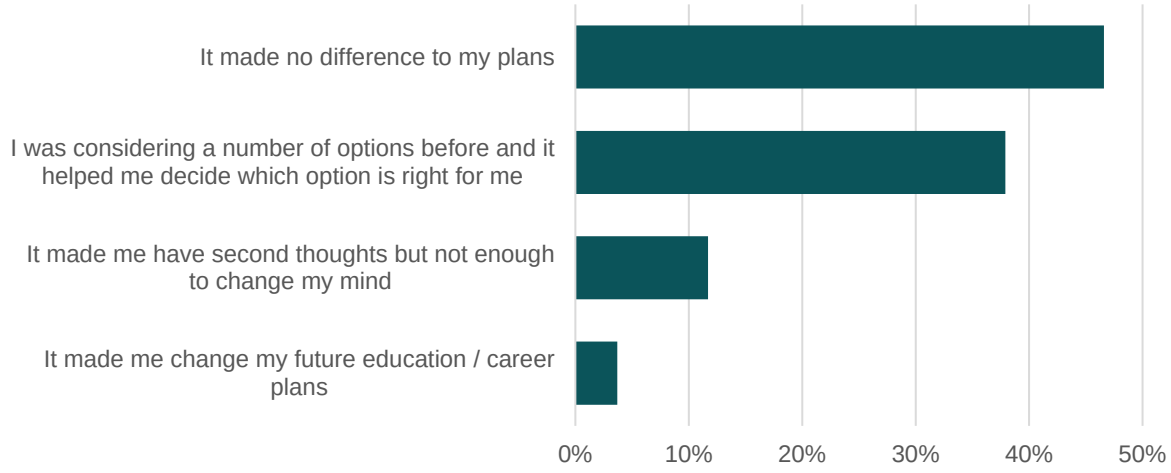
Figure 18: Students' plans after they have finished their current qualifications before and after participating in the programme (base = 515)



Summary means[14] exploring student perceptions of the impact of the programme on their future plans suggests that the 2019 programme (mean = 0.10, SD = 0.30) has been more impactful compared with the 2020 programme (mean = 0.04, SD = 0.19). Regression analysis comparing the outcomes of the 2019 and 2020 cohort confirms this finding and shows that the 2020 programme is significantly less impactful in terms of changing student perceptions about their future plans compared to the 2019 programme. However, as Figure 19 demonstrates, very few students (4%) really change their plans as a result of their experience, so this does not present a cause for concern in the event that online delivery continues.

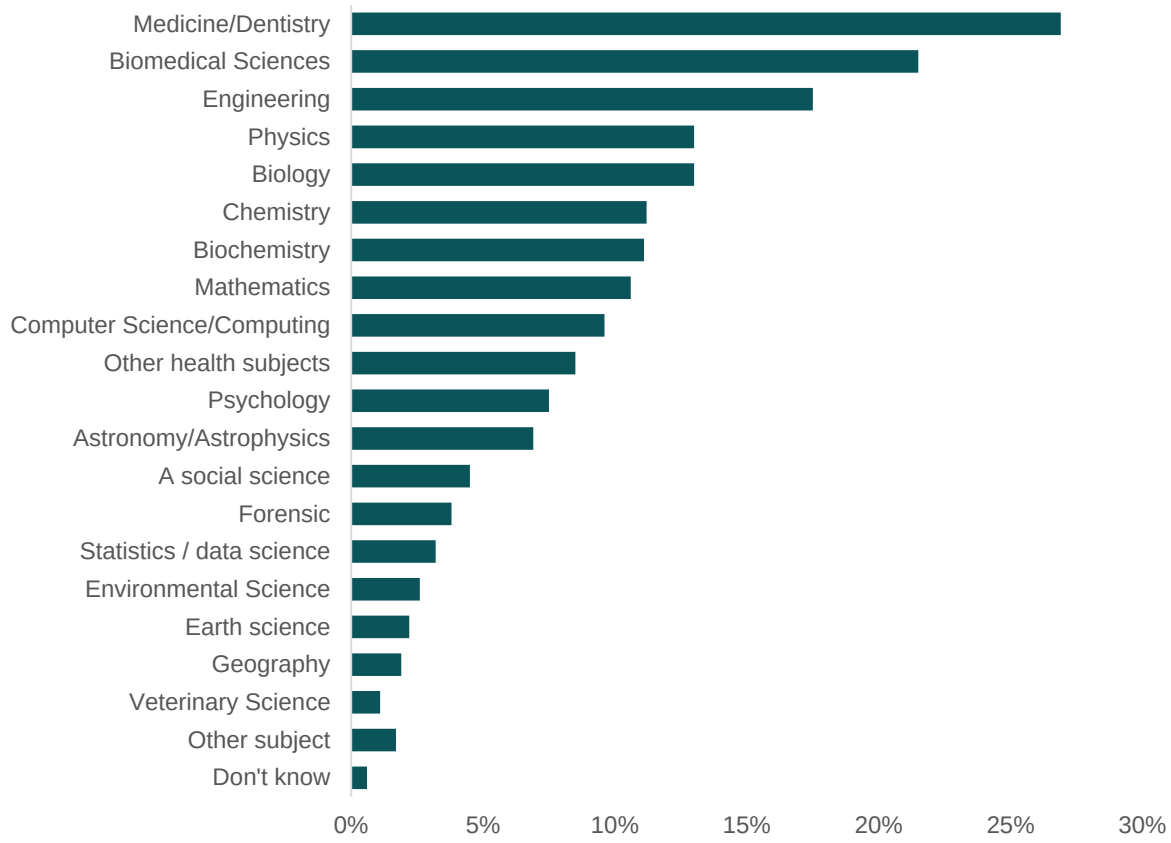
[14] The variable to measure impact of the programme on future plans was recoded such that 0 = no change (this includes 'Confirmed that I had made the right choice', 'Made me have second thoughts but not enough to change my mind', 'Made no difference to my plans' and 1 = changed plans (Made me change my future education/career plans).

Figure 19: Impact of Nuffield Future Researchers on student future plans (base = 783)



Insights from the interviews reaffirm that the programme has limited impact on student decision-making. Rather than changing students' minds, the programme helps them to reaffirm their choice or decide which of the options they are considering is right for them. Particularly, interviewees highlight that their experience helped to clarify which subject/career area they wanted to pursue. Medical subjects are the most popular choice for those intending to study a STEM degree. However, as Figure 20 (below) demonstrates, students who take part in Nuffield Future Researchers are interested in a range of subjects that span the entire STEM footprint.

Figure 20: Science degree subjects which students are considering studying at university, following participation in Nuffield Future Researchers (base = 624)



5.4.1 Knowledge of and attitudes towards STEM

An overwhelming majority of students who participated in the 2020 programme[15] perceive that STEM industries offer interesting job opportunities (96%). Analysis of student perceptions of the importance of STEM for their future career shows that ratings significantly *decreased* for those who participated in the 2019 programme. In contrast, ratings slightly *increased* for those who took part in the 2020 programme, although this difference is not significant (Table 4).

This suggests that the online mode of delivery is effective in supporting students to maintain their views about the importance of STEM and in their decision. Student interviewees perceive that one of the main benefits of participating in Nuffield Future Researchers is that it enhances their understanding of STEM careers.

[15] There was no equivalent comparative question in the 2019 dataset.

Table 4: Descriptives (means and SD) for student pre-post perceptions about the importance of STEM for their future career and the difference in scores for the 2019 and 2020 programmes.

	2019	2020
Pre-STEM is important for future career	6.579	6.480
	(0.952)	(1.046)
Post- STEM is important for future career	6.401	6.508
	(1.082)	(1.090)
Difference in STEM importance	**-0.178*** **	0.028
	(1.312)	(1.326)
N	636	506

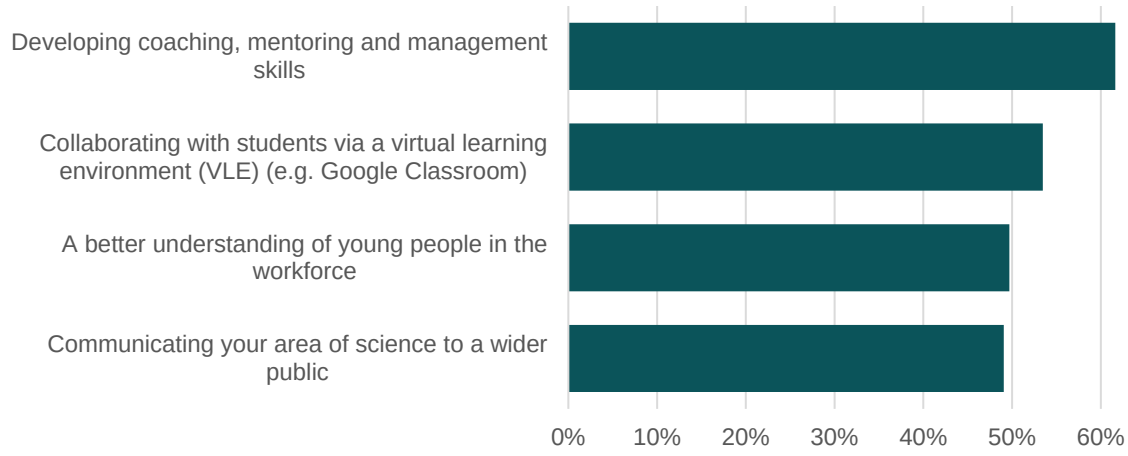
Notes – Item rated on a Likert scale ranging from 1 = strongly disagree to 7 = strongly agree. Significant differences between pre and post values, within a year, are indicated as: *** pvalue<0.01, ** pvalue<0.05, * pvalue<0.10

Benefits for supervisors and their organisations

The evidence suggests that supervisors also benefit from their engagement in Nuffield Future Researchers. As a result, almost all (98%) would recommend the programme to others and most (84%) are prepared to supervise students in the future.

The most common benefits for supervisors are the opportunities to develop their coaching, mentoring and management skills. This is particularly pertinent for the early career researchers who take part and have more limited supervisory experience. Supervisors also value the opportunity to develop their ability to collaborate with students via a VLE, which according to interviewees, is new to some supervisors (Figure 21).

Figure 21: Supervisor perceptions about their skills gained from their experience of supervising a Nuffield student (base = 159)



Around half of supervisors believe that they have a better understanding of young people as a result of their involvement in the programme. According to interviewees, this includes an improved awareness of the capabilities of young people and the support they need to achieve their ambitions in STEM, as well as a better understanding of how to work and effectively communicate with diverse student groups.

> It always helps you communicate with different groups of peoples and learn how to communicate quite complicated sorts of projects in a manner that is understandable by people who are not professionals.
>
> Supervisor (Higher Education)

Supervisors also identify several ways in which their organisation benefits from their involvement in Nuffield Future Researchers. About half of supervisors are based within higher education institutions, most of which are committed to enhancing access and participation for under-represented groups through their access and participation plans. Given that Nuffield Future Researchers now targets students who are likely to meet the criteria for national and institutional outreach programmes, it is perhaps not surprising that such a high proportion of supervisors perceive that their participation in the programme helps their institution/organisation fulfil its public engagement, widening participation or corporate social responsibility obligations (Figure 22). The programme is perceived to help them achieve these objectives by fostering strong links with schools and colleges, particularly those attended by the students they supervise.

Figure 22: Supervisors' perceptions of the wider organisation benefits from participation in Nuffield Future Researchers (base = 159)

Just under two-fifths of supervisors (37%) report that their involvement in the programme helps to strengthen their talent pipeline by identifying potential candidates for future recruitment. A quarter of those who have supervised students in the past are aware that some have indeed returned to their organisations to gain further work experience or employment. Given the socio-economic characteristics of target students, the programme is also recognised for helping placement providers diversify their workforce in the future.

Some interviewees indicate that the outputs produced by the students also benefit their institution/organisations. In the previous evaluation, academic supervisors reported that some of the reports their students produced were of publishable standard. These were used as the basis for conference papers and academic journal articles which subsequently

contributed to the institution's submission to the Research Excellence Framework.[16] In 2020, some supervisors report that they have used the findings to inform the development of their work:

> Part of the reason why we chose the research topic that we did is that we thought it could genuinely help inform the work that we do… Because we moved to working online so quickly there wasn't really an opportunity to understand or have an evidence-based way of saying 'this is how we are going to do it and this is why'.
>
> Supervisor (Higher Education)

[16] https://www.ref.ac.uk/

6. Effectiveness of the online delivery model

The online delivery model was developed in response to national restrictions that prevented the Nuffield Foundation from offering a physical research placement. This chapter examines the effectiveness of this model from the perspective of students, supervisors and co-ordinators, drawing primarily on the findings from the focus groups and interviews. We identify the advantages and limitations of the model in order to identify those elements which could be integrated to enhance programme delivery in the future.

Advantages of online approach

Despite some initial reservations, the majority of students, supervisors and co-ordinators perceive that the online model worked very effectively. They also identify a number of ways in which the virtual platform enhanced delivery and the experience for all.

Extending the reach of Nuffield Future Researchers

The number of applicants to the programme typically exceeds the number of placements and this year was no exception. Each year, to minimise the number of students who cannot be matched to a suitable placement/project, co-ordinators seek to increase the number of supervisors and the diversity of the placements/projects on offer. Although some supervisors withdrew in response to the switch to online delivery, most co-ordinators report that, on balance, the change had a **positive impact on recruitment** and helped to attract new supervisors. This included those who had been deterred from taking part in the past by perceptions of the administrative burden and/or the time and resources required to support a student on a physical placement, as well as those who were new to the programme and could offer projects that were more suited to an online approach.

In practice, many supervisors perceive that the online model is **less resource intensive** than the face-to-face approach and more than a fifth of those who responded to the survey (22%) agree that they were **able to supervise more students** as a result.

> It was actually quite easy to have the student there online and have access to all the work and be able to set assignments for them through Google Classroom. I felt, certainly compared to my last supervision experience, which was under the normal format, that it was actually easier to manage.
>
> Supervisor (Higher Education)

The move to online delivery also **helped to address 'cold spots'** by overcoming geographical constraints. Often placement organisations are clustered within major towns and cities that are easy to reach by public transport. Removing the need for students to travel to a physical location helped to widened access to placement hosts based in less accessible locations; it also opened the programme to students without access to a car and those who live in rural locations with poor public transport links.

The lack of geographical constraints also helped to **enhance the match rate** and **quality of the match** between the project and students' research interests. According to co-ordinators, a key advantage of the online approach is that it enabled them to allocate students from one

region to supervisors in another. This occurred where the supply of placements outstripped demand in a region and in instances where there was a limited number or no supervisors with expertise in the subject a student was interested in, in their region.

Communication

Once again, despite some initial concerns, most supervisors, students, and co-ordinators perceive that communication worked effectively and was enhanced by the online platform in some instances. A virtual induction makes it **easier for geographically dispersed supervisors and students to attend**, and as noted earlier in this report, the ability to record the meeting helps to ensure no-one misses out.

Access to technology, particularly a fast and stable Wi-Fi connection, was identified as a potential barrier by co-ordinators and the central team. However, this did not present a problem for the majority of students and supervisors and most found it **easy to engage** with the programme activities and each other virtually; most co-ordinators feel that the online platform has enabled them to **communicate more regularly** with students and supervisors and build a **stronger rapport**. More regular communication has also enabled co-ordinators to develop a **fuller understanding of student progress** and their **level of engagement** with the different activities.

Networking

Just under half of students report that they had the opportunity to work with other staff, and in some cases students, while on project and just over a third of supervisors indicate that an early-career researcher or other member of staff was involved in the supervision of the students at their organisation. **Wider staff engagement** with students was enabled by the online approach and is perceived to be a further advantage over traditional face-to-face delivery. Working with a range of staff enriches the experience for students by exposing them to a **broader range of perspectives** as well as **raising their awareness of the skills required for different job roles in STEM**. It was also beneficial for staff, particularly those with limited experience in a supervisory role.

Flexible engagement

The flexibility afforded by online delivery is particularly valued by students. Online delivery allows them to engage with activities, as well as with their supervisor, at a **time that suits them**. This was especially important in 2020 because students were balancing the demands of the programme with their school/college work, for the most part from home.

Most of the students interviewed had existing commitments outside of school/college and some had additional responsibilities as a result of lockdown. The more flexible online approach enables students **to fulfil their existing commitments while also participating in the programme.** This would not have been possible if students had been required to be on site 9am to 5pm to complete a physical placement. Maintaining a degree of flexibility would help to ensure these students can continue to access the programme in the future. It may also help to broaden access to other students who may be deterred by wider factors, such as a need to temporarily stop their paid part-time work to complete the placement,

particularly if they are not eligible for the Nuffield bursary or it does not fully compensate them for their loss of earnings.

Limitations of online approach

While most participants recognised the advantages of the online approach, some limitations are also identified.

Communication

Although many perceive that the online platform enhanced communication, there are some that feel it is **more challenging to establish relationships, maintain communication and monitor the progress** of their students while working remotely. Communication difficulties are a major contributing factor in the small number of projects that are perceived to have been less successful. More information about the student and their interests prior to the project is needed in the context of an online delivery model to help supervisors establish relationships in the absence of face-to-face contact and set realistic expectations.

> It would have been good to know what [the student] was interested in. What makes them interested in science? That might be a good way of building that relationship. So then when a supervisor starts, they've got things that they can ask them about.
>
> Supervisor (Higher Education)

Maintaining relationships and monitoring progress was also more difficult than some supervisors expected. This was in part because some students were not comfortable with online methods of communication. Some were slow to respond to emails and not willing to switch on their camera during video calls. As the following supervisor highlights, a **lack of face-to-face interaction**, including online, can act as a barrier to establishing effective working relationships.

> It's hard. You don't know if they're not answering emails if they're not doing any work, whereas if they are there, communication is easier. I had one student who was never comfortable enough to turn their camera on, which, you know, is entirely their choice, but it is harder to make that sort of connection if you can't see them.
>
> Supervisor (Higher Education)

Although most co-ordinators also agree that the virtual platform helped to facilitate communication, some found the **technology presents a barrier to rapport building.** However, as noted earlier this was, at least in part, because of their own lack of confidence and skills.

Replicating the professional environment

All stakeholders identified **benefits of a face-to-face placement which cannot be easily replicated online**. Principal among these is the opportunity to interact with other

professionals and to gain hands-on work experience in a physical STEM setting. This element of the traditional programme is highly valued by students and perceived to set the programme apart from other enrichment activities. In the absence of this, a minority of students **did not feel a genuine sense of engagement** in an authentic 'live project'.

The online delivery model, coupled with the lack of opportunities for students to work alongside other researchers in a physical setting, is also perceived to have **limited the range of research skills** students developed. As noted earlier, less than half of students had the opportunity to collect and analyse primary data during their project. Opportunities to collaborate and network with their peers were also limited; however, it is important to note that **isolation from peers** was also identified as an issue during the previous evaluation of Nuffield Research Placements (Cilauro & Paull, 2019), particularly among those who were placed on a university campus where few staff and students are present during the summer months when the placement takes place.

Although most students are satisfied with the amount of support they received, a minority report feeling somewhat **overwhelmed by the level of autonomy** afforded to them by remote working and this had a **demotivating effect**. There is a perception that students can more easily seek the direction and support of their supervisor on a face-to-face basis to allay any concerns.

> You felt not very directed. You didn't really know what you were working toward. If you were in the building you could at least ask questions. It just felt very distant like you were doing something on your own.
>
> Student (Earth Sciences)

Nature of the research project

In practice, **some research projects proved to be less suitable for online delivery** while others, such as those involving lab-based experiments, were not possible to deliver in this way. This was a source of disappointment for some students which affected their overall experience:

> I didn't get practical experience. I really wanted to do some lab work in the university, but I didn't get a chance to do that. I'd have got to use the scientific library and coming to university I'd have got so much inspiration […] that was really sad.
>
> Student (Chemistry)

Supervisors and co-ordinators both recognise that the **types of project** that can be offered through the programme are **limited by mode of delivery**.

Some individual tasks and activities are also perceived to be more challenging to deliver effectively online. Several supervisors report that **providing technical instructions** and **practical support are particularly problematic** and this impacts on the quality of the student experience and the outputs they can produce.

> I think being face-to-face and actually seeing people collect data is important because just saying, ‘here's a set of chemicals and a bucket and spade, go out and sample a field’ is not fair really. They need to have that demonstrated to make sure that they're following the correct protocols.
>
> Supervisor (Higher Education)

To help address this, some supervisors tried to adapt their approach by breaking the project down and providing guidance and instructions to students in manageable ‘chunks’. However, some supervisors found this challenging and may need further advice and support to structure a project for delivery online in the future:

> I think the challenges were breaking down the project into milestones and giving the student the opportunity to go and do some independent work. It was quite hard that the student was working remotely behind a computer; the ability for them to get started and become effective was quite tough.
>
> Supervisor (Private Sector- Pharmaceutical)

Based on their experience this year, the majority of supervisors who responded to the survey suggest that the optimum model moving forward would be a blended approach, for example, one that combines online preparatory modules with a face-to-face placement; just 13% advocate for a return to the traditional model and 21% to maintain an entirely online approach. Some supervisors are unable to express a view and instead state that the optimum delivery model will depend on the nature of the placement or project, with some suitable for online delivery and others requiring a physical presence. Some supervisors also express concern that reverting to a physical placement, even in combination with online modules, could present a barrier to engagement for some target students and limit access to placements in the local area which may not be a suitable match for the student’s interests. These views are largely shared by co-ordinators and students.

7. Conclusions

In this final chapter, we address the four key research questions by summarising the 2020 programme's achievements and offer recommendations to inform the development of a future delivery model and its associated evaluation.

Engagement of socially and economically disadvantaged groups

A key priority of the programme is to target students from socially and economically disadvantaged backgrounds and to provide them with an opportunity to develop skills and gain research experience in a STEM setting. Evidence suggests that this has been achieved, assisted by the flexibility afforded by the online approach. In particular, the shift to online delivery has helped to open access to the programme to a broader range of students by overcoming geographical and other practical constraints such as travel as well as by increasing the range of supervisors and the types of project on offer.

Perceptions of the programme

Students and supervisors are broadly satisfied with their overall experience of Nuffield Future Researchers and almost all would recommend it to others. Despite some initial concerns, the shift to an online approach has not negatively impacted on the stakeholder experience and is perceived to have enhanced it in many respects.

Students, on the whole, find the pre-project activities enjoyable, but some are perceived to be less relevant and useful in preparing students for the research project. 'Developing research skills' is widely recognised as equipping students with the skills and confidence they need to successfully complete the project. In contrast, 'building essential professional skills' and 'developing data analysis and numerical skills' are perceived to be less useful by some students. There is sense that the extent to which a student benefits from and enjoys an activity is dependent on their existing knowledge and skills. Those who start from a relatively low base have further to travel and can find the pre-project activities more challenging.

Undertaking a skills assessment, including ability in numeracy, before students commence the pre-project modules would help to identify their starting point and ensure students are signposted to pre-project activities (compulsory and/or optional) that best meet their needs. It is imperative that these modules are then completed prior to commencing the research project to ensure students are adequately prepared. It is therefore important that the module requirements and the timeframe for completion are proportionate and realistic.

The opportunity to complete an authentic STEM research project is the element that students most value and students are most satisfied with this aspect of the programme. The vast majority of students felt well-supported by their knowledge expert and developed a range of research skills along with an appreciation of different approaches and where to use them. Working as part of a team, both with other researchers and peers, is regarded as particularly beneficial, although a substantial proportion of students did not have an opportunity to do this via the online approach.

To enhance the experience for students in the future, supervisors require further information about their existing knowledge, skills and research interests. They also need a more detailed understanding of the pre-project module content and what students are expected to know and be able to do once they have completed them. This would assist supervisors in tailoring research projects to students' abilities and interests. Opportunities to collect primary data and learn how to use a range of computer software packages were limited in the online model. The experience would also be enhanced by opportunities to develop these skills in future.

Outcomes for learners

The online programme is equally effective at delivering outcomes for students as the face-to-face model and has a similar effect on the development of students' generic skills and attributes. Small decreases in student perceptions of their skills and attributes after they have taken part in the programme are not a concern because they are likely to be the result of a common cognitive bias which leads individuals to overestimate their abilities prior to an intervention. The programme helps students to recalibrate their perceptions of their skills and abilities and supports them to identify the areas they need to focus on in order to realise their education and career ambitions. Improvements in report writing skills are the exception and the online delivery model seems to be an effective way to achieve this outcome. Supervisors also recognise the improvements made in students' report writing abilities. They also perceive that the programme has a particularly positive impact on students' abilities to work independently and their project management skills.

An immersive experience in a physical setting appears to have a greater impact on students' aspirations, intentions and decision-making than the online experience, although it is important to note that very few students change their future plans following the programme. Most are confident they know what they want to do when they finish their current qualifications before they apply for Nuffield Future Researchers and their experience on the programme helps to reassure them that they have made the right decision. The programme has a positive influence on the small number who are yet to decide between the options they are considering and those who do change their plans by helping to ensure their final decision is well-informed.

Students have a strong interest in STEM before they apply. Most agree that STEM industries offer interesting job opportunities, but the placement helps them to develop an awareness and understanding of the range of roles available within and outside of research. Student perceptions of the likely importance of STEM in their future careers increases after the programme. The evidence suggests that the online approach is an effective way to maintain students' commitment to STEM and encourage them to pursue STEM higher education and careers.

Benefits for supervisors and their organisations/institutions

The programme provides an opportunity for supervisors, including early career researchers with limited experience, to develop their coaching, mentoring and management skills in a virtual learning environment. By connecting them to a diverse range of young people, the programme also enables supervisors to gain a fuller understanding of their needs and the best ways to support them with a view to developing their future pipeline of talent. Involvement in Nuffield Future Researchers also supports organisations/institutions to achieve wider strategic objectives, including corporate social responsibility and widening participation obligations. The insights from student outputs can help to inform operational planning and delivery.

Recommendations on the optimum delivery model

There is widespread support for a blended approach that maintains the flexibility of online delivery but offers the immersive, authentic experience of a face-to-face placement. Based on the evidence, the following recommendations to inform the development of the optimum delivery model are offered:

- Maintain the virtual induction but ensure all supervisors, and particularly those who are hosting students for the first time, receive an invitation. A recording should be provided for those who are unable to attend to ensure they are fully prepared to undertake the role. This should also be accessible to those who do attend but who want to recap the information provided.

- Raise awareness of drop-in sessions for supervisors to ensure they are fully informed about their role and have access to opportunities for networking and peer support.

- Ensure drop-in sessions for students are focused on a theme to maximise attendance and engagement.

- Provide supervisors with further information about the pre-project module content and copies of the assignments that students produce, in addition to information on students' existing knowledge, skills and research interests, to enable them to tailor their projects appropriately.

- Consider implementing a skills assessment for successful applicants to identify existing knowledge and strengths as well as skills gaps.

- Provide co-ordinators with further information about the pre-project module content and what students are expected to achieve as a result of completing them in addition to the correct answers to enable co-ordinators to provide effective feedback to students.

- Provide additional training and support to those co-ordinators (and supervisors) who are less confident and experienced at working within a VLE.

- Consider making 'Developing research skills' compulsory and implementing a menu-driven approach for the other pre-project activities. Signpost students to appropriate options from the menu of pre-project activities to address skills gaps (identified through

the skills assessment) and equip them with the knowledge they need to complete their specific research project.

- Ensure the pre-project module requirements and timescales are proportionate and realistic so that students can complete the activities *prior to* commencing their research project and are adequately prepared.

- Support supervisors to adapt their project to the skills and interests of students as well as mode of delivery. Ensure projects that are designed to be delivered online can be broken into manageable 'chunks' and are achievable for students within the timeframe.

- Produce case studies to illustrate effective approaches of online delivery to help support supervisors to develop appropriate projects for students in the future.

Recommendations for future evaluation

To enhance the future evaluation activity of Nuffield programmes and further develop the evidence base regarding the extent to which the main programme aims are being met, the following recommendations are offered:

Measuring student outcomes

- Ensure permission is in place to link the application data with the pre- and post-application survey data to maximise the data available for analysis.

- Prior qualification level and predicted grades could be an important factor influencing student engagement and enjoyment of module activities. This data is not currently collected in a consistent and easy to analyse format. Consider adapting the application form so that students can select grades (achieved and predicted) from drop down menus for key subjects (e.g. maths, English and science) so that data is captured in separate columns to enhance analysis options.

- Ensure the variables that will be used for pre–post analysis are consistent in the post-application and post-project survey. Some of the response options were refined in the 2020 post-project survey to ensure clarity in the context of online delivery. These should be reflected in future versions of the pre-survey to ensure change over time can be measured.

Refinements to the student survey instrument

- The addition of a 'Not applicable – I did not receive a bursary' response option to Q18 (Which of the following areas describe what you spent your £400 bursary on?) will provide the opportunity to explore differences in student perceptions according to Nuffield bursary status.

- If future delivery is based on a blended model, it will be beneficial to include survey routing to distinguish between face-to-face and online elements of the programme in subsequent analysis.

Measuring supervisor outcomes

- The approach to sampling and survey dissemination varies across the regions. Going forward it is important to ensure a consistent approach is adopted so that the views of supervisors from all regions are represented in the evaluation. Given the size of the sample, it is recommended that a census rather than a sample is surveyed.

- Ensure the region of the supervisor is recorded and available for use in the analysis of the survey data so that any issues at a regional level can be identified.

- As the online approach enables supervisors to support students outside their home region, it would be useful to capture this information in the monitoring data.

Refinements to the supervisor survey instrument

- The number of students a supervisor supports could be a factor influencing their experience of the programme. At present, Q8 asks for the names of the students the supervisor supported. Although the number of students can be calculated from this information, to ensure an accurate figure and for ease of analysis, it is recommended that the following question is added: 'How many students did you supervise in total?' This could then be followed by the question: 'How many of these students were you the main supervisor for?' This could replace Revised Q15: 'Were you the main supervisor responsible for the day-to-day supervision of the student(s)?'

- Q9 enquires about the supervisor's placement subject area and is currently an open-response format. Deriving pre-coded response options for the main subject disciplines with the inclusion of an 'other' response will be beneficial for a consistent approach to the analysis.

- If a blended model is implemented in the future, it will be important to ensure the supervisor survey is adapted to collate perceptions about both face-to-face elements and online aspects.

Ongoing process evaluation

- Consultation with co-ordinators to explore both enablers and barriers experienced will help to ensure ongoing training and development needs are met.

- Follow-up interviews with students and supervisors should remain an integral element of future evaluations to offer detailed insights into 'how' and 'why' particular aspects of future provision are effective in making progress towards programme objectives, and to identify areas for improvement.

Appendix 1: Control Variables

- Gender (female and gender missing dummy[17])
- BAME (1 = BAME, 0 = White)
- Whether parent has a degree (1 = yes or 0 = no)
- FSM entitlement (1 = yes or 0 = no)
- Whether eligible for Nuffield bursary (1 = yes or 0 = no)
- Whether received Nuffield bursary (1 = yes or 0 = no)
- Number of STEM activities participated in (1 = yes, 0 = no, combined variable ranges from 0 to 7)
- Frequency of STEM activity participation (0 = never, 1 = less often, 2 = at least once a year, 3 = several times a year, 4 = at least once a month)
- Number of interest activities participated in (1 = yes or 0 =no, combined variable ranges from 0 to 3)
- Whether student has heard of BSA CREST award (1 = yes, 0 = no/don't know)
- Number of days of extracurricular activities participated in (total score ranging from 0 to 19)
- Number of planned extracurricular activities (0 indicates no plans)
- Connection with people in STEM jobs (0 = no one, 1 = one or two people, 2 = three to four people, 3 = at least five people)
- Whether student has talked to people about STEM, outside school (0 = never, 1 = occasionally, 3 = often)
- Whether parent(s) are interested science (1 = yes, 0 = no)

[17] The latter includes all those who said 'other' (n=3), 'prefer not to say' (n=5), and missing information (n=180)

Appendix 2: Regression analysis

Table 5: Summary means and SD () for student demographics for the 2019 and 2020 programme delivery models.

	2019	2020
Female	0.508 (0.500)	0.657 (0.475) ***
Gender missing	0.218 (0.413)	0.009 (0.096) ***
BAME	0.537 (0.499)	0.6005 (0.489) **
Parent has a degree	0.250 (0.434)	0.241 (0.428)
FSM entitlement	0.265 (0.441)	0.353 (0.478) ***
Entitled to Nuffield Bursary	0.393 (0.489)	0.518 (0.500) ***
Received Nuffield Bursary	0.880 (0.325)	0.905 (0.293)

Significant differences over the years are highlighted and shown as: * p< 0.10, ** p<0.05, *** p<0.01

Notes:

1. All variables are binary.
2. Number of observations vary across variables, some have more missing than others.
3. Gender is captured by two dummies: Female dummy, and Gender missing dummy. The later includes all those who said 'other' (n=3), 'prefer not to say' (n=5), and missing information (n=180). All 180 with missing information on Gender are in 2019, this is causing the Gender dummies to be significantly different over the years.
4. There are more BAME, FSM and bursary individuals in 2020 relative to 2019.

Table 6: Regression results (OLS) using pre-post differences in students' total knowledge, skills and attributes scores and the difference between the 2019 and 2020 programme delivery models.

	Difference in total knowledge, skills and attributes score			
	(1)	**(2)**	**(3)**	**(4)**
Treatment (0 = 2019, 1 = 2020)	**0.681**	**0.192**	**0.081**	**0.065**
	(0.471)	**(0.395)**	**(0.398)**	**(0.398)**
PRE: Skills score		-0.653***	-0.663***	-0.682***
		(0.029)	(0.030)	(0.030)
Female			-0.905**	-1.002**
			(0.419)	(0.427)
Gender missing			-1.235	-1.609
			(2.381)	(2.377)
BAME			0.873**	0.921**

			(0.412)	(0.427)
Parent has a degree			0.704	0.422
			(0.467)	(0.483)
FSM entitlement			0.008	-0.049
			(0.449)	(0.448)
Bursary entitlement			0.447	0.407
			(0.436)	(0.436)
Nuffield bursary			-0.485	-0.288
			(0.709)	(0.710)
Number of STEM activities				0.273*
				(0.161)
Frequency of STEM activities				0.000
				(0.203)
Number of interest activities				-0.118
				(0.301)
Heard of BSA CREST award				-0.251
				(0.428)
Number of extracurricular activities				-0.011
				(0.245)
Days of Extracurricular activities				0.002
				(0.004)
Connection with people in STEM jobs				0.148
				(0.269)
Talk to people about STEM, outside school				0.497**
				(0.247)
Parent interested in science				0.422
				(0.424)
Number of extracurricular activities planned				0.436**
				(0.222)
Constant	-1.294***	28.631***	29.311***	28.086***
	(0.315)	(1.367)	(1.509)	(1.606)
N	1154	1154	1127	1127

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01
Notes:

5. Read Table 5: Summary means and SD () for student demographics for the 2019 and 2020 programme delivery models

	2019	2020
Female	0.508 (0.500)	0.657 (0.475) ***
Gender missing	0.218 (0.413)	0.009 (0.096) ***
BAME	0.537 (0.499)	0.6005 (0.489) **
Parent has a degree	0.250 (0.434)	0.241 (0.428)
FSM entitlement	0.265 (0.441)	0.353 (0.478) ***
Entitled to Nuffield Bursary	0.393 (0.489)	0.518 (0.500) ***
Received Nuffield Bursary	0.880 (0.325)	0.905 (0.293)

Significant differences over the years are highlighted and shown as: * p< 0.10, ** p<0.05, *** p<0.01
Notes:

6. All variables are binary.
7. Number of observations vary across variables, some have more missing than others.
8. Gender is captured by two dummies: Female dummy, and Gender missing dummy. The later includes all those who said 'other' (n=3), 'prefer not to say' (n=5), and missing information (n=180). All 180 with missing information on Gender are in 2019, this is causing the Gender dummies to be significantly different over the years.
9. There are more BAME, FSM and bursary individuals in 2020 relative to 2019.
10. Table 6 in conjunction of Table 1.
11. Treatment is the main variable of interest, it takes value 1 for 2020 and 0 for 2019. The coefficient on 'Treatment' gives us the difference in the differenced (DiD) outcomes for each year.
    For e.g., DiD in skills scores: $(Post_{2020} - Pre_{2020}) - (Post_{2019} - Pre_{2019}) = -0.614 - (-1.294) = 0.680$. For skill scores this DiD score is insignificant. So while within a year we know from Table 7 that participation in the program makes a difference to the skill scores, there is no difference in the difference made between the two years. Another way: both programs make similar amount of difference to skill scores.
    For STEM importance DiD coefficient is significant and positive. Here while in 2019 the program was reducing the ratings of how important STEM is to future careers, in 2020 this is not happening.
12. Each column adds more controls, controlling for pre scores makes a difference to the magnitude of the coefficient, but after that adding any other kind of control demographic or social and cultural capital does not makes much of a difference.

Table 7: Regression results (OLS) using pre-post programmes differences for student perceptions of individual skill domains and the difference between the 2019 and 2020 programmes. No controls included.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.151***	**0.170****	**0.275*****	**0.445*****	**0.124**	**-0.079**	**0.020**	**0.038**
	(0.081)	**(0.081)**	**(0.074)**	**(0.082)**	**(0.086)**	**(0.083)**	**(0.073)**	**(0.068)**
Constant	-0.235***	-0.055	-0.205***	-0.183***	-0.122**	-0.202***	-0.232***	-0.061
	(0.054)	(0.054)	(0.049)	(0.055)	(0.057)	(0.056)	(0.048)	(0.045)
N	1150	1150	1150	1147	1149	1151	1140	1151

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Notes:

1. Read Table 7 in conjunction with Table 2.
2. Treatment is the main variable of interest, it takes value 1 for 2020 and 0 for 2019. The coefficient on 'Treatment' gives us the difference in the differenced (DiD) outcomes for each year.
   For e.g., DiD in skill 'Motivated': $(Post_{2020} - Pre_{2020}) - (Post_{2019} - Pre_{2019}) = -0.084 - (-0.235) = 0.151$. For 'Motivated' this DiD score is significant and positive. While in 2019 the program was reducing the ratings on 'Motivation', in 2020 this is not happening. Program makes no difference to the ratings in 2020 which is an improvement over the negative effect it was having in 2019

Table 8: Regression results (OLS) on difference in pre-post programme scores for student perceptions of individual skill domains and the difference between the 2019 and 2020 programmes. Model controls for pre-skills scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.051**	**0.123***	**0.192*****	**0.343*****	**0.057**	**-0.109**	**0.016**	**0.016**
	(0.064)	**(0.067)**	**(0.059)**	**(0.067)**	**(0.079)**	**(0.073)**	**(0.062)**	**(0.051)**
PRE domain specific score	-0.737***	-0.678***	-0.733***	-0.669***	-0.394***	-0.558***	-0.604***	-0.742***
	(0.028)	(0.029)	(0.029)	(0.028)	(0.027)	(0.029)	(0.029)	(0.026)
Constant	4.275***	3.696***	4.091***	3.371***	1.837***	2.930***	3.439***	4.621***
	(0.176)	(0.168)	(0.176)	(0.157)	(0.143)	(0.172)	(0.179)	(0.166)
N	1150	1150	1150	1147	1149	1151	1140	1151

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Notes: Controlling for pre (domain specific) scores reduces the magnitude of the coefficient on 'Treatment'

Table 9: Regression results (OLS) on difference in pre-post programme scores for student perceptions of individual skill domains and the difference between the 2019 and 2020 programmes. Model controls for pre-skills scores, student demographics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.034**	**0.102**	**0.191*** **	**0.327*** **	**0.030**	**-0.128***	**0.003**	**0.015**
	(0.064)	**(0.067)**	**(0.059)**	**(0.068)**	**(0.080)**	**(0.073)**	**(0.062)**	**(0.052)**
PRE domain specific score	-0.748***	-0.696***	-0.758***	-0.678***	-0.407***	-0.565***	-0.609***	-0.761***
	(0.029)	(0.030)	(0.030)	(0.029)	(0.027)	(0.030)	(0.029)	(0.027)
Female	-0.044	-0.281***	-0.311***	0.021	-0.157*	-0.047	0.039	0.012
	(0.068)	(0.071)	(0.063)	(0.072)	(0.084)	(0.078)	(0.066)	(0.055)
Gender missing	0.268	-0.455	-0.179	-0.200	-0.233	-1.102**	0.299	0.041
	(0.385)	(0.402)	(0.355)	(0.405)	(0.476)	(0.437)	(0.371)	(0.311)
BAME	-0.071	0.180***	-0.027	0.129*	0.325***	0.053	0.095	-0.060
	(0.067)	(0.070)	(0.062)	(0.070)	(0.083)	(0.076)	(0.065)	(0.054)
Parent has a degree	0.098	0.111	0.188***	0.059	0.101	-0.058	0.003	0.044
	(0.076)	(0.079)	(0.070)	(0.080)	(0.094)	(0.086)	(0.073)	(0.061)
FSM entitlement	-0.001	0.047	-0.057	0.029	-0.004	0.063	0.058	-0.029
	(0.072)	(0.076)	(0.067)	(0.077)	(0.090)	(0.083)	(0.071)	(0.059)
Bursary entitlement	-0.082	0.019	0.076	0.093	0.047	0.037	0.052	0.009
	(0.071)	(0.074)	(0.065)	(0.075)	(0.088)	(0.080)	(0.069)	(0.057)
Nuffield bursary	0.061	-0.115	-0.001	-0.009	-0.011	0.039	-0.057	-0.053
	(0.114)	(0.120)	(0.106)	(0.121)	(0.142)	(0.130)	(0.111)	(0.093)
Constant	4.388***	3.945***	4.394***	3.282***	1.801***	2.935***	3.398***	4.810***
	(0.209)	(0.200)	(0.206)	(0.187)	(0.191)	(0.207)	(0.201)	(0.189)
N	1123	1123	1123	1120	1122	1124	1113	1124

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Notes:

1. Adding demographic controls makes a few changes much from Table 11 above. We lose the marginal significance for the coefficient on 'Treatment' for 'Confident', 'and coefficient on 'Treatment' for 'Time management' is now significant and negative (it would seem that the program makes time management worse and the amount by which it makes is worse is even more in 2020).

Table 10: Regression results (OLS) on difference in pre-post programme scores for student perceptions of individual skill domains and the difference between the 2019 and 2020 programmes. Model controls for pre-skills scores, student demographics and science and cultural capital

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.021**	**0.104**	**0.189*** **	**0.321*** **	**0.035**	**-0.133***	**0.004**	**0.011**
	(0.064)	**(0.067)**	**(0.059)**	**(0.068)**	**(0.080)**	**(0.074)**	**(0.063)**	**(0.052)**
PRE domain specific score	-0.761***	-0.709***	-0.769***	-0.688***	-0.415***	-0.572***	-0.617***	-0.771***
	(0.029)	(0.030)	(0.030)	(0.029)	(0.028)	(0.030)	(0.030)	(0.027)
Female	-0.063	-0.295***	-0.322***	0.024	-0.150*	-0.070	0.026	0.014
	(0.069)	(0.073)	(0.064)	(0.073)	(0.086)	(0.080)	(0.067)	(0.056)
Gender missing	0.218	-0.502	-0.238	-0.258	-0.295	-1.145***	0.276	0.013
	(0.384)	(0.403)	(0.354)	(0.404)	(0.476)	(0.438)	(0.371)	(0.312)
BAME	-0.057	0.195***	-0.013	0.124*	0.328***	0.064	0.085	-0.049
	(0.069)	(0.072)	(0.064)	(0.073)	(0.086)	(0.079)	(0.067)	(0.056)
Parent has a degree	0.095	0.068	0.151**	0.008	0.069	-0.088	-0.053	0.025
	(0.078)	(0.082)	(0.072)	(0.082)	(0.097)	(0.089)	(0.076)	(0.063)
FSM entitlement	-0.005	0.044	-0.063	0.024	-0.010	0.058	0.051	-0.029
	(0.072)	(0.076)	(0.067)	(0.077)	(0.090)	(0.083)	(0.071)	(0.059)
Bursary entitlement	-0.089	0.013	0.074	0.090	0.053	0.030	0.044	0.005
	(0.070)	(0.074)	(0.065)	(0.074)	(0.088)	(0.081)	(0.069)	(0.057)
Nuffield bursary	0.076	-0.093	0.016	0.027	0.006	0.065	-0.031	-0.049
	(0.115)	(0.120)	(0.106)	(0.121)	(0.143)	(0.131)	(0.112)	(0.093)
Number of STEM activities	0.007	0.027	0.045*	0.035	0.069**	0.035	0.038	-0.003
	(0.026)	(0.027)	(0.024)	(0.027)	(0.032)	(0.030)	(0.025)	(0.021)
Frequency of STEM activities	-0.026	0.015	0.007	0.001	0.004	-0.053	-0.015	0.032
	(0.033)	(0.034)	(0.030)	(0.035)	(0.041)	(0.038)	(0.032)	(0.027)
Number of interest activities	0.043	0.001	-0.001	0.009	-0.034	0.009	-0.032	0.044
	(0.048)	(0.051)	(0.045)	(0.051)	(0.060)	(0.055)	(0.047)	(0.039)
Heard of BSA CREST award	-0.028	-0.013	-0.024	-0.021	-0.051	0.039	-0.060	-0.054
	(0.069)	(0.073)	(0.064)	(0.073)	(0.086)	(0.079)	(0.067)	(0.056)
Number of extracurricular activities	-0.055	-0.016	-0.043	0.015	0.037	-0.043	0.033	-0.045

	(0.040)	(0.042)	(0.037)	(0.042)	(0.049)	(0.045)	(0.038)	(0.032)
Days of Extracurricular activities	0.000	0.000	0.001**	-0.000	0.000	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Connection with people in STEM jobs	0.036	0.031	0.006	0.035	0.001	0.017	0.036	0.036
	(0.043)	(0.046)	(0.040)	(0.046)	(0.054)	(0.050)	(0.042)	(0.035)
Talk to people about STEM, outside school	0.113***	0.051	0.040	0.059	-0.007	0.084*	0.032	0.033
	(0.040)	(0.042)	(0.037)	(0.042)	(0.050)	(0.045)	(0.039)	(0.032)
Parent interested in science	-0.047	0.063	0.059	0.077	0.046	0.039	0.116*	0.012
	(0.069)	(0.072)	(0.063)	(0.072)	(0.085)	(0.078)	(0.067)	(0.056)
Number of extracurricular activities planned	0.085**	0.036	0.067**	0.110***	0.059	0.056	0.024	0.050*
	(0.036)	(0.038)	(0.033)	(0.038)	(0.045)	(0.041)	(0.035)	(0.029)
Constant	4.134***	3.750***	4.189***	2.946***	1.655***	2.685***	3.265***	4.654***
	(0.237)	(0.234)	(0.227)	(0.219)	(0.237)	(0.247)	(0.228)	(0.208)
N	1123	1123	1123	1120	1122	1124	1113	1124

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 11: Regression results (OLS) for the difference in total post-programme skills scores between the 2019 and 2020 programmes. Model 2 controls for student demographics and model 3 controls for science and cultural capital.

	(1)	(2)	(3)
Treatment	**-1.451*** **	**-1.538*** **	**-1.496*** **
	(0.166)	**(0.175)**	**(0.178)**
Female		0.064	-0.054
		(0.184)	(0.191)
Gender missing		-1.898*	-1.961*
		(1.056)	(1.053)
BAME		0.594***	0.666***
		(0.182)	(0.191)
Parent has a degree		-0.341*	-0.467**
		(0.205)	(0.215)
FSM entitlement		0.174	0.089

		(0.196)	(0.200)
Bursary entitlement		-0.128	-0.205
		(0.191)	(0.195)
Nuffield bursary		0.086	0.222
		(0.313)	(0.317)
Number of STEM activities			-0.007
			(0.072)
Frequency of STEM activities			0.114
			(0.091)
Number of interest activities			-0.017
			(0.134)
Heard of BSA CREST award			-0.036
			(0.191)
Number of extracurricular activities			-0.003
			(0.117)
Days of Extracurricular activities			-0.002
			(0.003)
Connection with people in STEM jobs			0.095
			(0.119)
Talk to people about STEM, outside school			0.335***
			(0.109)
Parent interested in science			0.283
			(0.189)
Number of extracurricular activities planned			0.030
			(0.099)
Constant	20.370***	20.080***	19.118***
	(0.103)	(0.306)	(0.479)
N	1321	1149	1114

Table 12: Odds ratios from logit specification comparing students' perceptions of impact for individual skills domains that are attributable to the 2019 and 2020 programmes, with no controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.341*** **	**0.610*** **	**0.557*** **	**1.599*** **	**0.662*** **	**0.721*** **	**0.332*** **	**0.513*** **
	(0.040)	**(0.069)**	**(0.063)**	**(0.183)**	**(0.082)**	**(0.082)**	**(0.039)**	**(0.070)**
N	1321	1321	1321	1321	1321	1321	1321	1321

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01
Each dependent variable is defined as 1 = A great deal, and 0 = no impact/somewhat/not sure

Note:
1. With the exception of report writing all odds ratios are less than one, indicating that impact in 2020 was less relative to 2019. Report writing has odds ratio greater than one, indicating higher impact in 2020 on this dimension. These findings are confirmed by the averages shown in Table 3

Table 13: Odds ratios from logit specification comparing students' perceptions of impact for individual skills domains that are attributable to the 2019 and 2020 programmes, with demographic controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.322*** **	**0.602*** **	**0.528*** **	**1.513*** **	**0.646*** **	**0.711*** **	**0.304*** **	**0.497*** **
	(0.040)	**(0.073)**	**(0.064)**	**(0.183)**	**(0.085)**	**(0.086)**	**(0.039)**	**(0.073)**
Female	0.982	0.920	0.810*	0.905	0.968	1.390***	1.271*	0.978
	(0.128)	(0.117)	(0.103)	(0.115)	(0.131)	(0.176)	(0.168)	(0.151)
Gender missing	0.560	0.617	0.554	1.142	0.412	0.466	0.392	0.576
	(0.431)	(0.460)	(0.416)	(0.852)	(0.446)	(0.387)	(0.336)	(0.437)
BAME	1.066	1.314**	1.318**	0.942	1.644***	1.162	1.670***	1.233
	(0.138)	(0.165)	(0.166)	(0.118)	(0.225)	(0.145)	(0.220)	(0.186)
Parent has a degree	0.877	0.780*	1.062	0.925	1.029	0.661***	0.848	0.882
	(0.127)	(0.110)	(0.151)	(0.130)	(0.155)	(0.093)	(0.125)	(0.149)
FSM entitlement	1.284*	0.930	0.955	1.020	0.922	0.959	1.464***	1.079
	(0.180)	(0.126)	(0.130)	(0.138)	(0.134)	(0.129)	(0.209)	(0.177)
Bursary entitlement	0.935	0.955	0.964	1.061	1.027	0.995	0.792*	0.725**
	(0.127)	(0.126)	(0.128)	(0.140)	(0.145)	(0.131)	(0.109)	(0.117)
Nuffield bursary	0.956	1.173	0.844	1.257	1.094	1.081	0.731	1.134
	(0.213)	(0.253)	(0.184)	(0.270)	(0.261)	(0.232)	(0.166)	(0.300)
N	1149	1149	1149	1149	1149	1149	1149	1149

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Each dependent variable is defined as 1 = A great deal, and 0 = no impact/somewhat/not sure

Note: results are similar to those in Table 12.

Table 14: Odds ratios from logit specification comparing students' perceptions of impact for individual skills domains that are attributable to the 2019 and 2020 programmes, with demographic and science and cultural capital controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Motivated	**Confident**	**Problem Solving**	**Report Writing**	**Confident Presenter**	**Time Management**	**Team working**	**Independent**
Treatment	**0.313*** **	**0.607*** **	**0.518*** **	**1.568*** **	**0.649*** **	**0.729** **	**0.305*** **	**0.505*** **
	(0.040)	**(0.075)**	**(0.065)**	**(0.196)**	**(0.087)**	**(0.090)**	**(0.040)**	**(0.075)**
Female	0.892	0.835	0.746**	0.911	0.906	1.359**	1.159	0.969
	(0.123)	(0.112)	(0.100)	(0.122)	(0.128)	(0.180)	(0.161)	(0.157)
Gender missing	0.567	0.564	0.522	1.051	0.341	0.429	0.399	0.576
	(0.437)	(0.426)	(0.399)	(0.807)	(0.372)	(0.360)	(0.347)	(0.437)
BAME	1.106	1.402**	1.377**	0.876	1.708***	1.236	1.700***	1.325*
	(0.152)	(0.187)	(0.185)	(0.117)	(0.248)	(0.164)	(0.239)	(0.212)
Parent has a degree	0.831	0.696**	0.963	0.947	0.960	0.637***	0.733**	0.792
	(0.129)	(0.105)	(0.145)	(0.142)	(0.153)	(0.095)	(0.115)	(0.142)
FSM entitlement	1.206	0.853	0.925	0.982	0.874	0.939	1.446**	1.064
	(0.175)	(0.119)	(0.130)	(0.137)	(0.131)	(0.130)	(0.214)	(0.178)
Bursary entitlement	0.897	0.962	0.925	1.076	1.046	0.966	0.723**	0.677**
	(0.127)	(0.132)	(0.127)	(0.147)	(0.151)	(0.131)	(0.104)	(0.113)
Nuffield bursary	1.006	1.268	0.917	1.310	1.130	1.103	0.788	1.251
	(0.231)	(0.280)	(0.204)	(0.290)	(0.275)	(0.243)	(0.184)	(0.337)
Number of STEM activities	0.945	1.038	1.045	0.949	1.067	1.017	0.977	0.972
	(0.049)	(0.052)	(0.053)	(0.048)	(0.057)	(0.051)	(0.051)	(0.058)
Frequency of STEM activities	1.015	1.033	1.056	1.056	1.070	0.993	1.047	1.068
	(0.067)	(0.066)	(0.067)	(0.067)	(0.072)	(0.063)	(0.070)	(0.083)
Number of interest activities	1.023	0.963	0.957	1.080	1.013	1.076	0.907	1.124
	(0.099)	(0.090)	(0.090)	(0.101)	(0.102)	(0.100)	(0.088)	(0.125)
Heard of BSA CREST award	0.891	0.992	0.912	1.066	0.883	1.075	0.930	1.031
	(0.123)	(0.133)	(0.122)	(0.143)	(0.127)	(0.143)	(0.130)	(0.167)

Number of extracurricular activities	0.959	0.958	1.057	1.121	1.065	0.848**	0.976	1.041
	(0.083)	(0.079)	(0.088)	(0.094)	(0.091)	(0.069)	(0.084)	(0.103)
Days of Extracurricular activities	0.995**	0.998	1.000	0.998	0.998	1.002	0.999	0.998
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Connection with people in STEM jobs	1.179*	1.124	1.014	0.963	1.043	0.937	1.160*	1.133
	(0.103)	(0.095)	(0.085)	(0.081)	(0.091)	(0.078)	(0.103)	(0.118)
Talk to people about STEM, outside school	1.308***	1.138*	1.193**	1.119	1.179**	1.164**	1.174**	1.027
	(0.103)	(0.087)	(0.092)	(0.085)	(0.097)	(0.088)	(0.094)	(0.095)
Parent interested in science	1.052	1.282*	1.274*	0.949	1.040	1.106	1.500***	1.135
	(0.144)	(0.170)	(0.169)	(0.125)	(0.147)	(0.145)	(0.209)	(0.181)
Number of extracurricular activities planned	1.053	0.986	0.940	1.292***	1.059	1.089	1.038	0.932
	(0.075)	(0.068)	(0.065)	(0.095)	(0.076)	(0.075)	(0.075)	(0.076)
N	1114	1114	1114	1114	1114	1114	1114	1114

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Each dependent variable is defined as 1 = A great deal, and 0 = no impact/somewhat/not sure

Note: results are similar to those in Table 13.

Table 15: Odds ratios from logit specification comparing students' perceptions of impact on future plans between the 2019 and 2020 programmes, no controls included in model 1, demographics included in model 2 and science and cultural capital added in model 3.

	(1)	(2)	(3)
	POST: Impact of the program on future plans	POST: Impact of the program on future plans	POST: Impact of the program on future plans
Treatment	**0.355*** **	**0.303*** **	**0.293*** **
	(0.089)	**(0.078)**	**(0.078)**
Female		1.982***	1.971**
		(0.525)	(0.535)
Gender missing		9.987***	10.740***
		(8.879)	(9.585)
BAME		1.103	1.189
		(0.257)	(0.289)
Parent has a degree		0.732	0.746
		(0.199)	(0.210)
FSM entitlement		0.688	0.705
		(0.178)	(0.185)
Bursary entitlement		0.956	0.961
		(0.229)	(0.233)
Nuffield bursary		1.670	1.873
		(0.705)	(0.835)
			0.947
Number of STEM activities			(0.090)
			1.121
Frequency of STEM activities			(0.129)
			1.070
Number of interest activities			(0.186)
			1.038
Heard of BSA CREST award			(0.251)
			1.058
Number of extracurricular activities			(0.168)
			0.995
Days of Extracurricular activities			(0.005)

			0.987
Connection with people in STEM jobs			(0.151)
			1.022
Talk to people about STEM, outside school			(0.141)
			0.917
Parent interested in science			(0.221)
Number of extracurricular activities planned			0.802
			(0.119)
N	1336	1165	1129

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

POST: Impact of the program on future plans, 0 = no change (this includes Confirmed that I had made the right choice, Made me have second thoughts but not enough to change my mind, Made no difference to my plans) and 1 = changed plans (Made me change my future education/career plans)

Table 16: Regression results (OLS) for students' perceptions about the importance of STEM importance for their future plans and the difference in scores between the 2019 and 2020 programmes. Model 2 controls for pre-STEM importance scores, model 3 control for student demographics and model 4 controls for science and cultural capital.

	Difference in STEM importance			
	(1)	**(2)**	**(3)**	**(4)**
Treatment (0 = 2019, 1 = 2020)	**0.205*** **	**0.128** **	**0.134** **	**0.128** **
	(0.079)	**(0.063)**	**(0.064)**	**(0.064)**
PRE: STEM is important for future career		-0.783***	-0.807***	-0.809***
		(0.032)	(0.032)	(0.032)
Female			-0.299***	-0.295***
			(0.067)	(0.069)
Gender missing			0.234	0.208
			(0.378)	(0.379)
BAME			-0.085	-0.080
			(0.066)	(0.068)
Parent has a degree			0.079	0.054
			(0.075)	(0.078)
FSM entitlement			-0.051	-0.051
			(0.072)	(0.072)
Bursary entitlement			-0.089	-0.090
			(0.070)	(0.070)
Nuffield bursary			-0.015	-0.016
			(0.113)	(0.114)
Number of STEM activities				0.006
				(0.026)
Frequency of STEM activities				0.019
				(0.032)
Number of interest activities				0.039
				(0.048)
Heard of BSA CREST award				-0.081
				(0.069)
Number of extracurricular activities				-0.064

				(0.039)
Days of Extracurricular activities				0.001
				(0.001)
Connection with people in STEM jobs				0.055
				(0.043)
Talk to people about STEM, outside school				-0.005
				(0.039)
Parent interested in science				0.040
				(0.068)
Number of extracurricular activities planned				0.057
				(0.035)
Constant	-0.178***	4.971***	5.427***	5.299***
	(0.052)	(0.213)	(0.238)	(0.262)
N	1142	1142	1115	1115

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Notes:

1. Read Table 16 in conjunction with summary means in Table 4
2. Treatment is the main variable of interest, it takes value 1 for 2020 and 0 for 2019. The coefficient on 'Treatment' gives us the difference in the difference (DiD) outcomes for each year. For STEM importance the DiD coefficient is significant and positive. Here, while in 2019 the program was reducing the ratings of how important STEM is to future careers, in 2020 this is not happening.
3. Each column adds more controls, controlling for pre scores makes a difference to the magnitude of the coefficient, but after that adding any other kind of control demographic or social and cultural capital does not makes much of a difference.

References

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