Evaluation of the National Levelling Up Widening Participation Pilot Programme

Full Report

Version 1.0

14/11/2022

Dr Helen Cramman, Dr Helen Gray, Dr Maria Ana Chavana, School of Education, Durham University

Contents

Acknowledgements

The authors would like to thank Lara Small, Beth March and Linh Phung for their support in compiling information about the Levelling Up programme, which has been included within the report. We would also like to thank the Levelling Up Hub and Spoke leads for their contribution and support with the data collection for the evaluation and to all the participants, tutors and mentors on the programme for being part of the evaluation.

Funding

The evaluation research was jointly funded by a philanthropic donation from Tony Hill, the Institute of Physics and the London Mathematical Society.

To cite this report:

Cramman, H., Gray, H., & Chavana, M.A. (2022). *Evaluation of the National Levelling Up Widening Participation Pilot Programme.* UK: Durham University. http://doi.org/10.15128/r18910jt623

1. Executive Summary

Introduction

Levelling Up is a national academic and pastoral online support programme spanning two academic years, targeted at Year 12 students who have an interest in potentially pursuing the study of Chemistry, Maths or Physics at University. In total, 226 students accepted places on the pilot cohort of the programme.

There were three subject strands in the pilot programme, with three Hubs coordinating the overall running of each subject strand. Durham University led the Chemistry strand, the London Mathematical Society the Maths strand, and the Institute of Physics the Physics strand.

For the pilot programme, six departments (Spokes) from four UK universities hosted a cohort of students. There was one Spoke for the Chemistry strand, based at Durham University (42 participants); two Spokes for Maths, based at Durham University (30 participants) and the University of Leicester (25 participants); and three Spokes for the Physics strand, based at the University of Birmingham (48 participants), Durham University (39 participants), and the University of Oxford (42 participants). The pilot cohorts started the programme between February 2021 and July 2021 and the last sessions ran between March 2022 and June 2022.

The design for the delivery of the programme varied across subjects and Spokes. In common across all Spokes, was that participants took part in online subject specific tutorials led by tutors. Participants in the Chemistry and Physics Spokes also had separate mentoring sessions. In addition, activities such as guest lectures were provided by some of the Spokes. The background of tutors varied across the programme. Tutors on the Physics Spokes were A-level teachers, tutors, teacher trainers and outreach officers. On the Maths Spokes tutors were undergraduate students. For the Chemistry Spoke, tutors were postdoctoral researchers and academic staff. Mentors on the Chemistry and Physics Spokes were undergraduate students.

The number of contact hours for participants in tutorial and mentor sessions varied across the Spokes with 34 hours of contact time for Chemistry – Durham participants (via 17 tutorial sessions and 17 mentor sessions), 33 hours for Maths – Durham and Maths – Leicester participants (via 22 tutorial sessions), 28 hours for Physics – Durham (19 tutorials and 9 mentor sessions), and 19 hours for Physics – Birmingham participants (via 10 tutorial sessions and 9 mentor sessions). The number of tutorial and mentoring sessions offered on the Physics – Oxford Spoke varied by tutor and mentor and the exact provision is not known.

Aims of the programme

At the outset of the programme, a detailed Theory of Change Model was developed in collaboration with the three programme Hubs in February 2021. This stated the impact the programme Hubs aimed to achieve by the end of a participant's time on the programme.

The stated seven areas in which the programme desired to have impact were:

1. Participants aspire to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university.
2. Participants apply to a high ranked university as listed in in the Times Good University Guide.
3. Participants aspire to study at university (in any subject).
4. Participants aspire to study at their Levelling Up host university.
5. Participants consider that the programme has helped them achieve higher grades at A level in their subject.
6. (Chemistry and Physics) Students consider that the programme has helped them achieve higher grades at A level in maths within their subjects.
7. Participants received offers to study the courses which they have applied for on their UCAS applications.

Evaluation

The evaluation of the programme sought to answer two overarching research questions:

1. Have the intended impact aims and outcomes for the Levelling Up programme been achieved?
2. Is it reasonable to conclude the Levelling Up programme of activities contributed to the achievement of these impact aims and outcomes?

The evaluation used a Contribution Analysis Framework to answer these questions, which is a robust method of undertaking evaluation of widening participation programmes with small numbers of participants in complex programmes (TASO, 2022).

To address the research questions, the evaluation utilised a concurrent triangulation mixed methods approach, collecting data in sequential stages with the first stage informing the development of the data collection tools in the second stage (Creswell et al., 2003). Data were collected using: start of programme participant application form, baseline and end of programme surveys, focus groups, interviews, and observation of training sessions and a tutorial session. Analysis was carried out in detail at two timepoints during the project (interim and end-point), with the findings from the interim analysis informing the development of subsequent data collection tools. At both timepoints, qualitative and quantitative data were analysed independently with the findings integrated at the data interpretation stage.

Key findings

Delivery of the programme

Assessing against the Contribution Analysis framework, the evidence indicates that all activities stated within the Theory of Change model were delivered by all Spokes to some extent.

There were, however, variations in delivery across Spokes as well as in the engagement from participants. Key areas of variation included:

> 1) the Physics – Birmingham and Physics - Oxford Spokes delivered fewer tutorial sessions than originally planned. The majority of respondents to the end of programme survey on the on the Physics – Birmingham Spoke reported that there were some parts of the programme they been unable to participate in fully.

2) for all Spokes, participants missed sessions, with average attendance across Spokes varying from 48% to 69%.

3) Levelling Up specific onsite/remote visits to the university were not possible due to COVID-19 for the three Durham Spokes, although central university open day provision was signposted.

Barriers to effective delivery of the programme had included low attendance by participants leading to cancelled sessions due to safeguarding requirements, and technology not functioning e.g. problems with Zoom or Teams.

For the participants that had engaged with the programme, they reported particularly valuing the structure of the programme, including the weekly cycles and the style and content of sessions. They appreciated the ability to delve deeper into content, that the content went beyond A level and liked the pre-work and found it helpful to attempt this before the tutorial sessions. The participants particularly commented on the benefits of the small group sessions and friendly, welcoming atmosphere. They valued how the tutors and mentors made the sessions interactive and engaging and welcomed being asked questions and working in groups to solve problems in different ways.

Chain of expected outcomes

The evaluation found evidence that the chain of results documented in the Theory of Change model had occurred, with the participants giving examples of the intended outcomes for the programme in action.

The Chemistry – Durham, Maths – Durham, Physics – Birmingham and Physics – Durham Spokes achieved all seven impact aims.

The Maths – Leicester and Physics – Oxford Spokes did not meet the aim for participants to choose to apply to their Levelling Up host university, with only a minority of participants applying to Leicester and Oxford. However, it is important to note that in the end of programme interviews with the Spoke leads, both universities considered that this aim was not of importance for the remit of Widening Participation initiatives at their universities. Since the start of the programme, this aim is also now discouraged by the UK government within university Widening Participation strategies.

The impact aim of participants applying to a high ranked university as listed in the Times Good University Guide was also slightly weaker for Maths – Leicester and Physics – Birmingham than the other Spokes. Although the majority of participants at these two Spokes applied to at least one course in the top 10 for their chosen subjects, less than a third of application choices were to courses ranked in the top 10 for their subject.

Contextual factors

Additional contextual factors considered by the evaluation included the background of participants and support from school and parents/carers with the university application process and knowledge about studying at university. There were differences between Spokes in the proportion of participants by gender, ethnicity and whether the participants would be the first in their family to attend university. For all Spokes there were areas where participants considered that there was missing knowledge either from school or parents/carers.

The data highlights the complexity of potentially differing needs of participants across the programme and that they are joining the programme with different backgrounds and therefore potentially different areas in which they would benefit from additional support. This was highlighted in the range of different, and sometimes contradictory, comments from participants as to which areas of the tutoring and mentoring provision they found most beneficial, where they felt topics were particularly relevant or less useful, whether they would like easier or harder problems set, and more or less frequent sessions.

The evaluation concludes that within this complexity, there were areas where the programme had the potential to fill gaps in knowledge for students from all Spokes and that there were no external contextual factors that may have negatively affected the intended chain of results for the programme.

Conclusions and recommendations

Based on the above evidence, the evaluation considers it reasonable to conclude that the Levelling Up programme has contributed to achieving the stated impact aims for the programme.

The evaluators have several recommendations for the refinement of the programme moving forwards:

1) That wherever possible, the programme runs with small group sessions, with consistency week-on-week in the participants, tutors and mentors within groups.
2) That training and processes are put in place to support tutors and mentors in tailoring the weekly topics and differentiating the difficulty of activities within the sessions to the specific interests and needs of the participants within their groups.
3) That there is an opportunity for participants to communicate with each other outside the organised weekly sessions to enable them to work together on pre-work and discuss topics such as university applications.
4) That for the Spokes where it isn't already in place, that a method is found for tutors and mentors to communicate with one another to keep up to date on what has been covered with the participants within their groups.
5) That graphics tablets are provided for the Chemistry and Physics programmes to support delivery and to make activities such as drawing graphs and writing equations easier.
6) That careful consideration is made as to the most effective pedagogical practice when working with participants who are not visible on screen to the tutor or mentor (i.e. with cameras off).

Limitations of the research

It is important to note the limitations of the evaluation study. A key limitation was the number of participants responding to the end of programme survey. Multiple strategies were implemented to attempt to increase participation, however, the response rate was only 30%. Although a lower number than hoped, the data still provides a useful insight into the experiences of participants.

Analysis of attendance data indicated that the participants that completed the end of programme survey and participated in focus groups attended more sessions than the average for the cohort. The findings may therefore represent a more positive outlook than the cohort as a whole, however, this exemplifies delivery for participants who maximised their engagement.

A second limitation was in the level of engagement of tutors and mentors with the focus groups. Multiple calls were made to encourage participation, and timings were adapted to avoid undergraduate exam periods, however, it was not possible to get good representation of tutors and mentors across Spokes, especially in the end-point focus groups. This had the potential of reducing the range of views captured by the evaluation.

Future research

The evaluators recommend further research is undertaken to understand in more detail what influences participants' choices of university courses. There were clear differences between the rank of participants' course choices on the Maths – Leicester and Physics – Birmingham Spokes compared to the other Spokes on the programme. A more detailed investigation is required to understand what led to these differences. This is particularly of interest in the case of the Maths – Leicester, where delivery and content of the programme was the same as the Maths – Durham Spoke.

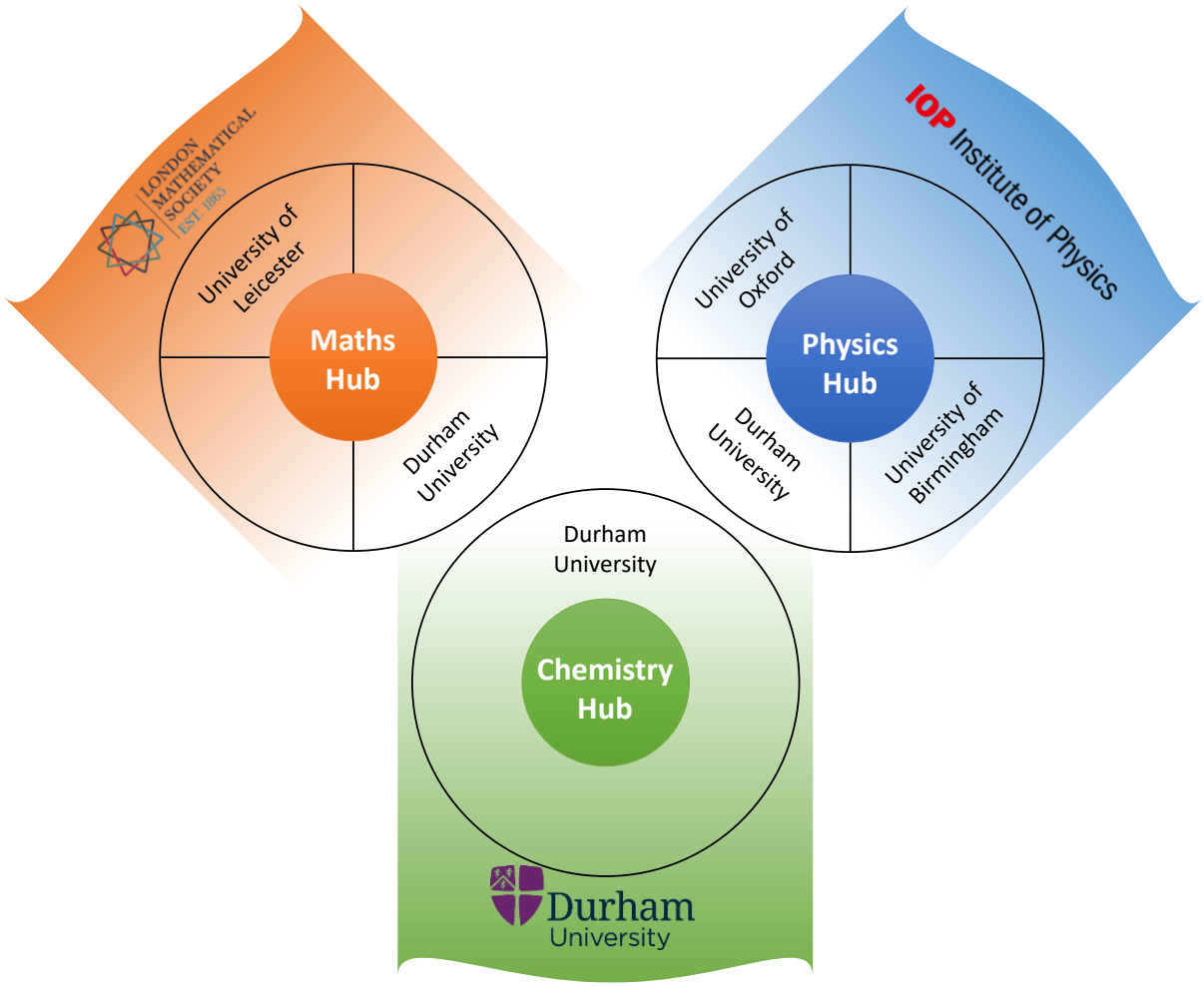
2. Introduction

Levelling Up is a national academic and pastoral online support programme spanning two academic years, targeted at Year 12 students who have an interest in potentially pursuing the study of Chemistry, Maths or Physics at University.

There were three subject strands in the pilot programme, with three Hubs coordinating the overall running of each subject programme. Durham University led the Chemistry programme, the London Mathematical Society the Maths programme and the Institute of Physics the Physics programme.

For the pilot programme, six departments (Spokes) from four UK universities hosted a cohort of students. There was one Spoke for the Chemistry programme, based at Durham University; two Spokes for Maths, based at Durham University and the University of Leicester; and three Spokes for the Physics programme, based at the University of Birmingham, Durham University, and the University of Oxford. The pilot cohorts started the programme between February 2021 and July 2021 and the last sessions ran between March 2022 and June 2022. Figure 1 shows the Hub-Spoke arrangement for the pilot programme.

Figure 1. Overview of the pilot Levelling Up programme.



Intended aims and impact of the Levelling Up programme

At the outset of the programme, a Theory of Change Model (Table 1, Appendix 1) was developed in collaboration with the three programme Hubs in February 2021. This stated the impact the programme Hubs aimed to achieve by the end of a student's time on the programme (i.e. by July 2022).

The stated seven areas in which the programme desired to have impact were:

1. Participants aspire to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university.
2. Participants apply to a high ranked university as listed in the Times Good University Guide.
3. Participants aspire to study at university (in any subject).
4. Participants aspire to study at their Levelling Up host university.
5. Participants consider that the programme has helped them achieve higher grades at A level in their subject.
6. (Chemistry and Physics) Students consider that the programme has helped them achieve higher grades at A level in maths within their subjects.
7. Participants received offers to study the courses which they have applied for on their UCAS applications.

Longer term, the programme aimed to have impact to:

1. Increase the number of students from under-represented groups applying to study Chemistry, Maths and Physics at top UK universities
2. Encourage other universities to become part of the Levelling Up programme
3. Encourage participants on the programme go on to study a STEM related subject at university

Pilot programme design and timeline of delivery

The design for the delivery of the programme varied across Spokes. In common across all Spokes, was that students took part in online subject specific tutorials. Students in the Chemistry and Physics Spokes also had separate mentoring sessions. In addition, activities such as guest lectures were provided by some of the Spokes. A detailed description of each Spoke's programme design is given in Appendix 2 – Table 2, with the information documented using a TIDieR framework checklist (Hoffmann et al. 2014). A brief summary of the key elements of the programme design and delivery timeline for each Spoke is given in Table 1 below.

Table 1. Brief summary of the programme design and delivery timeline for the six Spokes on the Levelling Up programme. The table summarises delivery as it was planned at the outset of the programme, it is important to note that modifications were made to some of the programme elements during delivery. Modifications will be discussed as part of the implementation and process evaluation.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Subject specific tutorials	Yes	Yes	Yes	Yes	Yes	Yes
Separate mentoring sessions	Yes	No	No	Yes	Yes	Yes
Guest lectures	Yes	Yes	Yes	No	Yes	Yes
Onsite/remote university visits	Yes	Yes	Yes	No	Yes	No
Guaranteed conditional university offer	Yes	Yes	Yes	No	Yes	No
Graphics tablets provided to students	No	Yes	Yes	No	No	No
Date recruitment opened	December 2020	December 2020	January 2021	May 2021	December 2020	April 2021
Date recruitment closed	January 2021	January 2021	February 2021	May 2021	January 2021	May 2021
Date of welcome event	March 2021	March 2021	March 2021	June 2021	March 2021	July 2021
Date of first tutoring/mentoring session	March 2021	March 2021	March 2021	June 2021	March 2021	September 2021
End date for the programme	May 2022	March 2022	April 2022	March 2022	March 2022	May 2022
Planned modifications made during delivery	No onsite visits due to COVID	No onsite visits due to COVID	None	None	No onsite visits due to COVID	None

Ethics

Ethical approval for the evaluation research was granted by the School of Education Ethics Committee at Durham University on 26 November 2020. Subsequent addendums have been made to the initial application to cover further data collection as the project progressed. Initial agreement to participate in the evaluation was sought via several means, dependent upon the Spoke that the participant was part of. Further agreement to participate in specific evaluation activities e.g. focus groups was sought from individual participants at the time of the separate data collection.

The method of collecting initial agreement to participate in the evaluation is summarised in Table 3 below.

Data protection

The lawful basis being used for the evaluation research was Public Task Article6(1)(e): the processing is necessary for an activity being carried out as part of the University's public task, which is defined as teaching, learning and research. Special category data was processed under Article 6(1)(e): Public Task and Article 9(j): Archiving, research and statistics.

3. Methodology

Research questions

The evaluation of the Levelling Up national widening participation pilot programme has two overarching research questions:

1. Have the intended impact aims and outcomes for the Levelling Up programme been achieved?
2. Is it reasonable to conclude the Levelling Up programme of activities contributed to the achievement of these impact aims and outcomes?

The evaluation will seek to answer these questions using a Contribution Analysis Framework, which is a robust method of undertaking evaluation of widening participation programmes with small numbers of participants in complex programmes (TASO, 2022).

Evaluation design

Contribution analysis

This study utilised Contribution Analysis as the underpinning evaluation framework to draw robust conclusions as to the contribution the Levelling Up programme made to achieving the stated aims of the programme.

Contribution analysis explores attribution through assessing the contribution that a programme is making to observed results (Mayne, 2008). To infer causality, four conditions must be met (Mayne, 2012)

- Step 1: the programme is based on a reasoned theory of change,
- Step 2: the activities within the programme were implemented as planned,
- Step 3: the expected chain of results have occurred,
- Step 4: other factors influencing the programme have not made a significant contribution.

Step 1: Development of a robust Theory of Change

In order for Contribution Analysis to be utilised, a detailed, robust theory of change is required in order to present the programme logic. The development of the theory of change was carried out in collaboration with the Levelling Up Hub leads before student participants had started the programme. Development was carried out from November 2020 to January 2021 through structured meetings, workshops and email communication, iteratively discussing and refining the aspects within the theory of change model. The resultant theory of change model can be seen in Appendix 1 – Table 1.

Steps 2 – 4: impact and implementation process evaluation

The theory of change model developed in Step 1 was used to create a logic model (Figure 2), from which a set of impact research questions and implementation process evaluation (IPE) questions were developed. These research questions aimed to collect robust evidence to address steps 2 to 4 of the Contribution Analysis framework. The research questions are presented in the relevant sections later in the report: Table 4 for the impact research question and Table 6 for the IPE research questions.

To address the research questions, the evaluation utilised a concurrent triangulation mixed methods approach collecting data in sequential stages with the first stage informing the development of the data collection tools in the second stage (Creswell et al., 2003) with data collected using: start of

programme participant application form, baseline and end-point surveys, focus groups, interviews, and observation of training sessions and a tutor session. Data were analysed in detail at two timepoints during the project (interim and end-point), with the findings from the interim analysis informing the development of subsequent data collection tools. At both timepoints, qualitative and quantitative data were analysed independently with the findings integrated at the data interpretation stage (Appendix 3 – Figure 1).

Data collection is summarised in Table 2. In addition to the methods summarised in the table, there had also been an intention to include observation of an on-site visit for students to Durham University. However, on-site visits were not possible due to COVID-19 restrictions and so this observation did not take place.

Additionally, observation of a sample of tutoring and mentoring sessions in the three Durham Spokes had originally been included as part of the planned data collection. However, it was not possible to get agreement from participants to enable any sessions to be observed. As participation in the evaluation was voluntary, after trying multiple approaches to recruitment, it became necessary to remove this element of data collection from the evaluation. An observation of one Maths tutor session through the University of Leicester Maths Spoke was able to take place.

Figure 2 Logic model developed from the Theory of Change model.

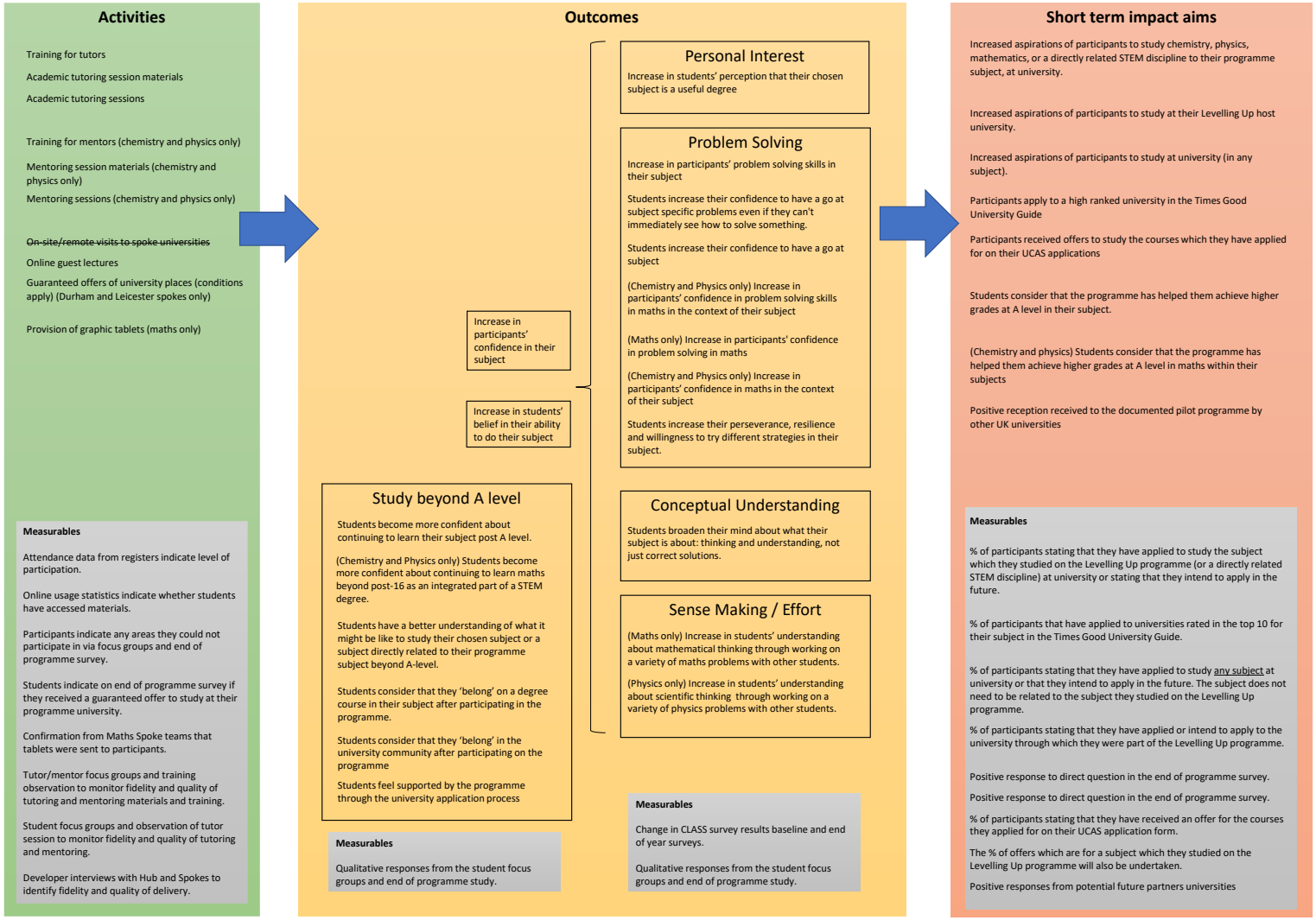


Table 2. Evaluation data collection.

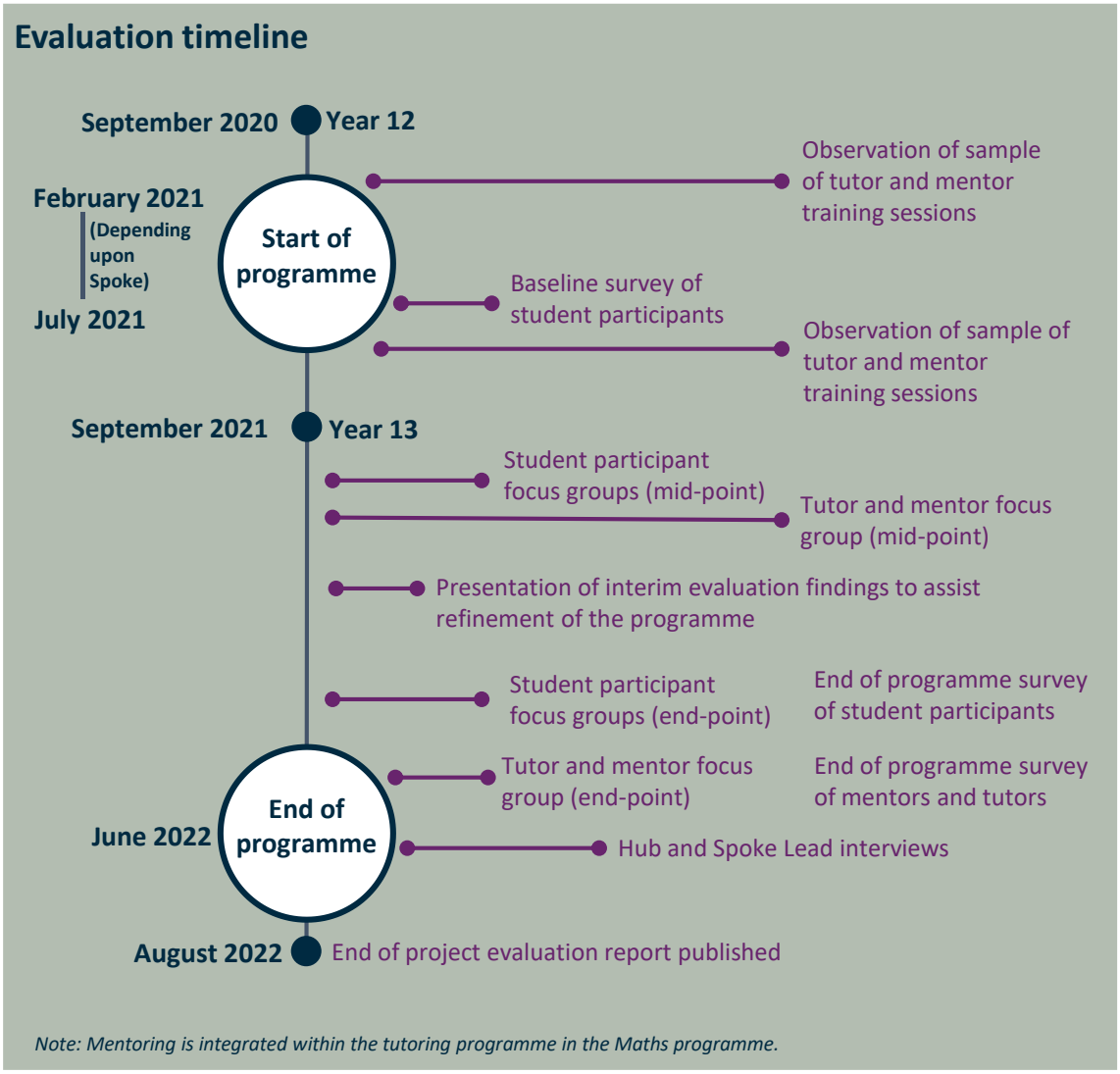
Method	Date/time of completion	Participants
Application form	On application to the programme	All student participants that gave permission for their application form data to be used by the evaluation.
Online baseline survey	Before the student's time on the programme commences. Durham (All spokes): 17 March to 9 May 2021 Leicester Maths: 17 March to 9 June 2021 Birmingham Physics: 18 June to 3 October 2021 Oxford Physics: 18 June to 3 October 2021	All student participants on the Levelling Up programme invited to participate.
Tutor/mentor information gathering questionnaire	June/July/August 2021	All tutors and mentors invited to complete.
Observation of a sample of tutor and mentor training sessions	February - March 2021 and June 2021	All attendees at the training sessions.
Student focus group (mid point)	October/November 2021	Voluntary subset of students from across all Spokes on the programme. All students invited to volunteer, all that volunteered and could be accommodated within the schedule included.*
Tutor/mentor focus group (mid point)	October/November 2021	Voluntary subset of tutors/mentors from across all Spokes on the programme. All tutors/mentors invited to volunteer, all that volunteered and could be accommodated within the schedule included.**
Student focus group (end point)	April 2022	Voluntary subset of students from across all Spokes on the programme. All students invited to

Method	Date/time of completion	Participants
		volunteer, all that volunteered and could be accommodated within the schedule included.*
Tutor/mentor focus group (end point)	May/June 2022	Voluntary subset of tutors/mentors from across all Spokes on the programme. All tutors/mentors invited to volunteer, all that volunteered and could be accommodated within the schedule included.**
Tutor and mentor session attendance registers	Collected by Spokes throughout programme	Data requested for all participants.
End of programme student survey	April – July 2022 (survey closed between 30/04/22 – 28/06/22 during A level exam period)	All students from all Spokes that had completed the baseline survey and/or for whom there was application form data.
Interviews with Hub and Spoke Leads	June – August 2022	Representatives from all Hubs and Spokes.

*Participation in certain elements of the evaluation sought additional permission from participants. For the student focus groups, the original intention had been to select students from specific groups in each Spoke. However, agreement to participate was low, and as such, an approach of asking for volunteers from all students on the programme and incentivising participation was employed for the mid point focus group. For the end point focus groups, all students that had participated in the mid point focus group were invited before the remaining spaces were opened up for volunteers from all participants on the programme.

**All tutors and mentors on the programme were invited to participate in mid point and end point focus groups. However, only a small number of tutors and mentors volunteered to be part of the focus groups. It was not possible to get representation from all Spokes and in some cases, the focus group was conducted as an interview due to the low number of volunteers and attendees.

Timeline



Participant selection

Recruitment of participants onto the Levelling Up programme was carried out by the Spoke teams. Once they had been offered a place on the programme, all participants on the programme were invited to be part of the evaluation. Recruitment to the evaluation research took place in three parts:

1) recruitment to the overall evaluation via the baseline evaluation survey
2) permission for application form data to be shared with the evaluation team
3) permission for the application form data to be linked with other evaluation data.

Table 3 summaries the methods used to collect these permissions from participants on the different Spokes. Spokes were responsible for advertising the baseline survey to participants as permissions were not in place for the evaluation team to have access to the application form data at that timepoint.

Table 3. Summary of the methods used to collect permissions from participants for participation and use of data in the evaluation research.

Spoke	Evaluation recruitment method	Agreement for application form data to be shared with the evaluation	Agreement for application form data to be linked with other evaluation
Chemistry - Durham	Evaluation baseline survey	Programme application form	Evaluation baseline survey
Maths - Durham		Programme application form	
Maths - Leicester		Additional permission asked from participants by the Leicester Spoke team	
Physics - Birmingham		Evaluation baseline survey	
Physics - Durham		Programme application form	
Physics - Oxford		Evaluation baseline survey	

Impact evaluation

Research methods

To aid in answering the overarching research questions for the evaluation of the Levelling Up programme, a series of sub-questions have been posed to investigate the impact and process of implementation of the programme. The impact research questions were developed using the Theory of Change (Appendix 1 – Table 1) and Logic model (Figure 2), to collect robust evidence for drawing conclusions within the Contribution Analysis evaluation framework. Table 4 below summarises the impact evaluation research questions, measurable outcomes and the measurement instruments that will be used.

Table 4. Summary of outcome measures linked to each research question.

Research question	Measurable outcome and method of collection
1. Have students on the Levelling Up programme chosen to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university?	(via end of programme survey): Number of participants stating that they have applied to study the subject which they studied on the Levelling Up programme (or a directly related STEM discipline) at university or stating that they intend to apply in the future.
2. Have students on the Levelling Up programme applied to a high ranked University (as defined by the ranking in the Times Good University Guide)?	(via end of programme survey): Number of participants that have applied to universities rated in the top 10 for their subject in the Times Good University Guide. (An investigation into any trends in the ranking will also be undertaken).
3. Have students on the Levelling Up programme applied to study at university (in any subject)?	(via end of programme survey): Number of participants stating that they have applied to study any subject at university or that they intend to apply in the future. The subject does not need to be related to the subject they studied on the Levelling Up programme.
4. Have students on the Levelling Up programme to study at their Levelling Up host university?	(via end of programme survey): Number of participants stating that they have applied or intend to apply to the university through which they were part of the Levelling Up programme.
5. How effective do students consider that the programme has been in helping them to achieve higher grades at A level in their subject?	(via end of programme survey): Positive responses in the end of programme survey. (Note that student opinions must be used as opposed to measuring actual grades achieved as the evaluation finishes before students will have their A level grades).
6. (Chemistry and Physics only) How effective do students consider that the programme has been in helping them to achieve higher grades at A level in maths within their subjects in their subject?	(via end of programme survey): Positive responses in the end of programme survey.

7. Have students on the Levelling Up programme received offers to study the courses which they have applied for on their UCAS applications?	(via end of programme survey): Number of participants stating that they have received an offer for the courses they applied for on their UCAS application form. The % of offers which are for a subject which they studied on the Levelling Up programme will also be undertaken.

Primary and Secondary outcome measures collected in the end of programme survey

Primary and secondary outcomes for the impact evaluation were measured via the end of programme survey. The survey also collected data for the IPE, which will be discussed in detail in the IPE method section.

The surveys were developed following a detailed review of the literature. Reliability and validity testing of the baseline survey was carried out through review by an expert panel of subject specialists, followed by piloting with students (Ball, 2019). The expert panel was comprised of subject specialists from across the Hub and Spokes, including undergraduate teaching specialists and science education research experts. Following the review, the survey questions were refined before being piloted with four students that were part of the Levelling Up programme. For the piloting stage, the students were each presented with a different scenario and asked to complete the survey with that student profile in mind. Following completion of the pilot survey using the scenarios, the students were then interviewed as a group to probe their understand of the intent of the questions and to identify where wording or content needed to be refined. As the end of programme survey contained the same questions as the baseline survey, only the additional IPE questions in the end of programme survey were piloted for understanding.

The dates when the surveys were live for the programme are shown in Table 5. The end of programme survey was live over two periods, having to be relaunched in July 2022 after the A level examination period in order to increase the response rate.

All students on the Levelling Up programme at all Spokes were invited to participate in the start of programme survey, advertised via the Levelling Up Spoke leads. Students were invited by the evaluation team to participate in the end of programme survey if they had agreed to participate in the evaluation by completing the baseline survey or agreed for their application form data to be shared with the evaluation. For the end of programme survey, the students were each sent a unique link via email in order to enable matching of their end of programme survey responses to their baseline and application form data. The total number of responses are shown in Table 9 below.

*Table 5. Dates when the surveys were live. *The survey originally closed 29/04/22, but was reopened on 29/06/22 after A level exams finished in order to increase the number of responses.*

	Baseline survey		End of programme survey	
Spoke	**Date survey launched**	**Date survey closed**	**Date survey launched**	**Date survey closed**
Chemistry - Durham	03/03/21	09/05/21	07/04/22	17/07/22*
Maths - Durham	17/03/21	09/05/21		
Maths - Leicester	17/03/21	07/06/21		
Physics - Birmingham	18/06/21	03/10/21		
Physics - Durham	17/03/21	09/05/21		
Physics - Oxford	18/06/21	03/10/21		

Statistical analysis

Impact Evaluation (primary and secondary outcomes)

Research Questions (RQ) 1 – 4 used responses from the end of programme survey about university applications alongside data from the Times Good University Guide 2022 (Times, 2022).

Numbers of students who have stated that they are applying to university to study a Levelling Up related subject (RQ1), a course which is in the top ten courses in the Times GUG (RQ2), any subject at university (RQ3) and a subject at their host Levelling Up university (RQ4) will be shown, broken down by Hub and Spoke. Numbers of students stating that they intend to apply to university in the in the next year or at a future time will also be given

For these research questions, if at least one university application fulfils the criteria it will be counted, it will not be necessary for all applications from a student to be to, for RQ2, to a top ten university in that subject.

For RQ7 students were asked to indicate whether they had received an offer from each application. Numbers of offers for each student will be shown, broken down by Hub and Spoke as well as the number of applications resulting in no offer or where the student is waiting to hear.

For attendance at tutor and mentor sessions, registers were used. Where a student had the opportunity to attend a session, they were marked present or absent. Where there was no opportunity, for instance if the session was cancelled, or the student had left the programme this was noted with a 'not available' code. Where the registers are incomplete, sessions were marked as missing data. Attendance was calculated as number of sessions attended divided by the number of sessions that were known to be available (i.e. not cancelled or missing).

There were 67 responses to the end of programme survey, across six spokes. Of these, we have 64 whose application data we have been given permission to share with the survey data. Unfortunately, once broken down by Spoke, the number of respondents was too small to undertake analysis by demographics such as gender or ethnicity.

Implementation and process evaluation

Research methods and analysis

Table 6 summarises the data collection methods that were used to support answering each IPE research question. A detailed description of each data collection method is provided below the table.

Table 6. Summary of data collection methods used to address each IPE research question.

IPE question	Data collection method
IPE1 - To what extent were activities within the programme delivered in line with the aims of the activity (fidelity/quality) and how have the activities been received by participants (responsiveness)?	• Observation of training for tutors and mentors • Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme) • Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups
IPE2 - How many people participated in the activities within the programme and from which groups? (fidelity)	• Attendance registers
IPE3 - What is the perceived impact of the programme for the participants (responsiveness)?	• Focus groups with students (mid-point) • Focus groups with students (end of programme) • End of programme survey of students
IPE4 - What barriers were faced by participants in implementing the advice given in the programme (quality)?	• Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme) • Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups
IPE5 - Are there any groups of participants that were not able to access the programme or advice given in the activities and why? (reach)	• Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme) • Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups
IPE6 - What issues (if any) have been encountered in delivering the programme (fidelity/quality)?	• Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme)

	• Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups
IPE7 - What areas of the programme could be further developed following completion of the project?	• Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme) • Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups
IPE8 - Programme differentiation	• Focus groups with students (mid-point) • Focus groups with tutors and mentors (mid-point) • Focus groups with students (end of programme) • Focus groups with tutors and mentors (end of programme) • End of programme survey of students • Hub and spoke lead focus groups

Focus groups (mid-point and end point) – Students, tutors and mentors

Student focus groups took place in November 2021 with 17 self-selecting volunteers across four focus groups and 16 students across five focus groups in May/June 2022 (Table 7). Of the 16 participating in May/June, seven were students that had taken part in the November 2021 focus groups. All students in the cohort received the invitation to participate at both timepoints.

Focus groups with tutors and mentors took place at a similar time-period to the students in November 2021 and May and June 2022. Five tutors and one mentor took part across four focus groups/interviews in November 2021, with eight tutors and two mentors taking part across four focus groups in May-June 2022 (Table 7). Tutors and mentors attended focus groups together, to facilitate discussions around the different roles and interactions with the students.

The focus groups were designed to probe deeper into the implementation of the programme and to gather a narrative around the impact of the programme for the students. The focus groups took place online via Microsoft Teams, lasting 45 minutes and discussed in relation to their experiences on the Levelling Up programme: the perceived impact for them of participating; what influenced their decisions relating to what to do after their A levels; what they considered had worked well; any barriers or challenges they had encountered; their interaction with other students; how the Levelling Up programme was different to any other widening participation programmes they knew about; and where they felt the programme could be refined in the future. The focus groups were conducted by two researchers, each with experience of conducting online focus groups and working with school age participants. The focus groups were recorded using the inbuilt functionality of Microsoft Teams before being professionally transcribed using an external organisation. The accuracy of transcriptions was

checked by the researcher as part of the analysis process. The data were analysed using inductive thematic analysis before being considered within the Implementation and Process evaluation questions (Braun & Clark, 2021).

Table 7. Summary of the number of focus group participants from each of the Spokes at each timepoint.

Participants attending focus groups	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
November 2021							
Students	3	2	2	3	4	3	17
Tutors	2	0	1	0	1	1	5
Mentors	1	N/A	N/A	0	0	0	1
May-August 2022							
Students	2	2	4	4	2	2	16
Tutors	1	2	0	1	2	2	8
Mentors	0	N/A	N/A	0	1	1	2

Attendance registers

Tutors and mentors across all Spokes were asked to complete attendance registers to capture the number of sessions attended by students. These were collated by the Spoke leads and sent to the evaluation team where they were analysed to identify the total number of tutor sessions and mentor sessions attended by participants out of the sessions available to them. Missing data (where the tutor or mentor had not filled in the register) was coded differently to a known absence (where the register had been completed but the student had not attended the session).

Registers were received from five out of the six spokes, with Physics – Birmingham not having registers to be able to share.

In addition to analysis at the level of the student, the data were also investigated to identify whether there were trends in attendance across the Spokes and programme as a whole. This was carried out by plotting the percentage attendance against the week of the programme.

Baseline and end of programme surveys of students

To answer the IPE research questions, the baseline and end of programme surveys of students asked a mixture of open text and quantitative scale questions on the themes of: their perceptions about their Levelling Up subject and people who study and work in that area; their perceptions about their own approach to learning in the subject and what they considered to be important for developing skills in the subject; support they receive from school and home in relation to studying their subject and continuing to study it beyond A level; support they receive from home and school in relation to studying at university. In addition to questions developed specifically for this study, the survey included the validated questions from the CLASS (Colorado Learning Attitudes about Science Survey) Physics and Chemistry questionnaires from the PhET (Physics Education Technology) Project and the PER@C (Physics Education Research Group at Colorado) (Adams et al., 2006; Adams et al., 2008). The baseline survey also included questions from the Development of Chemistry Attitudes and Experiences Questionnaire (CAEQ) (Dalgety, Coll & Jones, 2003).

Personal demographic information about the students was collected in the start of programme survey and application form.

The end of programme survey also collected detailed process evaluation information using a mixture of quantitative scale questions and open response questions to understand students' experience during across the programme; benefits, challenges and barriers; engagement with the Levelling Up activities; and suggestions for refinements to the Levelling Up programme. Development of the surveys and recruitment of participants were detailed in the impact evaluation methodology section.

Qualitative data from the surveys were analysed using inductive thematic analysis before being considered within the Implementation and Process evaluation questions (Braun & Clark, 2021). Quantitative IPE data (not including the CLASS survey data) were analysed using descriptive and inferential statistics, including cross-tabulation of data.

Colorado Learning Attitudes about Science Survey (CLASS)

The Colorado Learning Attitudes about Science Survey (CLASS) is a validated instrument developed to measure students' beliefs about physics and learning physics (Adams et al., 2006). The survey was developed for physics but has been adapted for chemistry (Adams et al., 2008). The surveys and related paper scoring sheets and Excel spreadsheets are available from https://www.colorado.edu/sei/class**.** The analysis that has been conducted for this study is based on the recommended analysis by the developers of CLASS. The CLASS survey has been used in different countries and on students of different ages (Perkins et al.,2005, Brewe et al., 2009, Madsen et al., 2015, Deslauriers et al., 2019,), has been extended to Biology (Semsar et al., 2011) and experimental Physics (Wilcox & Lewandowski, 2016) and has also been used as the basis of other instruments (Xu et al., 2018; Jugert et al., 2020; Rethman et al., 2021; Li and Singh 2021)). For the Levelling Up evaluation questions from the CLASS survey were included in the baseline and end of programme surveys.

The CLASS survey asks students to respond to a series of statements with a strongly disagree to strongly agree five-point Likert scale. Answers are compared with those given by experts and scores are calculated as to the percentage of answers that agree with experts ('percentage favourable'), and the percentage of answers that disagree with experts ('percentage unfavourable'). Missing data is ignored within the analysis.

As well as overall score, there are eight categories containing four to eight questions which cover a specific area of thinking about physics (or chemistry). These categories are Real World Connection, Personal Interest, Sense Making/Effort, Conceptual Connections, Applied Conceptual Understanding, Problem Solving General, Problem Solving Confidence and Problem Solving Sophistication. Some statements do not fall into any category and do not have an expert response (e.g. 'It is useful for me to do lots and lots of problems when learning physics'), however, these are included in the overall score.

The Excel spreadsheet provided by the CLASS developers is designed to allow the input of two datasets, for students who have taken survey taken pre and post programme. Overall and category favourable percentages and unfavourable percentages are calculated for each student and for the cohort. Any shift in thinking is shown in the output, as well as whether the finding is significant. The data is also broken down by gender. Descriptions of calculations are given in (Adams, 2006).

For the Levelling Up evaluation, the chemistry survey was used for the chemistry students and the physics survey for the physics students. Both physics and chemistry are validated surveys. The physics survey was also used for the maths students (with changes in vocabulary to refer to maths rather than physics). This is not using the survey for its intended use, however, it was felt that this would still provide useful information for the purposes of this study.

Hub and spoke lead focus groups

Hub and Spoke Lead focus groups took place in June and July 2022 with three Hub leads and eight Spoke leads (Table 8). All Hub and Spoke leads received the invitation to participate. The focus groups were designed to probe deeper into the implementation of the programme and to reflect and discuss the elements of the theory of change model in detail at the end of the programme. The focus groups took place online via Microsoft Teams, lasting between 60 and 90 minutes. The focus groups were conducted by one researcher experienced in conducting online focus groups. The focus groups were recorded using the inbuilt functionality of Microsoft Teams before being professionally transcribed using an external organisation. The accuracy of transcriptions was checked by the researcher as part of the analysis process. The data were analysed using inductive thematic analysis before being considered within the Implementation and Process evaluation questions (Braun and Clark, 2006).

Table 8. Summary of the number of developer focus group participants from each of the Hubs and Spokes

Participants attending focus groups	No. attendees
Hub	
Chemistry	1
Maths	1
Physics	1
Spoke	
Chemistry - Durham	2
Maths - Durham	2
Maths - Leicester	1
Physics - Birmingham	1
Physics - Durham	1
Physics - Oxford	1

4. Impact Evaluation

Participant data

Table 9 shows a summary of the number of applications received by the programme, the number of places that were offered, number of places accepted and completion of the baseline and end of programme surveys. In addition, students were asked to give permission for their application form data to be used in the evaluation, and separately if their application data could be linked to other information collected as part of the evaluation (e.g. baseline survey data). A full description of the different combinations of data available is given in Appendix 4 – Table 4.

Table 9. Summary of the number of applications received by the programme, the number of places that were offered, number of places accepted and completion of the baseline and end of programme surveys.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Applied	90	61	39	118	104	114	526
Offered place	44	30	25	48	46	42	235
Accepted place	42	30	25	48	39	42	226
Permission given for use of application data in evaluation	39	30	17	45	40	42	213
Completed baseline survey	34	25	17	14	36	16	142
Completed end of programme survey	12	10	11	13	11	10	67
Completed end of programme survey and baseline survey and have linked application form data (End + baseline + application)	*9*	*9*	*7*	*4*	*10*	*5*	*44*
Completed end of programme survey and baseline survey but don't have linked application form data (End + baseline)	*1*	*0*	*2*	*0*	*0*	*0*	*3*
Completed end of programme survey and we have linked application form data, but no baseline survey data (End + application)	*2*	*1*	*2*	*9*	*1*	*5*	*20*
Total number of unique students in the evaluation data set	**39**	**30**	**22**	**46**	**40**	**42**	**219**

Attrition

Spokes reported small numbers of students (<5 per Spoke) that had officially withdrawn from the programme, however, they noted that there were greater numbers of students that had stopped regularly attending sessions. Where reasons had been given by students for withdrawing, this included changes to availability due to part-time work commitments or other commitments, the additional work that was required by the programme on top of school work, or more generally changing their mind about being on the programme. Birmingham Physics noted that they had seen students drop out from the programme after some technical issues early on in the programme.

Participant characteristics

Personal characteristics

The data below show a summary of the demographic data for the participants across all of the Levelling Up programme Spokes. The data were provided by students in their application forms to the Levelling Up programme and are only included where students gave permission for their data to be used for the evaluation. Of the 226 students on the Levelling Up programme, 213 gave permission for their application form data to be included in the evaluation. Dependent upon the question, students were able to select that they preferred not to provide a response or could leave answers blank. To preserve the anonymity of participants, where there are fewer than five and greater than zero responses within a category, the data is displayed as <5.

The data in Table 10 shows that across the whole Levelling Up programme, 52% of participants were female and 42% male, with 6% giving an answer of "other", "prefer not to say" or did not give permission for their data to be used in the evaluation. The gender profile varied across Spokes, with Chemistry – Durham having the highest percentage of female participants (75%) and Physics - Durham and Maths - Leicester the lowest (42% and 38% respectively). However, it should be noted that data was not available for 35% (n=9) of Leicester Maths participants.

Table 10. Gender that participants reported identifying as on their application form to the Levelling Up programme (n=226).

Gender	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Female	29	17	10	24	17	18
Male	10	13	7	19	23	23
Other/Prefer not to say/Missing data	<5	0	9	<5	0	<5

Each Spoke collected ethnic group data in their application forms using different categories. In order to present a summary of the data across all Spokes, these have been aggregated for the cases when finer detail categories had been available, in order to enable the inclusion of the data for the Spoke that used the broadest categories (Table 11). A difference in the ethnic group of participants can be seen between participants on Durham and Oxford Spokes and those on the Leicester and Birmingham Spokes.

Table 11. The ethnic group that participants reported considering themselves to belong to on their application form to the Levelling Up programme (n=226).

Ethnic Group	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Asian /Asian British	<5	0	12	28	5	9
Black/African/Caribbean/ Black British	<5	<5	0	6	<5	<5
Mixed/ Multiple ethnic groups	5	0	0	<5	<5	5
Other ethnic group	0	0	<5	<5	0	<5
White	28	28	<5	8	31	24
Prefer not to say/Missing data	<5	0	10	<5	0	<5

Table 12 shows summary data about whether participants were eligible for Free School Meals. No data about eligibility for Free School Meals was available for the Physics – Oxford Spoke. Across the other Spokes, the average for the Levelling Up programme was 21% of participants reported being eligible for Free School Meals (74% not eligible). This varied by Spoke with Physics – Birmingham reporting the highest percentage of participants eligible for FSM at 36% and Durham Maths and Physics the lowest at 10%.

Table 12. Whether participants were eligible for Free School Meals as self-reported on their application form to the Levelling Up programme.

Eligible for Free School Meals	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Yes	9	<5	5	17	<5	0
No	30	27	12	28	36	0
Prefer not to say/Missing data	<5	0	6	<5	0	43

No data about eligibility for a 16-19 bursary was available for Maths – Leicester, Physics – Birmingham or Physics – Oxford. For students on the Durham Spokes, the average was for between 13% and 15% of students to be in receipt of a 16-19 bursary.

Table 13 summarises whether participants considered themselves to be a First Generation Scholar. No data was available for the Physics – Oxford Spoke. Across the rest of the Levelling Up programme, an average of 39% of participants considered themselves to be a First Generation Scholar. This varied across Spokes from 51% for Physics – Birmingham to 30% for Chemistry – Durham.

Table 13. Whether participants considered themselves to be a First Generation Scholar, as self-reported on their application form to the Levelling Up programme.

First generation Scholar	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Yes	12	11	10	24	14	0
No	27	19	7	21	26	0
Prefer not to say/Missing data	<5	0	6	<5	0	43

Participants also provided information on the highest qualification of the parent/carer in the baseline survey. Participants had the option to select Don't Know if they did not know the highest qualification of their parents/carers. Across the Levelling Up programme, of the 120 participants that provided a response, 25% reported that the highest qualification of their parents/carers was a postgraduate qualification, 35% an undergraduate qualification, and less than 20% for each of GCSE and A level qualifications. The proportions varied by Spoke, however little can be interpreted from the differences as the number of responses was low for Maths – Leicester, Physics - Birmingham and Physics – Oxford.

Where fewer than five respondents across the whole Levelling Up programme (all Spokes) stated an answer, these have not been presented in tables to preserve the anonymity of the participant. This was the case for students stating that they had a disability; for students reporting that they had been looked after, accommodated or in care; and for students that reported being irreconcilably estranged from both of their biological or adoptive parents, or only living parent.

Attendance

Table 14and Table 15 below present the attendance for all participants in the programme, for those that responded to the end of programme survey and for those that participated in focus groups. The average attendance for tutorial sessions over all Spokes was 58%, ranging from 65% for Chemistry - Durham to 49% for Physics – Oxford. Data were not available for Physics – Birmingham. Attendance at mentor sessions was 59% for the whole cohort, ranging from 69% for Chemistry – Durham to 48% for Physics – Oxford. The attendance was calculated using data available (i.e. where attendance at a session was known about). Where attendance at a session had not been recorded, this has not been included in the calculation.

To understand whether participants in the focus groups and end of programme survey were representative of the attendance of their Spoke as a whole, attendance for these sub-groups of students have been calculated (Table 14, Table 15). Maths – Leicester respondents to the end of programme survey and focus group participants had very similar attendance levels to their Spoke. For all other Spokes (apart from Physics – Birmingham, where data was not available), attendance at tutor and mentor sessions was higher for respondents to the end of programme survey and participants in the focus groups than the average for the whole cohort. This is usual for voluntary participation surveys and focus groups, and it is important for the results to be interpreted with this finding in mind.

*Table 14. Average proportion of tutorial sessions attended for the whole cohort, those that completed the end of programme survey and those that participated in focus groups. Averages are calculated for the sessions for which data was available (i.e. where the tutor had completed the register). * Data for the 13 respondents from the Physics – Birmingham Spoke is not available. ** Data for the 3 focus group participants from the Physics – Birmingham Spoke is not available.*

	Chemistry - Durham		Maths - Durham		Maths - Leicester		Physics - Durham		Physics - Oxford		Total	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
All students	0.65	39	0.62	29	0.63	20	0.55	40	0.49	42	0.58	170
Respondents to the end of programme survey	0.81	11	0.94	10	0.64	10	0.74	11	0.61	8	0.75	50*
Focus group participants	0.69	3	0.97	2	0.68	2	0.72	4	0.44	3	0.68	14**

*Table 15. Average proportion of mentor sessions attended for the whole cohort, those that completed the end of programme survey and those that participated in focus groups. Averages are calculated for the sessions for which data was available. * Data for the 13 respondents from the Physics – Birmingham Spoke is not available. ** Data for the 3 focus group participants from the Physics – Birmingham Spoke is not available.*

	Chemistry - Durham		Physics - Durham		Physics - Oxford		Total	
	Mean	N	Mean	N	Mean	N	Mean	N
All students	0.69	39	0.59	40	0.48	42	0.59	110
Respondents to the end of programme survey	0.82	11	0.68	11	0.55	8	0.70	30*
Focus group participants	0.69	3	0.60	4	0.66	3	0.69	10**

Tutors and mentors

The background of tutors varied across the programme. Tutors on the Physics Spokes were current A-level teachers, tutors, teacher trainers and outreach officers. On the Maths Spokes tutors were undergraduate students. For the Chemistry Spoke, tutors were postdoctoral researchers and academic staff. Mentors on the Chemistry and Physics Spokes were undergraduate students.

Findings

Research Question 1: Have students on the Levelling Up programme chosen to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university?

Levelling Up participants were asked in the end of programme survey to list the universities and courses that they had applied to on their UCAS application forms. Students were able to submit up to five choices in their UCAS application. Table 16 below summarises the number of respondents that had made at least one application to study a subject which they studied on the Levelling Up programme (or a directly related STEM discipline). Whether a subject was classed as "directly related" to their Levelling Up programme was determined by the Chemistry and Physics Hub leads for the Chemistry and Physics programmes. For Maths, the Hub did not specify which subjects were considered to be directly related and therefore only university programmes with Maths in the title, or where the student stated that it was a Maths programme have been included.

The data show that 52 out of the 67 respondents to the end of programme survey had made at least one application to either a Chemistry, Maths or Physics course (depending upon their programme subject) or a subject directly related to these. Six students made applications that had none of their choices linked to their Levelling Up programme subject (or a directly related subject).

Table 16. Number of respondents with at least one application to study a subject which they studied on the Levelling Up programme (or a directly related STEM discipline).

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
At least one application is in Levelling Up (or related) subject or a related subject	11	8	7	9	8	9	52
No applications to a Levelling Up (or related) subject	0	2	1	2	1	0	6
Planning to apply next year or at some point in the future (subject not specified)	1	0	2	0	2	0	5
Not applying to university	0	0	1	2	0	1	5
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Changing perceptions and supporting decision making

Several students gave examples of how participating in the programme had provided information to help them in their decision making around which subjects to apply for at university. Key factors that

were mentioned by several students were around the maths content of courses and identifying the balance of maths content they wanted within their degrees, the theoretical vs applied nature of subjects and being able to ask current students questions.

Several students mentioned that the programme had helped them to see that they wanted vocational aspects within their courses and so had chosen routes such as medicine and optometry.

Research Question 2: Have students on the Levelling Up programme applied to a high ranked University (as defined by the ranking in the Times Good University Guide)?

As for RQ1, Levelling Up participants were asked in the end of programme survey to list the universities and courses that they had applied to on the UCAS application forms. Students were able to apply to five courses in their UCAS application. Table 17 gives a summary of the number of students for whom at least one of their applications was in for university that was in the top 10 in the Times Good University Guide 2022 for their chosen subject.

The data show that for the students that were applying to university this year, in all Spokes the majority of students applied for at least one university ranked in the top 10.

Table 17. Respondents who have at least one application to a university ranked in the top ten of the Times Good University Guide 2022 for their chosen subjects.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
At least one application to a top 10 university for their chosen subjects	9	10	5	7	9	9	49
Applying to university but no applications to a top 10 university for their chosen subjects	2	0	4	3	0	0	9
Not yet, I am planning to apply next year or at some point in the future	1	0	2	0	2	0	5
Not applying to university	0	0	1	2	0	1	4
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Figure 3, Table 18 and Table 19 show the rankings of all application choices and show that for students in the Physics – Oxford Spoke the mean ranking was 8.0 and the median rank for applications was in band 1-5 (actual = 5.5). For students on the Chemistry – Durham, Maths – Durham and Physics – Durham, the mean ranking was 12.0, 10.0, and 11.8, respectively, and the median ranks for applications were in band 6 – 10 (actual Chemistry - Durham 8.0, Maths - Durham 6.0, Physics - Durham 7.0). For students on the Maths – Leicester and Physics – Birmingham Spokes the mean rankings were 15.3 and 23.5, respectively and the median rank for applications were in band 16-20 (actual Leicester maths 16.0, Birmingham physics 19.0).

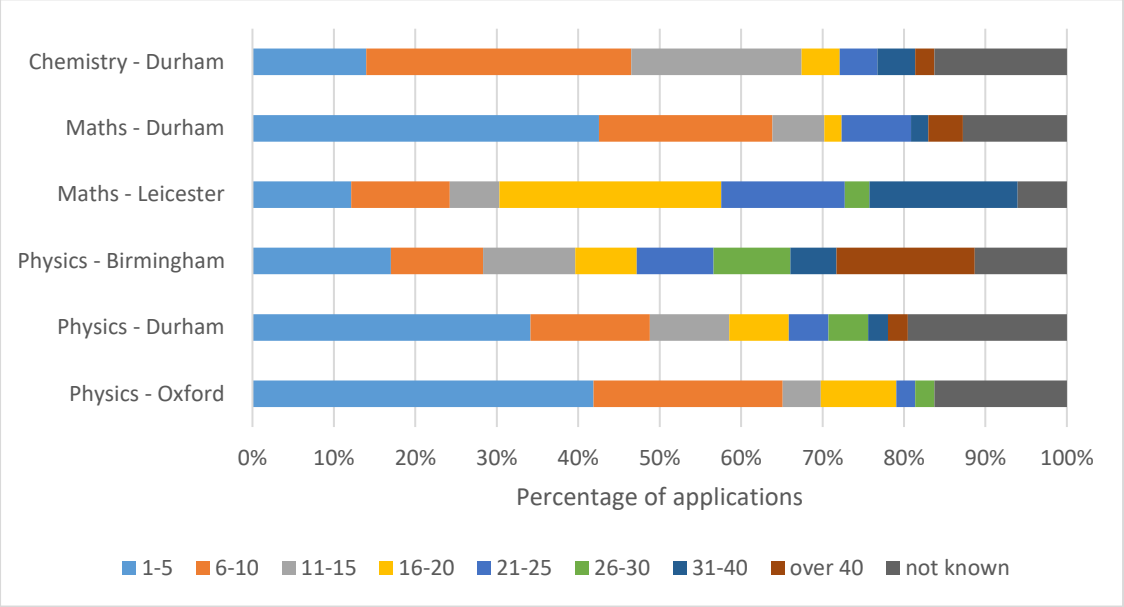
Table 18. Mean and median rankings by Spoke for respondents' application choices based on the ranking for subjects in the Times Good University Guide. Note that respondents could have made up to five choices for their applications.

Spoke	Number of students	Mean rank	Median rank
Chemistry – Durham	11	12.0	8.0
Maths – Durham	10	10.0	6.0
Maths – Leicester	8	15.5	16.0
Physics – Birmingham	11	23.5	19.0
Physics – Durham	9	11.8	7.0
Physics - Oxford	9	8.0	5.5

Table 19. Number of applications by respondents by rank in the Times Good University Guide 2022 for their chosen subjects (i.e. in all subjects, not just their Levelling Up subject). NB 'Not Known' could refer to a subject and/or university and/or combination of both not seen in the Times Good University Guide 2022 or because it was not possible to determine which subject in the Times Good University Guide 2022 the course referred to.

Rank	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
1-5	6	20	4	9	14	18	71
6-10	14	10	4	6	6	10	50
11-15	9	3	2	6	4	2	26
16-20	2	1	9	4	3	4	23
21-25	2	4	5	5	2	1	19
26-30	0	0	1	5	2	1	9
31-40	2	1	6	3	1	0	13
over 40	1	2	0	9	1	0	13
Not Known	7	6	2	6	8	7	36
Total	**43**	**47**	**33**	**53**	**41**	**43**	**260**

Figure 3. The percentage of applications by respondents to a university ranked in the top ten of the Times Good University Guide 2022 for their chosen subjects.



Research Question 3: Have students on the Levelling Up programme applied to study at university (in any subject)?

As for RQ1 and RQ2, Levelling Up participants were asked in the end of programme survey to list the universities and courses that they had applied to on the UCAS application forms. Students were able to apply to five courses in their UCAS application. Out of the 67 respondents to the end of programme survey, only five did not plan to apply to university at all, with a further five stating that they planned to apply at some point in the future.

The respondents to the end of programme survey that reported they were not applying to university in the current year, or in future years, gave examples of their plans beyond A level. These included further study through apprenticeships and Higher National Diplomas (HND); taking a gap year and consideration of other career paths.

Research Question 4: Have students on the Levelling Up programme applied to study at their Levelling Up host university?

Table 20 shows a summary of whether the respondents to the end of programme survey had selected their Levelling Up host university as at least one of their choices on their UCAS application. The data show different trends between the students on the different Spokes.

Out of the students that had applied to university this year, 100% of the Physics – Durham Spoke had applied to Durham, 90% of Maths – Durham, 72% of Chemistry - Durham, 64% of Physics – Birmingham, 50% of Maths - Leicester and 33% of Physics – Oxford.

Table 20. Number of respondents who have made at least one application to the university through which they were part of the Levelling Up programme.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
At least one application is to host university	8	9	4	7	9	3	40
Applied to university this year but not to host university	3	1	4	4	0	6	18
Didn't apply to university this year	1	0	3	2	2	1	10
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Research Question 5: How effective do students consider that the programme has been in helping them to achieve higher grades at A level in their subject?

In the end of programme survey, the students were asked how they felt participating in the Levelling Up programme had impacted on the grades they would achieve in their A level in their Levelling Up subject. Table 21 shows a summary of the data. The majority of the students considered it would have a positive (large or small) impact on their grades they would achieve in their A level Chemistry, Maths or Physics (depending upon their programme). This ranged from 100% of Chemistry – Durham students to 73% on the Maths – Leicester programme. Two students considered that the programme would have a negative impact on their performance.

Table 21. Responses to the question How do you feel participating in the Levelling Up Chemistry/Maths/Physics programme will impact on the grades you will achieve in A level Chemistry/Maths/Physics?

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Will have a (large or small) positive impact on my grades	12	8	8	10	9	9	56
Will have no impact	0	2	2	3	2	0	9
Will have a (large or small) negative impact on my grades	0	0	1	0	0	1	2
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Research Question 6: (Chemistry and Physics only) How effective do students consider that the programme has been in helping them to achieve higher grades at A level in maths within their subjects in their subject?

In the end of programme survey, students on the Chemistry and Physics programmes were asked how they felt participating in the Levelling Up programme had impacted on the grades they would achieve in A level Maths. Table 22 shows a summary of the data. The majority of respondents considered that the programme would have a positive (large or small) impact on their performance, ranging from 83% of Chemistry - Durham students to 54% of Physics – Birmingham students. Only one student considered that the programme would have a negative impact on their performance.

Table 22. Responses to the question 'How do you feel participating in the Levelling Up Chemistry/Physics programme will impact on the grades you will achieve in A level Maths?'

	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Will have a (large or small) positive impact on my performance	10	7	7	6	30
Will have no impact on my performance	2	6	4	3	15
Will have a (large or small) negative impact on my performance	0	0	0	1	1
Total	**12**	**13**	**11**	**10**	**46**

Research Question 7: Have students on the Levelling Up programme received offers to study the courses which they have applied for on their UCAS applications?

In addition to specifying the courses they had applied to in the UCAS forms, the students were also asked whether they had received offers to study on the courses. Out of the 260 applications made, 245 had received a decision on the offer at the time of the survey (Table 23). Of these, 85% had been successful in receiving an offer to study on their courses. There was little variation between Spokes, ranging from 93% successful for Maths – Leicester to 80% for Chemistry – Durham.

Table 23. Numbers of applications to, and offers received from, universities by respondents to the end of programme survey.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Total number of applications to university	43	47	33	53	41	43	260
Successful in receiving offer	33	42	28	41	33	31	208
Unsuccessful in receiving offer	8	5	2	9	6	7	37
Waiting to hear about decision	2	0	3	3	2	5	15
Percentage of successful offers received (for those with a decision)	**80**	**89**	**93**	**82**	**85**	**82**	**85**

5. Implementation and Process Evaluation (IPE)

The Implementation and Process Evaluation (IPE) section is structured in three parts:

- Firstly, the perceived benefits that students considered they gained from being part of the programme (structured using the original intended Outcomes of the programme, as detailed in the Theory of Change model), along with how useful they found the different activities within the programme will be presented.
- This is followed by a detailed investigation into the delivery of the programme and whether this took place as planned, the extent to which students engaged with the programme and any reasons that prevented students from being able to fully engage with the programme.
- Other contextual factors that have arisen from within the data will then be discussed.
- Finally, suggestions from participants and the programme team for refinements to the programme will be detailed.

Perceived benefits of the programme for participants

This section presents findings from the CLASS survey (collected as part of the baseline and end of programme surveys), mid-point and end-point focus groups and open text responses in the end of programme survey to investigate participants perceived benefits of being part of the programme.

CLASS Survey Findings

The CLASS survey findings are analysed to assess whether there has been a large (i.e. statistically significant) shift in students' beliefs towards being more expert-like or more novice-like (see the methodology section for a more detailed description of the CLASS survey and analysis). It should be noted that shifts towards more novice-like beliefs should not be interpreted that that the programme has been detrimental to the students. They are indicating a shift has occurred in the students' thinking between the beginning and end of the programme.

There are seven categories in common between the Chemistry version of the CLASS survey and the Physics version (used for the Maths and Physics Spokes), these were:

1. Personal Interest
2. Real World Connection
3. Problem Solving General
4. Problem Solving Confidence
5. Problem Solving Sophistication
6. Sense Making/Effort
7. Conceptual connections

The Chemistry survey then has a further two categories:

8. Conceptual learning
9. Atomic-Molecular Perspective of Chemistry

Whilst the Physics survey has one further category:

8. Applied Conceptual understanding

A full breakdown of the findings from the analysis of the CLASS survey data is provided in Appendix 5. A summary of the statistically significant findings is given below.

Chemistry: For the Chemistry students that completed both the baseline and end of programme surveys, there was a large shift away from more novice like responses for the questions related to "Real World Connection". The students demonstrated a large shift towards more novice responses in "Problem Solving General".

Maths: For the Maths students that completed both the baseline and end of programme surveys, there was a large shift in responses towards those of an expert in the questions related to "Real World Connection". The students demonstrated a large shift towards more novice responses in "Sense Making/Effort".

Physics: There was a large shift in responses towards those of an expert in Problem Solving Sophistication, Conceptual Understanding and Applied Conceptual Understanding. There was a large shift towards more novice responses in Problem Solving Confidence. A large shift towards those of an expert was also seen for when all responses were combined.

Students' perceptions of benefits by programme Outcomes

The findings in this section are summarised under the original intended Outcomes for the programme (as specified in the Theory of Change model), with quotes from students included in Appendix 6.

Outcome 1. Increased confidence in the subject

The students participating in the focus group from all subjects stated that the programme had improved their confidence. They suggested some of the elements of the programme that had assisted with this:

- Covering material in advance of it being covered at school
- Providing continuous extra learning
- Having someone to be able to ask for help
- Creating a solid foundation to work from
- Enabling them to become comfortable around topics on the A level syllabus
- Helping to develop an understanding of topics
- Teaching the content from different perspectives to those in school
- Enabling them to answer their questions carefully and sensibly
- Working in a group and sharing ideas with others.

Outcome 2. Increased problem solving skills in the subject

Participants from the Physics and Maths Spokes commented in the focus groups that the programme had increased their problem solving skills as it had helped them to "think outside the box" when answering questions, assisted them with how to approach "weird" and "unfamiliar" problems, talking through their answers with other people and seeing how problems are tackled by different people.

Outcome 3. Increased confidence at having a go at problems even if they can't solve them

Physics and Maths participants commented in the focus groups that they found the programme encouraged them to try new approaches, think in different ways and to keep trying. They felt it didn't matter about getting the right answer, it was about giving things a try. This was also highlighted by one of the Maths tutors as the approach they encouraged their students to take.

Outcome 4. Increased perseverance, resilience, willingness to try different strategies in their subject

Physics and Maths students commented in the focus groups on how the programme had been of benefit in helping them to consider and undertake a range of different approaches to answering questions and to understand that there was not just a single method that could be used. Where students struggled to conceptualise different approaches, they appreciated tutors demonstrating a variety of approaches. The ability to discuss ideas in small groups and to gain "tips and tricks" for answering questions they felt supported them in their A level studies.

Outcome 5. Increase in students' belief in their ability in the subject

Physics and Maths students commented in the focus groups about how they found the programme had developed their interest in the subject and they felt they could choose topics that they "really want to explore". The programme had helped them to understand topics from their A levels better and helped them feel more comfortable with particular aspects of their courses. Through the activities on the course helping them to approach questions in different ways helped them to see the subject differently and they reported they were finding it easier at A level.

Outcome 6. Broaden their mind regarding thinking and understanding of subject, not just correct solutions

Students in Physics and Maths gave multiple examples of activities within the programme that went beyond content on the A level syllabus or teaching to pass an exam. They commented on how discussions which enabled them to "apply the subject to real life" were beneficial and that they felt that "instead of teaching us physics to pass an exam, it's to cultivate an interest in the next generation". The students commented that they found the approach made the subject more creative, enjoyable and interesting. Multiple students commented how they felt the programme gave them the opportunity to ask subject related questions that they either did not get the time to ask in school, or which they felt their teachers at school would be unwilling to answer.

Outcome 7. Better understanding of what it may be like to study their subject beyond A-level

Students from all three subjects commented about how the programme had helped them to see what it would be like to study their subject beyond A level. These split into two main themes relating to subject content and level, and logistical arrangements of studying in HE.

Students commented that the programme had helped them to see "the overlap between A level and graduate level", to experience doing university level questions, helping to "bridge the gap", and that it had "prepared them for [working at a] university level". They also could see how their learning at A level could be applied to the real world.

The students commented that they had gained an understanding of where lectures may be located within the university and that they would not be located in the same place all the time, that group work was a part of university work and that it wasn't all just working on their own, what the mix of lab work and lectures would be like within the course, what it would be like to balance living and studying at university, and how university terms and exams work. They also commented that they had the opportunity to see the way things were taught at university with the pre-reading and tutorial structure of the Levelling Up programme.

Outcome 8. Increased perception that chosen subject is a useful degree

Chemistry and Physics students commented that they had appreciated the talks and guest lectures that had helped to make "real life connections" and that had demystified what certain jobs or job titles do and had helped them understand what certain jobs entail.

Outcome 9. More confident about continue to learn subject beyond A-level

Students from all three subjects gave multiple examples of what they perceived to have been the benefit of the programme. Two main themes emerged.

The first was around students being able to experience the subject through the Levelling Up programme and to see whether they wanted to continue to study it or choose an alternative subject. They commented that the programme was engaging and had helped to "get you more into what you really want to do in the future" and that seeing what the subjects were like at university had helped them in making up their mind about whether that was what they wanted to do.

The second theme related to the Levelling Up programme helping to make the studying the subject at university more inviting. Students commented that the programme had helped them to "be less intimidated by going to uni and doing [their subject]" by helping them to develop resilience in their approach to solving problems, and giving them confidence in the future to approach the subject "from a calmer or more confident point of view. Rather than panic about the unexpected." Students commented that seeing their tutors and mentors work through steps in problems made the subject seem "less daunting" and would help them prepare in advance for the anticipated difference in level.

Outcome 10. Students feel supported by programme throughout their application process

Students from all three programmes provided examples of how the Levelling Up programme had helped them with the university application process.

These fell into three themes:

- Application process advice and support: This included receiving advice on their personal statement (along with seeing examples of personal statements), advice on student finance (which wasn't something that was known about within their family), feeling a sense of community with the other students during discussions about the UCAS application process and making the application process "less daunting".

- Help with preparing for academic interviews at university, including some mentors that had produced videos of mock interviews or ran through examples to help with interview questions.
- Guaranteed or reduced offers from universities: Some students had received a guaranteed conditional offer from attendance on some of the Spokes of the programme which they reported helped with a sense of security and that if they didn't receive other offers, they still had one. Other students received lower offers from universities (including non Levelling Up universities) due to having been part of the Levelling Up programme.

Outcome 11. Students feel they belong on a degree in their chosen subject after participating in the programme

Students from all three subjects discussed in detail how the programme had helped them to confirm or change their mind about the subject or the universities they wanted to study at. One student on the Chemistry programme reported how they had initially used the Levelling Up programme as a means of getting extra support for their Chemistry studies, but after taking part they had changed their mind to wanting to study Chemistry at university. Students on the Physics and Maths programme shared how it had helped them decide between their Levelling Up subjects and subjects such as Engineering and Computer Science. They also discussed how it had helped them to find particular topics within the subject that they decided they wanted to study to a higher level and for some it had influenced their future career choices. Students also reported how getting to know staff and students at the universities had influenced their decisions as to whether they wanted to study the subject there.

One student also commented on how their mentor had acted as a role model showing how it was possible to "thrive" as a woman studying Physics.

> *"I was one of two girls in my physics class, and it was just a very daunting experience going into a sixth form full of boys who do my subject. I thought, 'The attitude sometimes can be a bit iffy from them,' but meeting my mentor, obviously she was a girl, so seeing her thrive in that environment really helped."*
>
> Oxford – Physics, Mid-point student Focus Group

Outcome 12. Students feel they belong in the university community after participating in the programme

Students from all three subjects discussed how the Levelling Up programme had helped to make university life "seem a lot less alien" and had helped them to develop their understanding of university life (e.g. study skills, social life, activities on offer, meeting new people, work-life balance). The students emphasised in numerous examples how much they had appreciated being able to ask questions about "practical knowledge" around what university was like outside of studying the subject.

> *"Being able to talk to other students about university life, without teachers breathing down your neck or the university faculty being there, was really helpful. In terms of being able to openly ask questions and for them to be able to openly answer to you, as well. .. finding out what university life is like, finding out tips and tricks, to help, when you do start university, or*

how to prepare for exams, that kind of practical knowledge, rather than the academic knowledge, is what I take away most from this programme."

Birmingham – Physics, End-point student Focus Group

Other skills

Other areas where students considered there had been benefits from participating in the programme were in developing their time management and independent learning skills.

Programme differentiation from other Widening Participation schemes

Students, mentors and tutors were asked in the mid-point and end-point focus groups and end of programme survey in what ways they considered the Levelling Up programme to be different to other widening participation programmes.

Key themes which emerged were the:

- Benefit of the programme running over a longer period of time helping them to "grow with the programme", developing their learning "throughout their A levels", and developing consistent relationships with the tutors, mentors and participants.
- Depth and breadth of subject content, going beyond A level which helped them "to understand content taught better and allowed [them] to expand on [their] super-curricular knowledge on the subject",
- Combination of tutoring and mentoring (Chemistry and Physics) helping develop "greater confidence in both academic content and the university application process/undergraduate student life and helped to alleviate underlying anxieties regarding both". Students valued the perspectives they gained from working with more than one person and engaging with a range of different activities as part of that.
- Insight into how university works from speaking with current students. However, concern was expressed by one mentor that they felt that the programme had the potential to feel more removed from the university than other schemes, such as supported progression, because of the online delivery method.
- Close knit nature of the community due to the smaller number of students on the programme at the university and in the small group tutorial and mentor sessions. This helped by reducing pressure in the tutorials and questions feeling more targeted.
- Interactivity of the sessions through the questioning and discussion during sessions. This had helped the students remain engaged.

Several students commented that they did not know about any other Widening Participation programmes.

Programme delivery

This section is structured in two parts.

- **Delivery of activities**: The delivery of activities within the programme will be discussed and whether these were delivered as planned and the reason for any changes, if they occurred.
- **Participant engagement**: The number of participants engaging in the programme activities and drivers for engagement or a lack of engagement, including barriers to participation will be discussed.

Delivery of activities

The planned activities for the Levelling Up programme were outlined in the Theory of Change model (Appendix 1) by the three Hub teams before the programme commenced. The activities as specified at the outset of the programme were:

Activities

1. Training for tutors
2. Training for mentors (chemistry and physics only)
3. Academic tutoring session materials
4. Academic tutoring sessions
5. Mentoring session materials (chemistry and physics only)
6. Mentoring sessions (chemistry and physics only)
7. On-site/remote visits to spoke universities
8. Online guest lectures
9. Guaranteed offers of university places made to participants on the programme (conditions apply)
10. Provision of graphic tablets (maths only)

At the end of the programme, the Hubs and Spokes were asked to discuss to what extent they considered that the Levelling Up activities had been delivered as planned. They were also asked to describe what any changes/adaptions had been if they occurred and the reasons for any changes.

All activities within the programme were delivered to some extent by all the Spokes, with the exception of on-site/remote visits which had been planned by the Durham Spokes but were unable to take place due to COVID-19 restrictions (these had not been planned as part of the programme by the other Spokes).

However, variation in the extent of the delivered programme took place for the Physics – Birmingham and Physics – Oxford Spokes as the programme commenced later than originally planned. Only 10 out of 19 tutorial sessions were delivered on the Physics – Birmingham Spoke (all nine mentoring sessions took place). It is unknown how many tutorial or mentoring sessions were able to take place for the Physics – Oxford Spoke as the number varied by group and registers were not completed by many of the tutors and mentors.

Students, tutors and mentors provided detail on aspects of the programme delivery in the mid-point and end-point focus groups. Areas raised within the discussion included: recruitment to the programme; style of delivery of tutorials; interactiveness of sessions; content of the programme; adaption to the content; timing of content; time needed for tutors, mentors and students to prepare

for sessions; views on pre-work set for students; perceived benefits of small groups; student engagement; communication and support for students within and outside sessions; communication between tutors and mentors outside sessions; technology supporting delivery of the programme and the use of cameras and audio by students.

Recruitment

In the end-point focus groups, the students were asked how they had found out about the programme. Two main methods were evident, which were the student finding out about the programme through their A level subject teacher or through a central school careers/outreach provision. The student searching for information themselves, parents searching online, or direct contact by the university were mentioned by a small number of students as the methods by which they had found out about the programme.

Tutorial and mentor sessions

Style of delivery

Chemistry and Physics students commented that they liked the structure of the cycles with their own learning week and then the tutorial. The style and content of the sessions was also commented to be engaging. The concise videos in the self-learning were felt to be informative along with the links to useful sites.

Content

The breadth and depth of topics covered was discussed by Physics tutors and Physics and Maths students, with the students commenting how they appreciated being able to think more deeply about the subject content and how it had increased their enjoyment of the subject. They also appreciated the content going beyond just what was required for their A level studies and the connection to real world examples.

Two of the Physics tutors commented how they considered that there was too much content included within the slides provided by the programme. However, the implication of this was perceived differently by each. Once commented that they felt that there was too much content and that the level went beyond what was required for A level. They were concerned that this would add pressure for the students which was not required if the aim was to help them with their A level grades. The other tutor considered the additional content to be useful in helping them as a tutor pick and choose what they wanted to include in the sessions (see next section below for adaption to content). From observation of the tutor training for Physics, the trainer specifically mentioned that not all content needed to be included, and so this may be a misconception by some tutors that all materials needed to be included. This may also be an indication of some of the different perceptions as to the aim of the Levelling Up programme by different tutors.

Adaption to content

Physics and Chemistry tutors and mentors commented that they had used the resources provided, but had also adapted these to create their own presentations. In some cases they had adapted them to make it more interactive with activities or asked the students what they would like to cover in the next session. One mentor commented that although they had adapted the material, it was not fully clear in the training whether this was something that they were expected/allowed to be doing. The students valued the tutors and mentors adding their own interests into the discussion.

Physics tutors commented on how they adapted sessions for students that would benefit from alternative approach to the content. This included adapting their style to more of a coaching role for students that were already comfortable with the content, or in another case, creating additional videos on YouTube with solutions to the problems to provide a student that was struggling with more support.

Timing of content

One mentor noted that the challenge of timing of sessions, particularly around when personal statements was covered, as this took place after students in their group had already applied to university.

Time

Time preparing for tutoring and responding to communications was mentioned by Chemistry and Physics tutors as presenting a challenge. For the Chemistry tutor, this was in relation to finding time within the week to schedule preparation as materials were sometimes only available shortly before sessions. For the Physics tutors, it was in relation to the expectation for preparation time to be on top of what they were paid for. The arrangement was changed early in the programme to pay the Physics tutors for additional preparation time.

The initial arranging of times for the sessions was also commented to have been challenging for some of the tutors on the Physics – Oxford programme. This was due to scheduling alongside home commitments such as school pick up times.

Fitting all of the content into the time available was also commented on by a Maths - Durham tutor in relation to the length of the individual sessions and a Physics - Birmingham tutor in relation to the number of sessions possible within the programme.

A Chemistry – Durham student mentioned that timing of when homework materials were released could be problematic when they were released later than scheduled.

Pre-work

Students from both the Maths and Physics programmes agreed that the pre-work was helpful, giving them the chance to attempt the problems first and then go through them asking questions and going into more depth.

Comments were received from Physics and Chemistry tutors that pre-work set for students was a good way for them to assess students' understanding, with one Physics tutor noting that students were engaging with the pre-work, which given the pressure of their A levels, must have meant that they found value in carrying it out. However, concerns were raised by several Physics tutors, who felt that the pre-work may have a negative impact on attendance with students that had not completed it being concerned about attending and that this would then create a disparity between students that may or may not have completed it. Some Physics tutors had chosen to remove pre-work from what they asked students to do, others considered moving it to after the tutorial session may be an option if the student had not had chance to complete it. Reflecting on the ongoing engagement with the pre-work, one Maths tutor noted at the mid-point focus groups that they felt the students were no longer engaging with the pre-reading in the second year of the programme.

Safeguarding

Issues around the challenges posed by safeguarding procedures impacting the way the programme could run were mentioned across several Spokes. This was particularly highlighted in sessions not being able to run as only one student was present. Many sessions on the Physics – Birmingham Spoke ended up with only one student attending, which meant that for safeguarding purposes, these sessions could not run. The decision was therefore made to move to single large sessions where the students would then be put into breakout rooms. However some tutors commented that this made it difficult to run their sessions as they did not know who the students would be that they would be working with, or which material to cover in advance as this sometimes depended upon what had already been covered with the students.

Students also commented that they felt that they lacked a sense of community outside of their weekly sessions because they had no means of contacting the other students outside the sessions. They understood this was for safeguarding purposes, but commented that some means of safely contacting one another would have been beneficial for seeking mutual support for homework or UCAS applications .

Frequency and timing of the sessions

A mixed set of comments were received relating to the frequency of sessions. Tutors and mentors had experienced challenges around the scheduling of sessions not being on a weekly or regular cycle (e.g. being interrupted by school holidays). However, one tutor commented how the expectation around communication within holidays was also problematic.

Two Physics students commented that they felt that the mentor sessions did not occur often enough and would have liked to see them occur more frequently (on the Physics – Durham Spoke the ratio of tutorials to mentor sessions was 19 tutorials to 9 mentoring sessions).

Benefits of small groups and friendly atmosphere

Students commented extensively on how they had found their sessions to be friendly and particularly valued being in small groups, working on problems together and “feeling in the same boat”. They also commented on the sense of community that they felt had developed and gave examples of how their bond with the other students had developed within the sessions. Two Physics students commented in the end of programme survey that they had felt anxious about giving wrong answers in the tutorials, however, this was something that at least one of the respondents felt the set up and environment enabled them to overcome. However, one student from the Physics – Birmingham Spoke commented on how they felt the sense of community had been lost when the programme moved to a larger single group part way through the programme.

Engagement within the sessions

Students commented on the range of ways that the tutors and mentors had made the sessions engaging. They particularly valued the interactivity of the sessions, mentors and tutors encouraging discussion, working on problems together, being asked questions in the session by the tutors and mentors, pre-work including videos. They felt the interactive nature of the tutorials were beneficial and that tutors made an effort to get the students involved.

However, comments from one Physics - Oxford tutor and one Chemistry - Durham mentor indicated that on occasion the content was not always designed to generate discussion, but sometimes more towards individual study. For the tutor, they tried to address this by modelling answers for students

rather than simply presenting the solution on the next slide. This was echoed by two students (Maths - Leicester and Chemistry - Durham) in the end of programme survey who commented that some sessions were occasionally less participatory and more like a presentation, especially when they were whole group sessions. However, they did not consider this to be a problem. Comments were also received from tutors that it was not always possible to easily gauge level of engagement if students had their microphones and cameras off and were not responding to questions. This is discussed in more detail in a later section.

Communication for support and community

Students commented on the challenges that they perceived around support and their relationship with the other students and tutors being confined to the mentor and tutor sessions and those in their particular group. They felt this limited the support they were able to access. The students discussed in the focus groups how they would like additional communication with the tutors, mentors and other students outside of the weekly sessions. Several students commented on how they would have liked to be able to discuss the pre-work/homework with other students or options and applications for university. Students suggested methods to improve communication such as a group chat outside of the sessions.

Students and tutors commented on the difficulty of communication and forming a community in an online environment including a lack of interaction by some students and not having much opportunity for social discussions. One student commented that they considered that the social aspect was not something that was the purpose of the sessions.

However, although there were challenges to the online environment, students commented on some of the benefits of the programme being online, including the flexibility and ease of joining meetings from home; not needing to be located geographically close to the host university; meeting students from across the country; increased confidence and feeling more comfortable from having space and the ability to use Google as additional support by not being in a physical classroom with the teacher.

The use of collaborative software to facilitate working on problems together and to keep at the end of the activity was commented on by one tutor as being an advantage of the online environment. Students also using Google efficiently to help them find answers to questions along with formulae sheets were also methods students used to support their learning.

Communication between tutors and mentors

The opportunity for communication between tutors and mentors was raised several times by tutors and mentors as something that could have been beneficial for them in supporting the students. They considered that there was a disconnect in knowledge between tutors and mentors relating to what the students were being asked to do which sometimes meant that they had to ask the students for information that they felt they should already know. Physics – Oxford tutors and mentors commented that a means by which they could see and discuss what had been done in the other sessions with the same group would be beneficial. This was provision which was available to the Chemistry – Durham and Physics – Durham tutors and mentors through the MS Teams channel for their group of students.

Technology

Students commented on some of the challenges they had faced around communication, which had made accessing the sessions more difficult. In some cases these were early teething problems for the programme as online platforms such as Zoom or links to MS Teams sessions were implemented for

the first time within the programme. Other challenges occurred periodically throughout the programme such as broken microphones.

There were complications in the initial set up of the programme for Physics – Birmingham, which meant that the delivery platform changed after 2 – 3 weeks of the programme.

Several comments were received from tutors around functionality to support the tutorials. This aligned with comments received from students around difficulties relating to drawing or writing equations and diagrams. It should be noted that the Maths programme provided graphics tablets for students to make it easier to draw graphs and write equations. Comments received from students and tutors on the Maths programme show that these were used effectively for this purpose, although one tutor did comment that they had seen a decrease in their use by students over time.

Graphics tables were not available on the Chemistry or Physics Spokes.

Use of cameras in tutor and mentor sessions

Tutors and mentors commented on the challenges they found were presented by the students having their cameras turned off and not speaking up in sessions or using written chat. The lack of active engagement meant that judging levels of engagement was difficult. Where students did use the chat, comments often were delayed from the main discussion due to the time required for typing. There was a mixed opinion as to whether cameras being turned off was problematic for delivery with some finding that the students still communicated via microphone or chat, but other tutors and mentors commenting that they felt some students rarely communicated at all. Tutors and mentors had not been insistent that students have their cameras on, conscious of the varied reasons the students may have had for turning the camera off. However, many had gently encouraged students to engage as far as they felt comfortable.

Students, tutors and mentors commented on some of the reasons they had observed or experienced for cameras being turned off which included: the student couldn't/didn't want to turn it on due to their location/environment; the student commented they didn't consider there to be a benefit from having it on; internet bandwidth was not sufficient; they were self-conscious/anxious about having the camera on; the rest of their group was not using it; or there was no particular pattern or reasons for them having it turned on.

Participant engagement

Findings in this section are presented by activities in the programme as well comments on the overall programme:

- Tutorial sessions (including pre-work/homework and graphics tablets)
- Mentor sessions
- On-site visits
- Guest lectures

For each activity data are presented on:

- Student attendance measured using two methods: attendance registers collected by Spokes for tutorial and mentor sessions; as well as students being asked to report in the end of programme survey how many sessions they had missed.
- Student assessment in the end of programme survey of the extent to which they felt they had been able to fully participate in different aspects of the programme, and how useful they had found aspects of the activities.
- Qualitative responses by students in the end of programme survey and mid-point and end-point focus groups sharing reasons for their motivation to participate or challenges in participating in the programme.

Tutor sessions

All Spokes delivered tutorials as part of their programme, however, the specific details of delivery varied between Spokes. A summary of the planned tutor session activity details is given in Table 24 below. This is an excerpt of Appendix 2 – Table 2, which shows the full description of the planned programme delivery in each Spoke using the TiDIER framework. The table does not take into account modifications to delivery during the programme, which has been discussed above and the impact of which will be discussed below.

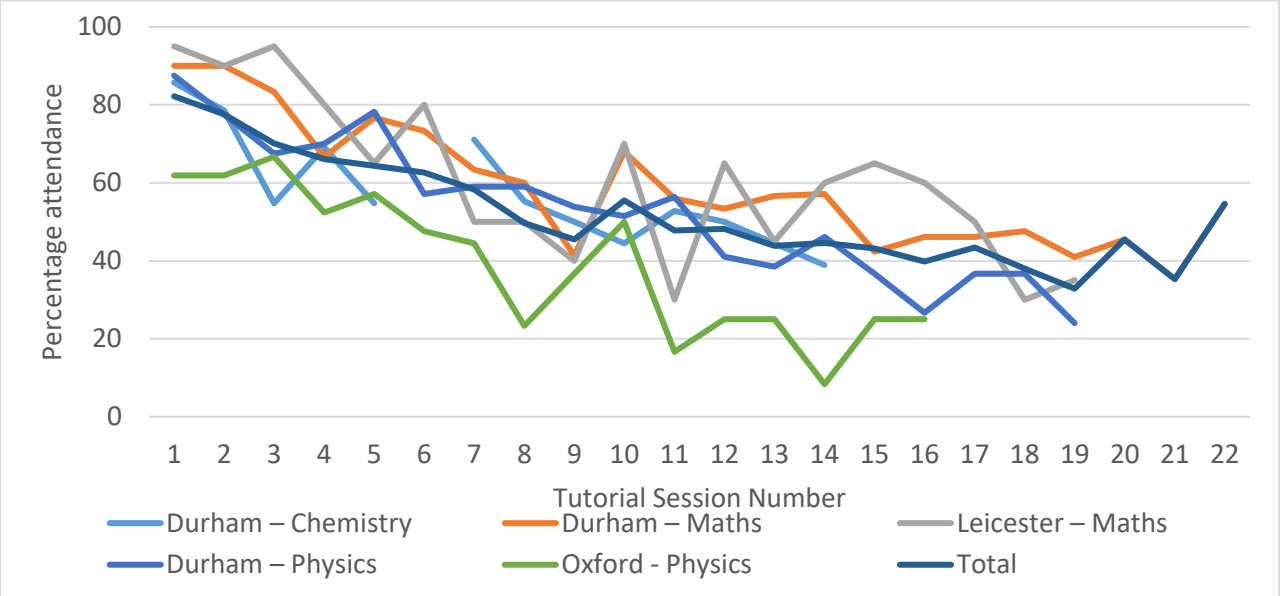
Table 24. Summary of the planned tutorial programme delivery by Spoke. A more detailed description is providing in Appendix 2 – Table 2.

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Start and end date of any set work	12/04/21-16/05/22	22/03/21-02/05/22	March 2021 – April 2022	06/21 - 03/22	12/04/21-21/03/22	September 2021 - May 2022
Who provided tutorial sessions	Postgraduate students and members of academic staff	Undergraduate Maths students	Undergraduate and Postgraduate Maths students	IoP appointed tutors (A level teachers)	IoP appointed tutors (A level teachers)	IoP appointed tutors (A level teachers)
Number and size of tutor groups	8 groups of 5-7 students	6 groups of 4-5 students	2 groups, anywhere from 2-10 people in size	8 groups of 5-7 students	7 groups of 5-7 students	7 groups of 6 students
Amount of work set	30 pieces (15 of pre-work and 15 diagnostic Qs post-tutorial)	22 pieces	22 pieces	10 pieces	19 pieces	One per tutorial

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Frequency of set work	Every 3 weeks during term time	Every 2 weeks	Every 2 weeks during school term time	every 3 weeks	Every 2/3 weeks	One per tutorial
Total mandatory pieces of work set	30	0	1	10	19	One per tutorial
Start and end date of tutorials	22/03/21-23/05/22	29/03/21-09/05/22	March 2021 – April 2022	14/6/21 - 23/3/22	19/04/21-25/04/22	September 2021 - May 2022
Number of tutorials	17	22	22	10	19	Varied by group / tutor
Frequency of tutorials	Every 3 weeks during term time	Every 2 weeks	Every 2 weeks	every 3 weeks	Every 2/3 weeks	Every 2-3 weeks
Length of tutorials	1 hour	90 minutes	90 minutes	1 hour	1 hour	1 hour
Total mandatory contact time for tutorials	17 hours	33 hours	33 hours	10 hours	19 hours	Varied by group / tutor

Figure 4 below shows a summary of the percentage of students attending tutor sessions for each Spoke. Data are from the attendance registers collected by the Spokes. As there was some missing data within the attendance registers the percentage attendance has been calculated using data where the attendance data were known. No data was available for Birmingham – Physics. Appendix 2 – Table 2 provides a more detailed breakdown of the data and indicates where data was missing.

Figure 4. Percentage of students attending tutorial sessions by Spoke and for the Levelling Up programme as a whole. Data used is from the attendance registers collected by each Spoke. The percentage attendance has been calculated using data where the attendance data for the session was known.



In addition to the registers, respondents were asked in the end of programme survey to indicate how many tutor sessions they had attended over the programme and to what extent they felt able to participate in tutor sessions. Table 25 and Table 26show the responses by Spoke. For the Chemistry – Durham, Maths – Durham Spokes, the majority of students reported having attended all sessions or missing only one or two (out of 17 and 22 sessions, respectively). For the Maths – Leicester Spoke, the majority reported missing three or four sessions (out of 22 sessions). On the Physics – Birmingham Spoke, the majority of respondents to the end of programme survey reported missing five or more sessions (out of 10 sessions). There was no dominating trend in attendance for the Physics – Durham and Physics – Oxford Spokes. The majority of participants on all Spokes other than Physics – Birmingham considered they were able to participate fully in tutor sessions. The majority of students on the Physics – Birmingham Spoke reported that there were some parts of tutor sessions that they were not able to participate in.

Table 25. There were approximately [x] tutor sessions as part of the programme. Roughly how many of these did you attend? *the number of tutorials depended on Spoke*

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
All of them	2	7	0	0	4	0	13
I missed one or two	7	3	2	1	1	4	18
I missed three or four	2	0	7	2	4	1	16
I missed five or more	1	0	2	10	2	5	20
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 26. Student responses in the end of programme survey to the question 'To what extent did you feel able to participate in: Tutor sessions?'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
I was able to participate fully	11	10	7	5	10	7	50
There were some parts I was not able to participate in	1	0	4	7	1	3	16
Not applicable/not offered	0	0	0	1	0	0	1
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Students were asked in the end of programme survey to score on a Likert Scale how useful they found the tutor session materials and advice provided as part of the programme. The findings are shown in

Table 27 and Table 28 below. The majority of students on all Spokes other than Physics – Birmingham reported that they considered tutor session materials and advice given in tutor sessions to all be very useful. On the Physics – Birmingham Spoke there was an even split between students that reported finding it all very useful and others finding parts useful.

Table 27. Student responses in the end of programme survey to the question 'How useful did you find the following parts of the programme? Tutor session materials'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
It was all very useful	9	8	8	6	9	7	47
There were some parts that were useful	3	2	2	6	2	3	18
Not useful at all	0	0	0	0	0	0	0
Not applicable/not offered/no response	0	0	1	1	0	0	2
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 28. Student responses in the end of programme survey to the question 'How useful did you find the following parts of the programme? Advice given to me in tutor sessions'.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
It was all very useful	11	8	8	5	7	7	46
There were some parts that were useful	1	2	3	6	3	2	17
Not useful at all	0	0	0	1	0	1	2
Not applicable/not offered/no response	0	0	0	1	1	0	2
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Respondents to the end of programme survey shared a range of reasons as to why they had missed tutorial sessions. The most commonly reported reason was clashes with other commitments or appointments, which included: extracurricular activities; attending university open days, working part

time jobs; medical appointments; and general "other commitments". Other commonly shared reasons were: conflicting priorities between doing work for the programme and school work, illness and internet connection issues at the student's end. Less frequently mentioned reasons for not attending included students forgetting about or confusing the timing of the session and family emergencies. Where respondents had missed sessions, some shared how they had caught up on missed sessions using the recordings of the sessions.

Reasons shared for sessions not taking place that related to programme logistics included technical issues; too few students being present for the session to run; as well as the sessions times being changed and the respondents no longer being able to attend.

Physics students and tutors commented in the end-point focus groups about the impact of students not attending tutorial sessions. These included: the students feeling awkward when there were only two students to one tutor; not being able to build up a rapport with the students when they only attended intermittently; frustration at dedicating time for the session and preparation only for a few people to turn up.

One tutor on the Birmingham Physics programme explained the challenge presented by the move to a single central session, where the students that attended were split into breakout rooms once attendees were known. They found this arrangement meant that they couldn't prepare and tailor the sessions in advance to particular students' needs as they didn't know who would turn up or be in their group and they couldn't get to know their particular subject related challenges.

Pre-work/homework

As part of tutorial sessions, students were also set pre-work/homework. These were specified as mandatory for the Chemistry and Physics Spokes, but optional for the Maths Spokes. Table 29 shows the planned pre-work/homework set by the Spokes as per the information in the TiDiER Framework in Appendix 2 – Table 2.

Table 29. Summary of the planned pre-work by Spoke. A more detailed description is providing in Appendix 2 – Table 2.

Programme element	Durham Chemistry	Durham Maths	Leicester Maths	Birmingham Physics	Durham Physics	Oxford Physics
Amount of pre-work/homework	30 pieces (15 of pre-work and 15 diagnostic Qs post-tutorial)	22 pieces	22 pieces	10 pieces	19 pieces	One per tutorial
Frequency of pre-work/homework	Every 3 weeks during term time	Every 2 weeks	Every 2 weeks	every 3 weeks	Every 2/3 weeks	One per tutorial
Total mandatory pieces of pre-work/homework	30	0	1	10	19	One per tutorial

Students were asked in the end of programme survey to score on a Likert Scale how useful they found the pre-work/homework provided as part of the programme. The findings are shown in Table 30. For all Spokes apart from the Physics – Birmingham and Physics – Oxford Spokes, the majority of students found the pre-work/homework/home learning all very useful. The majority of students on the Physics – Birmingham and Physics – Oxford Spokes had found parts of the work useful.

Table 30. Student responses in the end of programme survey to the question 'How useful did you find the following parts of the programme? Pre-work/homework/home learning'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
It was all very useful	10	5	6	5	6	2	34
There were some parts that were useful	2	4	4	7	4	6	27
Not useful at all	0	0	1	0	0	2	3
Not applicable/not offered/no response	0	1	0	1	1	0	3
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Three respondents commented on the pre-work/homework in the end of programme survey in response to the question "If you found anything was not useful and are happy to share the reasons, please explain the reasons why." These included existing workload being high, the pre-work not feeling necessary and there not being time to complete it in advance of a session if the homework was set late.

Mentor sessions

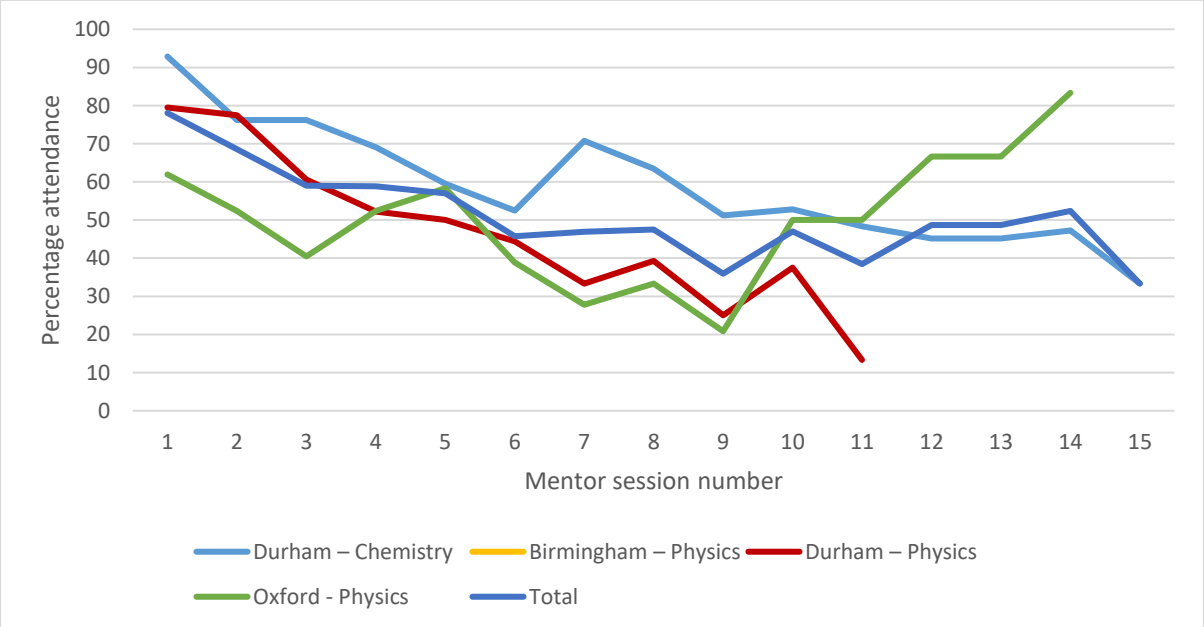
Only the Chemistry and Physics Spokes delivered Separate mentor sessions as part of their programme. The specific details of delivery varied between Spokes. A summary of the planned mentor session activity details is given in Table 31below. This is an excerpt of Appendix 2 – Table 2, which shows the full description of the planned programme delivery in each Spoke using the TiDIER framework. The table does not take into account modifications to delivery during the programme, which has been discussed above and the impact of which will be discussed below.

Table 31. Summary of the planned mentoring programme delivery by Spoke. A more detailed description is providing in Appendix 2 – Table 2.

Programme element	Durham Chemistry	Birmingham Physics	Durham Physics	Oxford Physics
Start and end date of mentor sessions	29/03/22-30/5/2022	21/6/21 - 30/3/22	26/04/21-7/3/22	September 2021 - May 2022
Who provided the mentor sessions	Undergraduate Chemistry/Natural Sciences students doing a large proportion of Chemistry	Undergraduate Physics students	Undergraduate Physics/Natural Sciences students doing a large proportion of Physics	Undergraduate and graduate students in Physics
Number of mentor groups and group size	8 groups of 5-7 students	8 groups of 5-7 students	7 groups of 5-7 students	7 groups of 6 students
Number of mentor sessions	17	9	9	Varied by group / mentor
Frequency of mentor sessions	Every 3 weeks during term time	every 3 weeks	Every 3 weeks during term time	Every 2-3 weeks
Length of mentor sessions	1 hour	1 hour	1 hour	1 hour
Total mandatory contact time for mentor sessions	17 hours	9 hours	9 hours	Varied by group / mentor

Figure 5 below shows a summary the percentage of students attending mentor sessions for each Spoke. Data are from the attendance registers collected by the Spokes. As there was some missing data within the attendance registers the percentage attendance has been calculated using data where the attendance data were known. No data was available for Birmingham – Physics.

Figure 5. Percentage of students attending mentor sessions by Spoke and for the Levelling Up programme as a whole. Data used is from the attendance registers collected by each Spoke. The percentage attendance has been calculated using data where the attendance data for the session was known.



In addition to the registers, respondents were asked in the end of programme survey to indicate how many mentor sessions they had attended over the programme. Table 32 below shows the responses by Spoke. A similar pattern to the tutorial attendance can be seen for the mentoring session, with the majority of Chemistry – Durham students attending all sessions or missing one or two (out of 17), no particular trend for Physics – Durham and Physics – Oxford and the majority of Physics – Birmingham students reporting they had missed five or more sessions (out of nine sessions).

Table 32. Student responses in the end of programme survey to the question 'There were approximately [x] mentor sessions as part of the programme. Roughly how many of these did you attend?' * number varied by Spoke*

	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
All of them	5	1	3	2	11
I missed one or two	5	1	2	3	11
I missed three or four	0	4	4	3	11
I missed five or more	2	7	2	2	13
Total	**12**	**13**	**11**	**10**	**46**

For all Spokes other than the Physics – Birmingham Spoke, the majority of students reported that they were able to participate fully in the mentor sessions (Table 33). The majority of students on the Physics – Birmingham Spoke had found that there were some parts that they were not able to participate in.

Table 33. Student responses in the end of programme survey to the question 'To what extent did you feel able to participate in: Mentoring sessions'.

	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
I was able to participate fully	10	5	9	8	32
There were some parts I was not able to participate in	2	7	2	2	13
Not applicable/not offered	0	1	0	0	1
Total	**12**	**13**	**11**	**10**	**46**

Students were asked in the end of programme survey to score on a Likert Scale how useful they found the mentor session materials and advice provided as part of the programme (Table 34 and Table 35). The majority of students on the Chemistry – Durham and Physics – Oxford Spokes had found that the advice that had been given to them was all very useful. The majority of students on the Physics – Birmingham and Physics – Durham Spokes had found that there were some parts that were useful.

The majority of students on the Physics – Birmingham Spoke had found the mentoring session materials all very useful, with the majority of students on the Chemistry – Durham, Physics – Durham and Physics – Oxford Spokes finding some parts that were useful.

Table 34. Student responses in the end of programme survey to the question 'How useful did you find the following parts of the programme? Advice given to me in mentor sessions'.

	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
It was all very useful	10	6	3	7	26
There were some parts that were useful	1	5	7	3	16
Not useful at all	1	0	1	0	2
Not applicable/not offered/no response	0	1	1	0	2
Total	**12**	**12**	**12**	**10**	**46**

Table 35. Student responses in the end of programme survey to the question 'How useful did you find the following parts of the programme? Mentoring session materials'.

	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
It was all very useful	5	6	3	4	18
There were some parts that were useful	6	4	5	5	20
Not useful at all	1	0	1	0	2
Not applicable/not offered/no response	0	3	2	1	6
Total	**12**	**13**	**11**	**10**	**46**

The two main reasons that students gave in the end of programme survey as to why they had not been able to attend or had chosen not to attend, were the same as for the tutor sessions i.e. the sessions clashing with "other commitments" and conflicting priorities with school work. Mentioned by one or two students each were the content not being useful or relevant to their individual circumstances; technical issues logging on; the changed timing of the sessions meaning they could no longer attend; and mixing up session times.

On-site visits

Feedback in the developer interviews was that none of the Spokes that had planned on-site visits were able to run these due to the on-going COVID-19 restrictions in place at the time. In some cases, students were invited to attend the main university run open days at a later date as an alternative, however, these were not programme specific.

Guest lectures

Respondents were asked in the end of programme survey to indicate how many guest lectures they had attended over the programme. Table 36 below shows the responses by Spoke. Information from the programme team indicated that there were no centrally organised guest lectures by the Physics - Birmingham Spoke. When asked about the extent to which they had been able to participate in the

guest lectures/whole group activities (Table 37), the majority of students on the Maths – Durham and Physics – Oxford Spokes reported that they had been able to participate in them fully. There was a mixed response from the other Spokes.

Table 36. Student responses in the end of programme survey to the question 'How many guest lectures/whole-group events/extra events (not including visits/open-days) did you attend?'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
None	2	2	3	5	2	2	16
One to two	5	4	3	1	6	5	24
Three to four	3	1	0	1	2	0	7
Five or more	0	3	0	1	0	1	5
No response	2	0	5	5	1	2	15
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 37. Student responses in the end of programme survey to the question 'To what extent did you feel able to participate in: Online guest lectures/ extra events/whole-group events'.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
I was able to participate fully	6	6	4	2	4	7	29
There were some parts I was not able to participate in	1	2	5	3	3	0	14
I was not able to participate at all	2	1	0	2	0	2	7
Not applicable/not offered/no response	3	1	2	6	4	1	17
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Other contextual factors

Several additional findings emerged from the data, providing an insight into other contextual factors impacting on the students outside the programme delivery. These included:

- Support from school/college
- Support from parents/carers
- Factors impacting on students' decisions about university

Support from school/college

Students were asked in the end of programme survey what support they had received from their school or college in the process of applying to university (Table 38). The majority of students across all Spokes agreed that they had received support from their schools when they chose to apply to university and that their school/college had been a good source of knowledge for the application process (Table 39). There was more variation across Spokes as to whether students considered that their school/college had been a good source of knowledge about what it is like to study at university (Table 40), with the majority of Maths – Durham, Physics – Birmingham, Physics - Durham and Physics – Oxford students agreeing their school had good knowledge. The majority of students from the Physics – Oxford Spoke agreed that their school/college had been a good source of knowledge about what it is like to study [Chemistry/Maths/Physics] at university (Table 41), however, the majority of students from the Chemistry – Durham Spoke disagreed with this statement.

Table 38. Student responses in the end of programme survey to the question 'I have had support from my school/college when I chose to apply for university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	0	0	0	0	0	0	0
Disagree	1	1	0	0	0	0	2
Neutral	0	1	0	2	2	0	5
Agree	6	3	7	2	1	4	23
Strongly agree	3	5	1	7	5	5	26
No response	2	0	3	2	3	1	11
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 39. Student responses in the end of programme survey to the question 'My school/college have been a good source of knowledge for the university application process.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	1	0	0	0	0	0	1
Disagree	1	1	0	0	0	0	2
Neutral	1	2	1	1	1	2	8
Agree	4	4	3	3	4	4	22
Strongly agree	3	3	4	7	3	3	23
No response	2	0	3	2	3	1	11
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 40. Student responses in the end of programme survey to the question 'My school/college have been a good source of knowledge about what it is like to study at university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	1	0	0	1	0	0	2
Disagree	3	2	2	1	1	0	9
Neutral	2	1	3	1	2	3	12
Agree	4	5	2	5	2	4	22
Strongly agree	0	2	1	3	3	2	11
No response	2	0	3	2	3	1	11
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 41. Student responses in the end of programme survey to the question 'My school/college have been a good source of knowledge about what it is like to study [Chemistry/Maths/Physics] at university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	3	0	0	1	1	0	5
Disagree	3	4	1	1	1	2	12
Neutral	2	1	5	5	3	1	17
Agree	2	3	2	3	0	2	12
Strongly agree	0	2	0	1	3	3	9
No response	2	0	3	2	3	2	12
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Support from parents/carers

The majority of students that responded to the end of programme survey from all Spokes agreed that they had received support from their parents/carers when they chose to apply for university (Table 42). The majority of students from the Chemistry – Durham and Maths – Leicester Spokes agreed their parent(s)/carer(s)/family had been a good source of knowledge for the university application process (Table 43) and the majority of students from the Chemistry – Durham Spoke also considered that their parent(s)/carer(s)/family were a good source of knowledge about what it is like to study at university (Table 44). However, the majority of students from the Physics – Oxford Spoke disagreed with this statement. There was a 50:50 split in the views of students from the Maths – Durham Spoke. The majority of students on all Spokes disagreed that their parent(s)/carer(s)/family were a good source of knowledge about what it is like to study [Chemistry/Maths/Physics] at university (Table 45).

Considering that many of the students that responded to the end of programme survey felt that their parents/carers had some knowledge of the university application process and what it was like to study at university, the data for whether these students would be the first in their family to go to university was analysed. The data for students for whom data was available, showed a difference between Spokes, with the majority of Chemistry – Durham, Maths – Durham, Physics – Birmingham and Physics – Durham students reporting that they would not be the first in their family to go to university. However, the majority of students on the Maths – Leicester Spoke reported that they would be the first in their family to go to university. No data was available for Physics – Oxford as the question was not asked on the application form.

Table 42. Student responses in the end of programme survey to the question 'I have had support from my parent(s)/carer(s) when I choose to apply for university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	1	0	1	0	0	0	2
Disagree	1	1	0	1	0	0	3
Neutral	1	0	1	1	0	1	4
Agree	4	5	3	6	4	1	23
Strongly agree	3	4	3	3	4	7	24
No response	2	0	3	2	3	1	11
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 43. Student responses in the end of programme survey to the question 'My parent(s)/carer(s)/family have been a good source of knowledge for the university application process.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	1	4	1	0	1	3	10
Disagree	1	1	0	3	1	1	7
Neutral	3	1	2	3	2	2	13
Agree	4	3	4	2	3	3	19
Strongly agree	2	1	1	3	1	0	8
No response	1	0	3	2	3	1	10
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 44. Student responses in the end of programme survey to the question 'My parent(s)/carer(s)/family have been a good source of knowledge about what it is like to study at university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	0	4	2	1	2	4	13
Disagree	2	1	1	3	2	1	10
Neutral	3	0	1	4	1	1	10
Agree	6	5	3	2	2	2	20
Strongly agree	0	0	1	1	1	1	4
No response	1	0	3	2	3	1	10
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 45. Student responses in the end of programme survey to the question 'My parent(s)/carer(s)/family have been a good source of knowledge about what it is like to study [Chemistry/Maths/Physics] at university.'

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Strongly disagree	4	6	3	4	2	5	24
Disagree	3	2	2	2	5	1	15
Neutral	2	2	1	4	1	1	11
Agree	2	0	1	1	0	0	4
Strongly agree	0	0	1	0	0	1	2
No response	1	0	3	2	3	2	11
Total	**12**	**10**	**11**	**13**	**11**	**10**	**67**

Table 46. Responses for respondents to the end of programme survey that had applied to university this year to the question in the application form for the programme about whether they would be the first in their family to attend university.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
First in family to go to university	1	3	4	1	3	0	12
Not first in family to go to university	8	6	3	3	7	0	27
No response	1	0	2	0	0	5	8
Total	**10**	**9**	**9**	**4**	**10**	**5**	**47**

Factors influencing students' decisions about applying to university

Students shared some of the factors that had influenced their decisions when applying to university. Within the student focus group discussions, several themes emerged. These included:

- Location - For some students location was not a consideration, but for others it was a significant consideration.
- Finance – in some cases the students were waiting a year to apply to university in order to earn money before going to university.
- Flexibility for changing options and switching between courses, mentioning concerns over starting and then discovering they don't enjoy a course.
- Course structure, modules and style of teaching
- Whether the university prioritised student wellbeing
- What felt comfortable, enjoyable on visits to the universities
- Whether Further Maths was an entry requirement, with one student commenting that this had been a barrier to them applying for a natural sciences course at Durham.

Programme refinement

Participants were asked in the end of programme survey for any suggestions for how they felt the Levelling Up programme could be improved in the future. A short summary of the themes mentioned by the greatest number of students across multiple Spokes are mentioned below. However, a much wider range of suggestions were received, and these are given in full in Appendix 7.

Difficulty of the material covered and the content: Several respondents from the Physics and Chemistry programmes requested more challenging content, and some Maths respondents asked for more coverage from Further Maths. However, although more challenging content was desired, one student suggested that there could be some easier starter questions included as part of the programme. Respondents also suggested that the level of alignment to A level content should be made clearer in the information about the programme and to make it clear that the programme would be covering more than just A level content. One student also suggested that students could be involved in voting for which topics could be covered in future sessions, rather than having a set timetable.

Frequency of sessions: There were requests for more frequent sessions from at least one student on all of the programmes other than Leicester – Maths. However, there was also a comment that attending all the sessions in Year 13 had been challenging and so less frequent meeting in the second year may have been beneficial to them. There was a request that the timing of the sessions remained the same and did not change part way through the programme.

In person sessions: Respondents from several of the programmes suggested that they would like more in person sessions for some, if not all, of the sessions. However, the students in the focus group discussed the benefits they had found from the online programme and acknowledged that in person provision would not be suitable for all participants.

Tailoring sessions: Comments were received from tutors about the possibility of tailoring the topics covered in sessions to students' interests, with another suggesting that breaking down the long recordings of the sessions into shorter sections when they are put online may support students in rewatching the sessions.

6. Discussion

The discussion section is structured to consider the findings in terms of steps 2- 4 within the Contribution Analysis Framework

Step 2: activities of an intervention implemented as set out in the Theory of Change.

Step 3: the chain of expected results can be shown to have occurred.

Step 4: Other contextual factors have been shown not to have made a difference.

Contribution Analysis

Step 2: Was the programme delivered as planned?

Activities within the programme were delivered to some extent by all the Spokes, with the exception of on-site/remote visits which had been planned by the Durham Spokes but were unable to take place due to COVID-19 restrictions (these had not been planned as part of the programme by the other Spokes). Delivery of the programme in each of the Spokes is summarised in Table 47.

Variation in the extent of the delivered programme took place for the Physics – Birmingham and Physics – Oxford Spokes as the programme commenced later than originally planned. Due to this, only 10 out of 19 tutorial sessions were delivered on the Physics – Birmingham Spoke (all nine mentoring sessions took place). It is unknown how many tutorial or mentoring sessions were able to take place for the Physics – Oxford Spoke as the number varied by group and registers were not completed by many of the tutors and mentors.

For all Spokes, students missed sessions. For sessions where registers had been completed, attendance ranged between 68-69% (Chemistry – Durham) to 48-49% (Physics – Oxford). There were no registers available for Physics – Birmingham, however, self-report attendance in the end of programme survey showed that the majority of students reported missing five or more tutorial sessions and five or more mentoring sessions. The programme at Birmingham delivered 10 tutorial sessions and nine mentoring sessions, which suggests that attendance would have been less than 50% for the students on the Physics – Birmingham Spoke. This is supported by the need to change the method of delivery at Birmingham, which moved from delivery being in individual small groups of the same students each week, to students being asked to attend a single central session where they were then split into breakout rooms in groups which differed from week to week. The programme team made this change due to the number of sessions being cancelled for safeguarding reasons when only one student attended.

Table 47. Summary of delivery of the Levelling Up programme by Spoke, any changes made to delivery and student attendance from registers collected by Spokes.

Spoke	Changes to tutorials in delivery	Average tutorial attendance by students	Modal response from student self report	Changes to mentoring in delivery	Average mentoring attendance by students	Modal response from student self report
Chemistry – Durham	All delivered as planned (17)	65%	Missed one or two (7/12)	All delivered as planned (17)	69%	Attended all (5/12) or missed one or two (5/12)
Maths – Durham	All delivered as planned (22)	62%	Attended all of them (7/10)	N/A	N/A	N/A
Maths – Leicester	All delivered as planned (22)	63%	Missed three or four (7/11)	N/A	N/A	N/A
Physics – Birmingham	10 out of 19 delivered	Unknown	Missed five or more (10/13)	All delivered as planned (9)	Unknown	Missed five or more (7/13)
Physics – Durham	All delivered as planned (19)	55%	Attended all (4/11) or missed three or four (4/11)	All delivered as planned (9)	59%	Missed three or four (4/11)
Physics - Oxford	Unknown number out of 19 delivered – varied by group	49%	Missed five or more (5/10)	Unknown number out of 9 delivered – varied by group	48%	Missed on or two (3/10) or missed three or four (3/10)

The majority of students on all but the Physics – Birmingham Spoke considered that they were fully able to participate in tutorial sessions, also reporting that they found the tutorial session materials and advice given to them in the tutorial sessions very useful. A different trend was seen for the students from the Physics – Birmingham Spoke, where the majority reported that there were some parts of the programme that they were not able to participate in and where they found parts of the tutorial materials and advice given to them useful.

The impact of students missing tutorial sessions was commented upon by both staff and students, impacting on how comfortable students felt when there were only a small number of students present, and not enabling staff to build up a rapport and get to know the students well enough to tailor the programme content for them.

There was a more mixed picture for the mentoring provision. For all Spokes other than the Physics – Birmingham Spoke, the majority of students reported that they were able to participate fully in the mentor sessions. The majority of students on the Physics – Birmingham Spoke had found that there

were some parts that they were not able to participate in, however, they considered that the mentoring session materials were all very useful. From the students on the other Spokes, there was a mixed response as to whether the students found all or only parts of the advice given to them and mentoring materials useful. This mixed perception around the mentoring provision could be in part related to comments received as to the timing of when mentoring topics were delivered (e.g. UCAS applications being covered after some students had already submitted their applications) and focus around on topics that were less relevant to some students (e.g. Oxbridge applications or applications to English universities for students applying outside of England). The findings may indicate the need to tailor mentoring provision more specifically to students within a particular group.

There was variation across the Spokes as to the proportion of students that had attended guest lectures/whole group activities. From those that responded to the end of programme survey, on the Chemistry – Durham, Maths – Durham, Physics – Durham and Physics - Oxford spokes, more than 60% of students reported they had attended one or more guest lectures. However, on the Maths – Leicester and Physics – Birmingham Spokes, this was less than 30%. Students commented how the guest lectures had been useful in helping them to understand careers available in their subjects and to see the subject in the context of the real world. For all spokes other than Maths – Leicester and Physics – Birmingham, the majority of student reported being able to fully participate in the guest lectures/whole group activities. For Maths – Leicester the majority reported there were some parts they weren't able to participate in. Physics – Birmingham had a relatively even spread across not being able to participate at all, not able to participate in some parts and being able to fully participate.

There were two areas raised as barriers to delivery or engagement with the programme, which were sessions having to be cancelled due to student numbers being too low to meet safeguarding requirements or occasionally technology not functioning.

Several areas were mentioned by students, tutors and mentors relating to the effective delivery of the programme. Students noted particularly valuing the structure of the programme, including the structure of cycles and the style and content of sessions. They appreciated the ability to delve deeper into content, that the content went beyond A level and liked the pre-work and found it helpful to attempt before the tutorial sessions. The students particularly commented on the benefits of the small group sessions and friendly, welcoming atmosphere. They valued how the tutors and mentors made the sessions interactive and engaging and welcomed being asked questions and working in groups to solve problems in different ways.

Areas where there had been challenges for delivery included forming a community within the online environment. This was commented on by students and tutors, in that it could be challenging to know whether students were engaged when they had their cameras and microphones turned off. Students commented that they would have liked more of a sense of community outside the weekly sessions so that they could work together on the pre-work or discuss university applications. However, they were also understanding about the necessity of ensuring that these spaces were compliant with safeguarding requirements. This was also something that tutors and mentors from some Spokes requested, as they did not have a means of communicating with their counterparts. This provision was already in place for some Spokes. Other functionality that was requested by some Spokes but was already in place for others was to technology to support drawing graphs and writing equations. Chemistry and Physics tutors felt that this was something that would have greatly assisted them with delivering the programme. Graphics tablets were already in place and had been provided to all Maths

tutors and students and were commented on as having been very effective in supporting delivery. Time preparing for sessions was noted by tutors as being challenging and where possible this had been addressed during the programme delivery.

Students considered the programme to be different to other Widening Participation programmes being offered with differentiating factors including: the length of the programme, combination of tutoring and mentoring aspects, small group environment, interactivity, and depth and breadth of content being covered.

Step 3: Has the expected chain of results occurred?

The Levelling Up programme had 12 stated outcomes which it considered would lead to the intended impact for the programme. Without direct questions relating to each of the outcomes, students participating in the focus groups and end of programme survey gave examples of the outcomes being achieved. Examples were shared by students on the Maths and Physics programmes for all of the outcomes, Chemistry students did not mention all of the outcomes, however, this is not an indication that they did not happen, just that the students did not raise them in the discussions.

From the outcomes, the next step in the results chain is consideration of the intended impact of the programme, for which there were seven impact aims. From the respondents to the survey (which was 30% of the participants on the programme and approximately half of the average attendance on the programme) the end of programme survey data indicated whether these aims had been met (Table 48).

Table 48. Summary of whether the impact aims for the programme had been achieved based on the evidence collected by the evaluation of the Levelling Up programme.

	Impact aim	Summary of findings	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
1	Participants aspire to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university.	In general, students from all Spokes applied to study a subject related to their Levelling Up subject. Only a small number of students reported choosing not to apply to university this year or not to apply at all.	✓	✓	✓	✓	✓	✓
2	Participants apply to a high ranked university as listed in the Times Good University Guide	For all Spokes the majority of students applied for at least one university ranked in the top 10 for their subject. There was a variation across Spokes in the pattern of ranking of universities applied for. Chemistry – Durham, Maths – Durham, Physics – Durham and Physics – Oxford all had over 56%	✓	✓	✓	✓	✓	✓

	Impact aim	Summary of findings	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
		of student applications to subjects ranked in the top 10. For Maths – Leicester and Physics – Birmingham, this was 26% and 32% respectively.						
3	Participants aspire to study at their Levelling Up host university.	Variation in whether students chose to apply to their Levelling Up host university. From 100% Physics – Durham, 50% Maths – Leicester, 33% Physics – Oxford.	✓	✓	✗	✓	✓	✗
4	Participants aspire to study at university (in any subject).	Across all Spoke 92% had applied to university this year or intended to apply next year.	✓	✓	✓	✓	✓	✓
5	Participants consider that the programme has helped them achieve higher grades at A level in their subject.	Majority of students considered that the programme would help them achieve higher grades at A level in their Levelling Up subject.	✓	✓	✓	✓	✓	✓
6	(Chemistry and physics) Students consider that the programme has helped them achieve higher grades at A level in maths within their subjects	Majority of students considered that the programme would help them achieve higher grades at A level in the maths within their A level Levelling Up subject, although lower than helping overall with their subject.	✓	N/A	N/A	✓	✓	✓
7	Participants received offers to study the courses which they have applied for on their UCAS applications	Across all Spokes, where a decision had been received, greater than 80% of applications had successfully received an offer. There was little variation across Spokes ranging from 80% for Chemistry – Durham to 93% for Maths – Leicester.	✓	✓	✓	✓	✓	✓

Step 4: Contextual factors

The backgrounds of students completing the end of programme survey varied by Spoke. For the Chemistry – Durham, Maths – Durham, Physics – Durham and Physics – Oxford, the majority of respondents identified as female. Ethnicity also varied by Spoke with the majority of respondents from the Maths – Durham, Physics – Durham and Physics – Oxford identifying as belonging to a White ethnic group, and the majority of respondents from the Maths – Leicester and Physics – Birmingham identifying as belonging to an Asian ethnic group. The data in Table 49 shows that the majority of students from all Spokes other than Maths – Leicester would not be the first in their family to go to university (data was not available for Physics – Oxford). However, the majority of Maths – Leicester students would be the first in their family to go to university.

Responses from the end of programme survey showed that the majority of students from all Spokes considered that they had received support from school and parents/carers for applying to university, and that their schools were a good sources of knowledge about the university application process (Table 49). It was also consistent across Spokes that parents/carers did not have knowledge about what it would be like to study Chemistry/Maths/Physics at university. Variations between Spokes emerged for the other sources of knowledge at school and from parents/carers, and as to whether the majority of students would be the first in their family to attend university.

The data highlights the complexity of potentially differing needs of students across the programme and that they are joining the programme with different backgrounds and therefore potentially different areas they would benefit from additional support. This is highlighted by the range of different, and sometimes contradictory, comments from students as to which areas of the tutoring and mentoring provision they found most beneficial, where they felt topics were particularly relevant or less useful, whether they would like easier or harder problems set, and more or less frequent sessions. A potential solution could therefore be one suggested by some of the tutors, which is a greater level of tailoring topics to the interests and needs of the students within a group.

Table 49. Summary of students' access to support and knowledge from school and home around the university application process and what it is like to study at university. A tick symbol means that the majority of students stated they agreed with the statement, a cross indicates that the majority stated they disagreed with the statement. No symbol indicates that there was no majority finding. 50:50 indicates that there was an equal split between those agreeing and disagreeing with the statement.

	School					Parent/carer			
Spoke	**Support for applying**	**Knowledge of application process**	**Knowledge of studying at uni**	**Knowledge of studying Chem/ Math/ Phys at uni**	**Support for applying**	**Knowledge of application process**	**Knowledge of studying at uni**	**Knowledge of studying Chem/Math /Phys at uni**	**Not the first to attend uni**
Chemistry – Durham	✓	✓		✗	✓	✓	✓	✗	✓
Maths – Durham	✓	✓	✓		✓		50:50	✗	✓
Maths – Leicester	✓	✓			✓	✓		✗	✗
Physics – Birmingham	✓	✓	✓		✓			✗	✓
Physics – Durham	✓	✓	✓		✓			✗	✓
Physics - Oxford	✓	✓	✓	✓	✓		✗	✗	N/A

Limitations of the research

It is important to note the limitations of the evaluation study. A key limitation was the number of participants responding to the end of programme survey. With only 30% response rate, this removed the possibility of undertaking detailed statistical analysis on the data or considering findings by the backgrounds of students (e.g. by gender or ethnic group) or to undertake statistical comparisons between Spokes. Incentivisation to participate included a prize draw to win one of four £50 Amazon or Love2Shop vouchers, communication via multiple channels and reopening the survey after the A level exam period. However, the response rate remained lower than had been anticipated. Although a lower number than hoped, the data still provides a useful insight into the experiences of students. It should be noted that the students that completed the end of programme survey and participated in focus groups attended more sessions than the average for the cohort. The findings may therefore represent a more positive outlook than the cohort as a whole, however, this exemplifies delivery for students that maximised their engagement. A second limitation was in the level of engagement of tutors and mentors with the focus groups. Multiple calls were made to encourage participation, and timings were adapted to avoid undergraduate exam periods, however, it was not possible to get good representation of tutors and mentors across Spokes, especially in the end-point focus groups. This had the potential of reducing the range of views captured by the evaluation.

7. Conclusion

Summarising the findings in the previous sections and assessing against the Contribution Analysis framework, the evidence indicates that the requirements for Step 2 were successfully met, with all activities within programme stated in the Theory of Change model being delivered. There were however, variations in delivery across Spokes and in the engagement from students: 1) the Physics – Birmingham and Physics – Oxford Spokes delivered fewer tutorial sessions than originally planned and the majority of students on the Physics – Birmingham Spoke reported that there were some parts of the programme they had been unable to participate fully in. 2) for all Spokes, students missed attending sessions. 3) specific onsite/remote visits to the university were not possible due to COVID-19 for the three Durham Spokes, although central university open day provision was signposted. Barriers to effective delivery of the programme had included low attendance by students leading to cancelled sessions due to safeguarding provision, and technology not functioning e.g. problems with Zoom or Teams.

For the students that had engaged with the programme, they particularly valued the structure of the programme, including the weekly cycles and the style and content of sessions. They appreciated the ability to delve deeper into content, that the content went beyond A level and liked the pre-work and found it helpful to attempt before the tutorial sessions. The students particularly commented on the benefits of the small group sessions and friendly, welcoming atmosphere. They valued how the tutors and mentors made the sessions interactive and engaging and welcomed being asked questions and working in groups to solve problems in different ways.

For Step 3, the evaluation found evidence that the chain of results documented in the Theory of Change model had occurred, with the students giving examples of the outcomes in action. For four out of the six Spokes, all seven impact aims had been achieved. For two Spokes (Maths – Leicester and Physics – Oxford) the aim for students to apply to their Levelling Up host university had not been achieved as only a minority of students had applied to Leicester and Oxford. However, it is important to note that in the end of programme developer interviews, the Spoke leads at both of these universities considered that this aim was not of importance for the remit of Widening Participation initiatives at their universities. Since the start of the programme, this aim is also now discouraged by the UK government within university Widening Participation strategies. The impact aim of participants applying to a high ranked university as listed in the Times Good University Guide was slightly weaker for Maths – Leicester and Physics – Birmingham than the other Spokes. Although the majority of students at these two Spokes had applied to at least one choice in the top 10 for the subject, less than a third of the application choices were to courses ranked in the top 10 for their subject.

Additional contextual factors considered as part of Step 4 included the background of students and support from school and parents/carers with the university application process and knowledge about studying at university. For all Spokes there were areas where students considered that there was missing knowledge either from school or parents/carers. There were therefore areas where the programme had the potential to fill gaps in knowledge for the students.

Based on the above evidence, the evaluation therefore considers it reasonable to conclude that the Levelling Up programme has contributed to achieving the stated impact aims.

Recommendations

The evaluators have several recommendations for the refinement of the programme moving forwards:

1) That wherever possible, the programme runs with small group sessions, with consistency week-on-week in the students, tutors and mentors within groups.
2) That training and processes are put in place to support tutors and mentors in tailoring the weekly topics and differentiating the difficulty of activities within the sessions to the specific interests and needs of the students within their groups.
3) That there is an opportunity for students to communicate outside the weekly sessions to enable them to work together on pre-work and discuss topics such as university applications.
4) That for the Spokes where it isn't already in place, that a method is found for tutors and mentors to communicate with one another to keep up to date on what has been covered with the students within their groups.
5) That graphics tablets are provided for the Chemistry and Physics programmes to support delivery and to make activities such as drawing graphs and writing equations easier.
6) That careful consideration is made as to the most effective pedagogical practice when working with students who are not visible on screen to the tutor or mentor (i.e. with cameras off).

Future research

The evaluators recommend further research is undertaken to understand in more detail what influences students' choices of university courses. There were clear differences between the rank of students' course choices on the Maths – Leicester and Physics – Birmingham compared to the other Spokes on the programme. A more detailed investigation is required to understand what led to these differences. This is particularly of interest in the case of the Maths – Leicester, where delivery and content of the programme was the same as the Maths – Durham Spoke.

8. References

Adams, W. K., Perkins, K. K., Podolefsky, N. S., Dubson, M., Finkelstein, N. D., & Wieman, C. E. (2006). New instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey. Physical review special topics-physics education research, 2(1), 010101.

Adams, Wendy K., et al. "Modifying and validating the Colorado Learning Attitudes about Science Survey for use in chemistry." Journal of Chemical Education 85.10 (2008): 1435.

Ball, H. L. (2019). Conducting online surveys. *Journal of human lactation*, *35*(3), 413-417.

Brewe, E., Kramer, L. and O'Brien, G., 2009. Modeling instruction: Positive attitudinal shifts in introductory physics measured with CLASS. *Physical Review Special Topics-Physics Education Research*, *5*(1), p.013102.

Braun, V., & Clarke, V. (2021, December 15). *Thematic Analysis: A Practical Guide* (1st ed.). SAGE Publications Ltd.

Creswell, J. W., Plano Clark, V.L., Gutmann, M.L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), Handbook of mixed methods in social and behavioural research) pp. 209-240). Thousand Oaks, CA: Sage.

Dalgety, J., Coll, R. K., & Jones, A. (2003). Development of chemistry attitudes and experiences questionnaire (CAEQ). *Journal of research in science teaching*, *40*(7), 649-668.

Deslauriers, L., McCarty, L.S., Miller, K., Callaghan, K. and Kestin, G., 2019. Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*, *116*(39), pp.19251-19257.

Jungert, T., Levine, S. and Koestner, R., 2020. Examining how parent and teacher enthusiasm influences motivation and achievement in STEM. *The Journal of Educational Research*, *113*(4), pp.275-282.

Li, Y. and Singh, C., 2021. Effect of gender, self-efficacy, and interest on perception of the learning environment and outcomes in calculus-based introductory physics courses. *Physical Review Physics Education Research*, *17*(1), p.010143.

Madsen, A., McKagan, S.B. and Sayre, E.C., 2015. How physics instruction impacts students' beliefs about learning physics: A meta-analysis of 24 studies. *Physical Review Special Topics-Physics Education Research*, *11*(1), p.010115.

Mayne, J. (2008). Contribution analysis: An approach to exploring cause and effect. *ILAC brief*.

Mayne, J. (2012). Contribution analysis: Coming of age?. *Evaluation*, *18*(3), 270-280.

Perkins, K.K., Adams, W.K., Pollock, S.J., Finkelstein, N.D. and Wieman, C.E., 2005, September. Correlating student beliefs with student learning using the Colorado Learning Attitudes about Science Survey. In *AIP Conference Proceedings* (Vol. 790, No. 1, pp. 61-64). American Institute of Physics.

Rethman, C., Perry, J., Donaldson, J.P., Choi, D. and Erukhimova, T., 2021. Impact of informal physics programs on university student development: Creating a physicist. *Physical Review Physics Education Research*, *17*(2), p.020110.

Semsar, K., Knight, J.K., Birol, G. and Smith, M.K., 2011. The Colorado learning attitudes about science survey (CLASS) for use in biology. *CBE—life sciences education*, *10*(3), pp.268-278.

TASO (2022) https://s33320.pcdn.co/wp-content/uploads/TASO_-Report_Impact-evaluation-with-small-cohorts_methodology-guidance_Secured-1.pdf

Times (2022). https://www.thetimes.co.uk/article/good-university-guide-in-full-tp6dzs7wn**.** Accessed 27/07/2022

Xu, D., Solanki, S., McPartlan, P. and Sato, B., 2018. EASEing students into college: The impact of multidimensional support for underprepared students. *Educational Researcher*, *47*(7), pp.435-450.

Wilcox, B.R. and Lewandowski, H.J., 2016. Students' epistemologies about experimental physics: Validating the Colorado Learning Attitudes about Science Survey for experimental physics. *Physical Review Physics Education Research*, *12*(1), p.010123

To cite this report:

Cramman, H., Gray, H., & Chavana, M.A. (2022). *Evaluation of the National Levelling Up Widening Participation Pilot Programme.* UK: Durham University. http://doi.org/10.15128/r18910jt623

Evaluation of the National Levelling Up Widening Participation Pilot Programme

Appendices

Version 1.0

14/11/2022

Dr Helen Cramman, Dr Helen Gray, Dr Maria Ana Chavana, School of Education, Durham University

Contents

Appendix 1. Levelling Up Pilot Programme Theory of Change Model

Table 1. Theory of Change model for the Levelling Up Widening Participation Programme. Developed collaboratively with the Hub Leads in February 2021, before delivery of the programme commenced. Note: "Subject" means the Levelling Up programme subject (I.e. Chemistry, Maths or Physics).

Activities (inputs)	Assumptions	Outcomes	Short term impact (by end July 2022)	Longer term impact-beyond August 2022
Training for tutors Academic tutoring session materials Academic tutoring sessions Training for mentors (chemistry and physics only) Mentoring session materials (chemistry and physics only) Mentoring sessions (chemistry and physics only) On-site/remote visits to spoke universities Online guest lectures Guaranteed offers of university places made to participants on the programme (conditions apply) (Durham and Leicester spokes only)	Students from under-represented groups do not apply to universities **due to lower grades** and a **lack of confidence** Tutor and mentor programmes increase **attainment** and **confidence** Increased attainment and confidence **improve participants' likelihood of applying** to university chemistry, maths, physics or related STEM courses. Student **aspirations to study chemistry, maths, physics** or a related STEM discipline at university will be increased by students having a greater understanding of what it is like to study these subjects at university and by being motivated by a positive, broad and authentic experience of the subject as part of the programme.	Increase in participants' confidence in their subject Increase in participants' problem-solving skills in their subject Students increase their confidence to have a go at subject specific problems even if they can't immediately see how to solve something. Students increase their perseverance, resilience and willingness to try different strategies in their subject. Increase in students' belief in their ability to do their subject Students broaden their mind about what their subject is about: thinking and understanding, not just correct solutions. (Maths only) Increase in students' understanding about	Participants aspire to study chemistry, physics, mathematics, or a directly related STEM discipline to their programme subject, at university. ➢ Measurable outcome (via end of programme survey): % of participants stating that they have applied to study the subject which they studied on the Levelling Up programme (or a directly related STEM discipline) at university or stating that they intend to apply in the future. Participants apply to a high ranked university in the Times Good University Guide. ➢ Measurable outcome (via end of programme survey): % of participants that have applied to universities rated in the top 10 for their subject in the Times Good University Guide. (An investigation into any trends in the ranking of universities applied for will also be undertaken). Participants aspire to study at university (in any subject).	Increase in the number of students from under-represented groups applying to study chemistry, maths and physics at top UK universities Other universities become part of the Levelling Up programme Participants on the programme go on to study a STEM related subject at university

Provision of graphic tablets for effective written communication of thoughts, ideas, and formulas (maths only)	That being part of a community run by a university will give them a **sense that they can belong at university** socially and be happy there when they go to university.	mathematical thinking through working on a variety of maths problems with other students. (Physics only) Increase in students' understanding about scientific thinking[1] through working on a variety of physics problems with other students. (Chemistry and Physics only) Increase in participants' confidence in maths in the context of their subject (Maths only) Increase in participants' confidence in problem solving in maths (Chemistry and Physics only) Increase in participants' confidence in problem solving skills in maths in the context of their subject (Chemistry and Physics only) Students become more confident about continuing to learn maths beyond post-16 as	➢ Measurable outcome: % of participants stating that they have applied to study <u>any subject</u> at university or that they intend to apply in the future. The subject does not need to be related to the subject they studied on the Levelling Up programme. Participants aspire to study at their Levelling Up host university. ➢ Measurable outcome: % of participants stating that they have applied or intend to apply to the university through which they were part of the Levelling Up programme. Participants consider that the programme has helped them achieve higher grades at A level in their subject. ➢ Measurable outcome: Positive responses in the end of programme survey. (Chemistry and physics) Students consider that the programme has helped them achieve higher grades at A level in maths within their subjects. ➢ Measurable outcome: Positive responses in the end of programme survey.	

[1] Scientific thinking is defined as the application of the methods or principles of scientific inquiry to reasoning or problem-solving situations, and involves the skills implicated in generating, testing and revising theories, and in the case of fully developed skills, to reflect on the process of knowledge acquisition and change (Zimmerman, C. (2007). The development of scientific thinking skills in elementary and middle school. Developmental review, 27(2), 172-223.)

		an integrated part of a STEM degree. Students have a better understanding of what it might be like to study their chosen subject or a subject directly related to their programme subject beyond A-level. Increase in students' perception that their chosen subject is a useful degree Students become more confident about continuing to learn their subject post A level. Students feel supported by the programme through the university application process Students consider that they 'belong' on a degree course in their subject after participating in the programme. Students consider that they 'belong' in the university community after participating on the programme	Participants received offers to study the courses which they have applied for on their UCAS applications. ➢ Measurable outcome (via end of programme survey): % of participants stating that they have received an offer for the courses they applied for on their UCAS application form. The % of offers which are for a subject which they studied on the Levelling Up programme will also be undertaken.	

Appendix 2. TIDieR framework description of the six Levelling Up Spokes

Programme description

Table 2. Detailed description of the Levelling Up programme for each of the six Spokes based on the TIDieR checklist (Hoffmann et al. 2014).

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
3. MATERIALS (physical or informational materials provided to participants, used in delivery or in the training of providers. How can materials be accessed)						
Were structured materials provided to tutors for session delivery? What was the format of these?	Video for everyone, PowerPoint slides used in video, tutorial questions set with answers and outline lesson plan.	Electronic documents including question sheets, solution sheets and notes to the tutors separately. Pre-reading information. All given graphics tablets	Electronic documents including question sheets, solution sheets and notes to the tutors separately. Pre-reading information. All given graphics tablets	PowerPoint slides with questions and crib sheet documents with further reading/ answers to Qs	PPT slides with questions and crib sheet documents with further reading/ answers to Qs	PPT slides with questions and crib sheet documents with further reading/ answers to Qs
What materials were provided to participants before, during or after tutor sessions?	Before- study pack including video, links to resources and Qs. During- nothing. After- diagnostic questions to be submitted and marked	Graphics tablets posted out to each participant. Also had access to pre-reading before the sessions, questions made available to them after the sessions. Solutions were also released to the students at a later date (after all participants had completed the tutorial).	Graphics tablets posted out to each participant. Also had access to pre-reading before the sessions, questions made available to them after the sessions. Solutions were also released to the students at a later date (after all participants had completed the tutorial).	Reading/ a worksheet/ problem to solve. Had to prepare in advance but not submit.	Reading/ a worksheet/ problem to solve. Had to prepare in advance but not submit. Also occasionally included videos to watch or "activities to try at home"	Reading/ a worksheet/ problem to solve. Had to prepare in advance but not submit.

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Were structured materials provided to mentors for session delivery (or to tutors to include mentoring within tutorials)? What was the format of these?	Topic, suggested session outline and links to useful resources	N/A	N/A	Each mentoring session had a guidance sheet with some information, suggested questions for discussion etc..	Topic, suggested by IOP, subject lead then produced a list of things to discuss linking to access documents produced by the university	Topics from the IOP were suggested to the mentors. We created some resources (e.g. session plans) to go alongside some of these to support the mentors. It was up to the mentors whether they used them.
What materials were provided to participants before, during or after mentor sessions?	Suggested they complete a Personal Development Plan. Wasn't provided to them but a structure was provided.	N/A	N/A	none	N/A	Mentors determined this individually. Most did not often provide additional resources, but some sent follow-up material (e.g. links, suggested reading) as a post on the group's Virtual Learning Environment (VLE).
What materials were provided to tutors during training?	Slides, recording of training, additional links.	Slides, recording of training, additional links.	Slides, recording of training, additional links.	Slides, recording of training, additional links.	Slides, recording of training, additional links. IoP ran training.	Slides, recording of training, additional links. As run by the IOP.
What materials were provided to mentors during training?	Slides, recording of training, additional links.	N/A	N/A	Slides, recording of training, additional links.	Slides, recording of training, additional links.	Slides, suggested resources.

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
4. PROCEDURES (describe each procedure/activity used in the intervention including any enabling or support activities)						
Describe any set work	Participants were provided with formative questions to complete in the week before they were due to have a tutorial. These were handed in and reviewed by the tutor. To aid them with the questions they were directed to open access materials that related to the topic (Khan academy videos, ChemGuide links etc). After tutorial they were set a short diagnostic question to complete, be handed in and marked.	Each tutorial had some pre-reading, designed to prime them for what they were talking about and answering question on during the session. There was also a summer project that had a separate set of instructions, also available via Moodle.	Each tutorial had some pre-reading, designed to prime them for what they were talking about and answering question on during the session. There was also a summer project that had a separate set of instructions, also available via Moodle.	Participants were required to complete some form of reading/ questions as preparation for the sessions. This had to be completed before the sessions begun but were not submitted in advance of the sessions.	Participants were required to complete some form of reading/ questions as preparation for the sessions. This had to be completed before the sessions begun but were not submitted in advance of the sessions.	Participants were required to complete some form of reading/ questions as preparation for the sessions. This had to be completed before the sessions begun but were not submitted in advance of the sessions.
Describe the tutorials	Tutor led, discursive, review of work submitted, questions and answers, tutor designed based on recommended outline.	Tutor led participants through assigned questions, encouraging participation via graphics tablets or talking.	Tutor led participants through assigned questions, encouraging participation via graphics tablets or talking.	Tutor led, discursive, review of preparation, questions and answers, additional teaching/materials, going through concepts, self-guided questions tutor designed based on recommended outline.	Tutor led, discursive, review of preparation, questions and answers, additional teaching/materials, going through concepts, self-guided questions tutor designed based on recommended outline.	Tutor led, discursive, review of preparation, questions and answers, additional teaching/materials, going through concepts, self-guided questions tutor designed based on recommended outline.
Describe the mentor sessions	Mentor led, discursive, questions and answers, mentor designed based on recommended outline.	N/A	N/A	Mentor led, discursive, questions and answers, mentors followed suggested plan provided	Mentor led, discursive, questions and answers, mentor designed based on recommended outline.	Mentor led, discursive, questions and answers. Mentors had freedom to run the sessions as they wanted, and there was quite a lot of variation.

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Describe the Guest lectures	Research academics across STEM topics at local universities and industries presented on an interesting and relevant aspect of their work. Alongside this they did a section on their journey to where they are now and also took questions from participants.	Research academics across STEM topics at local universities and industries presented on an interesting and relevant aspect of their work. Alongside this they did a section on their journey to where they are now and also took questions from participants.	Single session around applying to maths degrees in the UK, including details and advice on maths admissions tests used at select universities.	n/a	Research academics across STEM topics at local universities and industries presented on an interesting and relevant aspect of their work. Alongside this they did a section on their journey to where they are now and also took questions from participants.	Online: some short and some long talks at various points in the programme, delivered by researchers at different stages of their career. In-person: a day of talks and hands-on workshops in the Department of Physics
Describe any other activities used in the programme (eg. Welcome and farewell sessions).	A whole cohort welcome session to start the programme off, a whole cohort session to welcome participants back in September (the start of the new academic year and a whole cohort farewell session to finish the programme. In person visit day planned (not used).	A whole cohort welcome session to start the programme off, a whole cohort session to welcome participants back in September (the start of the new academic year and a whole cohort farewell session to finish the programme. In person visit day planned (not used).	Welcome session at the beginning of the programme.	A whole cohort welcome session to start the programme off, whole cohort UCAS preparation session in September	A whole cohort welcome session to start the programme off, a whole cohort session to welcome participants back in September (the start of the new academic year and a whole cohort farewell session to finish the programme. In person visit day planned (not used).	Welcome session online, featuring explanation of the programme, some short talks, and a chance to meet the tutors. In-person visit day. Casual drop-in in the summer (2022) with mentors to finish the programme and catch up on any progress.
Contact method for participants	Email and Microsoft Teams	Email and Microsoft Teams	Email, SMS, Teams for delivery of sessions	Email, canvas, Zoom	Email and Microsoft Teams	Email, Canvas VLE

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Support available for tutors (what do they do when encountering problems)	Contact the project manager or programme leads either via email or Microsoft Teams. This could also be done by emailing the Levelling Up inbox which the programme leads had access to alongside the project manager.	Contact the project manager or programme leads either via email or Microsoft Teams. This could also be done by emailing the levelling up inbox which the programme leads had access to alongside the project manager.	Support from both the maths team at Leicester, as well as central recruitment and outreach team that oversee the programme delivery. Email, Teams availability during regular office hours.	Contact the programme lead by email .	Contact the project manager or programme leads either via email or Microsoft Teams. This could also be done by emailing the levelling up inbox which the programme leads had access to alongside the project manager.	Email project lead, or the IOP
Support available for mentors (what do they do when encountering problems)	Contact the project manager or programme leads either via email or Microsoft Teams. This could also be done by emailing the Levelling Up inbox which the programme leads had access to alongside the project manager.	N/A	N/A	Contact the programme lead by email .	Contact the project manager or programme leads either via email or Microsoft Teams. This could also be done by emailing the Levelling Up inbox which the programme leads had access to alongside the project manager.	Email the project lead. One-to-one discussions with each mentor half way through the project.
5. WHO PROVIDED (describe expertise, background and any specific training given)						
Describe the programme team structure (include role requirements for eg. spoke lead/project manager/project co-ordinator etc)	Programme leads- subject and pedagogical knowledge. Oversaw academic and mentor content. Project manager day to day running of programme, lead liaison with programme teams and externals.	Programme leads- subject and pedagogical knowledge. Oversaw mentor content. Subject lead across spokes (LMS) oversaw academic content. Project manager day to day running of programme, lead	Maths department provided overall academic lead, and dedicated admin support. Recruitment and outreach team provided overall project management, and ran recruitment of students from local	Programme Lead: subject and pedagogical knowledge, day to day management of the programme and communication with participants, developed mentor content. Subject lead across spokes (IOP) oversaw academic content.	Programme leads- subject and pedagogical knowledge. Oversaw mentor content. Subject lead across spokes (IOP) oversaw academic content. Project manager day to day running of programme, lead liaison with programme teams and externals.	Spoke lead. Support from local outreach team.

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
		liaison with programme teams and externals.	schools and colleges.			
Who provided tutorial sessions? (include role requirements, if any)	Postgraduate students and members of academic staff.	Undergraduate students	Mix of UG/PG students	IOP appointed tutors	IOP appointed tutors	IOP appointed tutors (teachers)
How many tutors?	8	6	2 (originally appointed 5, however 3 dropped out fairly soon after programme delivery began. We also utilised a tutor from cohort 1 to help facilitate some sessions)	4	5	4
What training did tutors have (e.g. Safeguarding, pedagogy etc)?	Levelling Up safeguarding training and tutor training (pedagogical).	Levelling Up safeguarding training and tutor training (pedagogical) including practice tutorials.	General training / specific safeguarding training and document	Safeguarding training with Birmingham and tutor training (pedagogical) with IOP.	Levelling Up safeguarding training and tutor training (pedagogical) with IOP. Also had training meetings every 3 tutorials or so to discuss what was coming up.	Tutor training with IOP.
What was the format of any training the tutors had? (e.g. live training, self guided reading etc)	Live online via Teams, also had to do university safeguarding training online via Oracle and DBS checks	Live online via Teams, also had to do university safeguarding training online via	Live online teams sessions, static document also provided to reiterate	Online, also had to be DBS checked	Live online via Teams, also had to be DBS checked	Live online via Teams, also had to be DBS checked

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
		Oracle and DBS checks	safeguarding training that was delivered.			
Who provided mentor sessions? (include role requirements, if any)	Undergraduate Chemistry/ Natural Sciences students doing a large proportion of chemistry	N/A	N/A	Undergraduate physics students	Undergraduate physics/ Natural Sciences students doing a large proportion of physics	Undergraduate and graduate students in physics
How many mentors?	8	N/A	N/A	6	7	7
What training did mentors have (e.g. Safeguarding, pedagogy etc)?	Live mentor training and safeguarding training, also had to do university safeguarding training online via Oracle and DBS checks	N/A	N/A	Online mentor training and safeguarding training, and DBS checks	Live mentor training and safeguarding training, also had to do university safeguarding training online via Oracle and DBS checks	Safeguarding training. DBS check. Mentor training with local team.
What was the format of any training the mentors had? (e.g. live training, self guided reading etc)	Live online via Teams	N/A	N/A	Online via Zoom	Live online via Teams	Live online via Teams
Who provided guest lectures? (include role requirements, if any)	Research academics and industrial scientists across STEM topics at local universities	Research academics and industrial scientists across STEM topics at local universities	Maths department delivered the session on maths admissions tests etc.	N/A	Research academics and industrial scientists across STEM topics at local universities	Research academics in physics
How many guest lecturers?	10	10	1	0	10	10
What training did guest lecturers have (e.g. Safeguarding, pedagogy etc)?	None (lectures were chaperoned by a DBS checked member of the programme team)	None (lectures were chaperoned by a DBS checked member of the programme team)	N/A as already UG teaching staff, with existing DBS check in place	N/A	None (lectures were chaperoned by a DBS checked member of the programme team)	None
What was the format of any training the guest lecturers had?	N/A	N/A	N/A	N/A	N/A	None

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
(eg. live training, self guided reading etc)						
Who provided any of the other activities delivered during the programme (e.g. Welcome and farwell sessions, include role requirements if any)	Members of the programme team. The programme lead for the university.	Members of the programme team. The programme lead for the university.	Programme lead / university outreach team	Programme lead / university outreach team	Members of the programme team. The programme lead for the university.	Members of the programme team.
What training did providers of any other activities have (eg. Safeguarding, pedagogy etc)?	Nothing specific for the programme.	Nothing specific for the programme.	None	None	Nothing specific for the programme.	Nothing new.
What was the format of any training the providers of other activities had? (eg. live training, self guided reading etc)	N/A	N/A	N/A	N/A	N/A	N/A
6. HOW (modes of delivery and whether sessions were provided individually or in a group)						
How was set work delivered?	Online via Microsoft Teams.	Online via Moodle	Online via Moodle	Canvas and email	Online via Microsoft Teams.	Online
Describe any hardware necessary for set work	None	None	Internet enabled device	None	None	Internet access to online VLE
How were tutorial sessions delivered?	Online via Microsoft Teams.	Online via Microsoft Teams	MS Teams	Zoom	Online via Microsoft Teams.	Online
Number of tutor groups and group size	8 groups of 5-7 people	6 groups of 4-5 people	2 groups, anywhere from 2-10 people in size	8 groups of 5-7 people	7 groups of 5-7 people	7 groups of 6
Describe any hardware necessary for tutor sessions.	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
		and graphics tablets (provided)	and graphics tablets (provided)			
How were mentor sessions delivered?	Online via Microsoft Teams.	N/A	N/A	Zoom	Online via Microsoft Teams.	Online
Number of mentor groups and group size	8 groups of 5-7 people	N/A	N/A	8 groups of 5-7 people	7 groups of 5-7 people	7 groups of 6 (the same groups as the tutorials)
Describe any hardware necessary for mentor sessions.	A device to connect to an online call	N/A	N/A	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call
How were guest lectures delivered?	Online via Zoom	Online via Zoom	MS Teams	N/A	Online via Zoom	Online, in person
Describe any hardware necessary for guest lectures.	A device to connect to an online call	A device to connect to an online call	Internet enabled device	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call
How were any other activities on the programme delivered (e.g. Welcome and farewell sessions)?	Welcome session online on Zoom, all others Online via Microsoft Teams. In person visit planned to include a tour of the University.	Welcome session online on Zoom, all others Online via Microsoft Teams. In person visit planned to include a tour of the University.	MS Teams	Zoom	Welcome session online on Zoom, all others Online via Microsoft Teams. In person visit planned to include a tour of the University.	Online, in person
Describe any hardware necessary for other activities provided.	A device to connect to an online call	A device to connect to an online call	Internet enabled device	A device to connect to an online call	A device to connect to an online call	A device to connect to an online call
7. WHERE (Location and any necessary infrastructure/relevant features)						
Location of tutor sessions	Online (Microsoft Teams)	Online (Microsoft Teams)	MS Teams	Zoom	Online (Microsoft Teams)	Online
Location of mentor sessions	Online (Microsoft Teams)	N/A	N/A	Zoom	Online (Microsoft Teams)	Online
Location of guest lectures	Online (Zoom)	Online (Zoom)	MS Teams	N/A	Online (Zoom)	Online
Location of other activities (eg.	Online (Zoom and Microsoft Teams).	Online (Zoom and Microsoft Teams).	MS Teams	Zoom	Online (Zoom and Microsoft Teams).	Online, in person

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Welcome and farewell sessions	Planned in person visit at Durham University	Planned in person visit at Durham University			Planned in person visit at Durham University	
8. WHEN + HOW MUCH (number of times delivered, over what period of time. Number of sessions/schedule/duration/intensity/ dose)						
Start and end date of any set work	12/04/21-16/05/22	22/03/21-02/05/22	March 2021 – April 2022	06/21 - 03/22	12/04/21-21/03/22	September 2021 - May 2022
Amount of work set	30 pieces (15 of pre-work and 15 diagnostic Qs post-tutorial)	22 pieces	22 pieces	10 pieces	19 pieces	One per tutorial
Frequency of set work	Every 3 weeks during term time	Every 2 weeks	Every 2 weeks during school term time	Every 3 weeks	Every 2/3 weeks	One per tutorial
Total mandatory pieces of work set	30	0	1	10	19	One per tutorial
Start and end date of tutorials	22/03/21-23/05/22	29/03/21-09/05/22	March 2021 – April 2022	14/6/21 - 23/3/22	19/04/21-25/04/22	September 2021 - May 2022
Number of tutorials	17	22	22	10	19	Varied by group / tutor
Frequency of tutorials	Every 3 weeks during term time	Every 2 weeks	Every 2 weeks during term time	every 3 weeks	Every 2/3 weeks	Every 2-3 weeks
Length of tutorials	1 hour	90 minutes	90 minutes	1 hour	1 hour	1 hour
Total mandatory contact time for tutorials	17 hours	33 hours	33 hours	10 hours	19 hours	Varied by group / tutor
Start and end date of mentor sessions	29/03/22-30/5/2022	N/A	N/A	21/6/21 - 30/3/22	26/04/21-7/3/22	September 2021 - May 2022
Number of mentor sessions	17	N/A	n/A	9	9	Varied by group / mentor
Frequency of mentor sessions	Every 3 weeks during term time	N/A	N/A	Every 3 weeks	Every 3-6 weeks during term time	Every 2-3 weeks
Length of mentor sessions	1 hour	N/A	N/A	1 hour	1 hour	1 hour
Total mandatory contact time for mentor sessions	17 hours	N/A	N/A	9 hours	9 hours	Varied by group / mentor

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Start and end date of guest lectures	24/05/21-03/01/22	24/05/21-03/01/22	June 2021	N/A	24/05/21-03/01/22	July 2021 - May 2022
Number of guest lectures	10	10	1	N/A	10	10
Frequency of guest lectures	2 a month for the first 6 months then move to 1 a month from there	2 a month for the first 6 months then move to 1 a month from there	June 2021	N/A	2 a month for the first 6 months then move to 1 a month from there	Intermittent
Length of guest lectures	1 hour	1 hour	1 hour	N/A	1 hour	Varied
Total mandatory contact time for guest lectures	0 hours	0 hours	N/A	N/A	0 hours	~6 hours
Start and end date of other activities	15/03/21-09/05/22	15/02/21-09/05/22	March 2021	21-Sep	15/02/21-09/05/22	July 2021 - August 2022
Number of other activities	4	4	1	1	4	4
Frequency of other activities (Additional to tutor/mentor sessions)	One at the beginning of the programme, one at the mid-point (start of the new academic year in September). In person visit planned July of Y12	One at the beginning of the programme, one at the mid-point (start of the new academic year in September). In person visit planned July of Y12	March 2021	UCAS application advice event	One at the beginning of the programme, one at the mid-point (start of the new academic year in September). In person visit planned July of Y12	Varied
Length of other activities	1 hour for online sessions, 3 hours in person	1 hour for online sessions, 3 hours in person	1 hour	1 hour	1 hour for online sessions, 3 hours in person	Varied
Total mandatory contact time for other activities	3 hours (online only mandatory)	3 hours (online only mandatory)	1 hour	1 hour	3 hours (online only mandatory)	0 hours

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
9. TAILORING (were materials planned to be adapted, if so what, why, when and how)						
Were the tutor materials designed to be tailored by the tutors? (What, why, when and how)	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by tutors according to needs of group	Yes, variety of ways of doing things included in the notes along with suggested ways of tailoring if participants were struggling. Tailored to needs of group	Yes, variety of ways of doing things included in the notes along with suggested ways of tailoring if participants were struggling. Tailored to needs of group	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by tutors according to needs of group	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by tutors according to needs of group	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by tutors according to needs of group
Were the mentor materials designed to be tailored by the mentors? (What, why, when and how)	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by mentors according to needs of group	N/A	N/A	Yes- the sessions were planned with suggested questions for discussion but mentors were encouraged to adapt to the needs and questions of the attendees in their groups.	Yes PowerPoint slides that could be amended. Variety of links and questions that could be selected by mentors according to needs of group	Yes, up to the mentors what they used / created.
10. MODIFICATIONS (official modifications during the course of the study. If so then what, why, when and how)						
Were any official modifications made during the study?	Yes, no in person visit and stopped diagnostic Qs.	No in person visit	No	No	No in person visit	No
If yes, describe the what, why when and how of the modifications	In person visit had to be cancelled due to Covid restrictions. Post-tutorial diagnostic questions were too laborious for the tutors to mark and return so they were stopped after 3 weeks.	In person visit had to be cancelled due to Covid restrictions.	N/A	No	In person visit had to be cancelled due to Covid restrictions.	N/A
11. HOW WELL (planned- if intervention adherence or fidelity was assessed, how and by whom, strategies to maintain or improve)						
Attendance monitoring system	Registers completed on excel spreadsheets in locked channels on Microsoft Teams.	Registers completed on excel spreadsheets in locked channels on Microsoft Teams.	Registers completed on excel from Teams attendance reports	Registers completed on excel spreadsheet	Registers completed on excel spreadsheets in locked channels on Microsoft Teams.	Registers completed by tutors and mentors

Programme element	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford
Describe any methods used to maintain or improve attendance	Email contact made with participants missing sessions to chase them up. Guaranteed conditional offer to study their chosen subject at Durham based on "full engagement" with the programme,. e.g.. attendance and participating in sessions.	Email contact made with participants missing sessions to chase them up. Guaranteed conditional offer to study their chosen subject at Durham based on "full engagement" with the programme. e.g. attendance and participating in sessions.	Email communication sent to students that had missed back to back sessions without providing a reason. If this persisted further, SMS was used, and if persisted further the programme manager phoned students to check in on them.	Regular email contact with participants (approx.. twice per week). Participants missing sessions followed up by email.	Email contact made with participants missing sessions to chase them up. Guaranteed conditional offer to study their chosen subject at Durham based on "full engagement" with the programme. e.g. attendance and participating in sessions.	Some pairs of groups were merged so that the keenest students could have a better experience. Students who didn't attend much to begin with were followed up by email
Did you offer a "guaranteed conditional offer", "reduced conditional offer" or nothing to the participants?	Guaranteed conditional offer for participants that fully engaged with the programme.	Guaranteed conditional offer for participants that fully engaged with the programme.	Reduced conditional offer of 2 A-level grades for Maths/STEM courses only.	No	Guaranteed conditional offer for participants that fully engaged with the programme.	No

Mentoring content

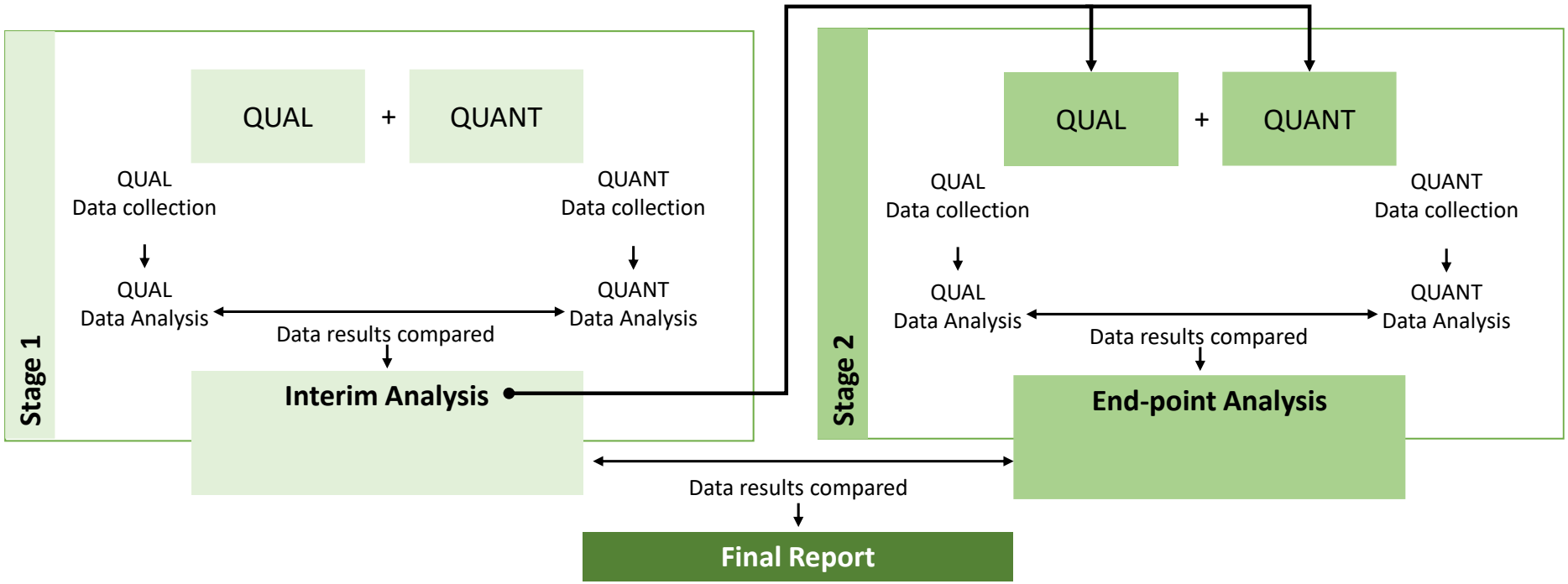
The table below summarises the mentoring programme content on the Chemistry and Physics Spokes. The Maths programmes did not have mentoring sessions.

Table 3. Summary of the mentoring programme content by Spoke.

Mentoring Topics Covered	Chemistry - Durham	Physics - Birmingham	Physics - Durham	Physics - Oxford
General information about your university	yes	yes	yes	Mentors were allowed to cover any topic they felt useful for their groups. As such it is not known which topics were aligned for mentoring sessions.
Course specific information at your university	yes	yes	Yes	
Social life at university	yes	yes	Yes	
Beyond university	yes	no	Yes	
Applications to university (UCAS etc)	yes	yes	Yes	
Personal statements	yes	yes	Yes	
Support and wellbeing at university	yes	yes	Yes	
College structure information	yes	no	Yes	
Student accommodation	yes	no	Yes	
Student finance and budgeting	yes	yes	Yes	
Independence at university	yes	yes	Yes	
Revision	yes	yes	Yes	
Dealing with Change	no	yes	No	

Appendix 3. Mixed methods design

Figure 1. Representation of the concurrent triangulation mixed methods design, with sequential phases (Cresswell et al., 2003)



Appendix 4. Participant numbers for application forms and surveys

Table 4. Summary of application, participation and survey completion numbers.

	Chemistry - Durham	Maths - Durham	Maths - Leicester	Physics - Birmingham	Physics - Durham	Physics - Oxford	Total
Applied	90	61	39	118	104	114	526
Offered place	44	30	25	48	46	42	235
Accepted place	42	30	25	48	39	42	226
Permission given for use of application data in evaluation	39	30	17	45	40	42	213
Completed baseline survey	34	25	17	14	36	16	142
Completed baseline survey and agreed could be joined to application data (if available)	33	25	11	12	36	15	133
Completed baseline survey and disagreed could be joined to application data (if available)	1	0	0	1	0	0	2
Completed baseline survey but did not give permission for Durham to have application data	0	0	6	1	0	1	8
Completed baseline survey but not end of programme survey	24	16	8	1	26	11	95
Did not complete baseline survey	5	5	5	32	4	26	77
Did not complete baseline survey but did complete end of programme survey	2	1	2	9	1	5	20
…And we have linked application form data	2	1	2	9	1	5	20
…But we don't have linked application form data	0	0	0	0	0	0	0
Completed both baseline and end of programme survey	10	9	9	4	10	5	47
…And we have linked application form data	9	9	7	4	10	5	44
…But we don't have linked application form data	1	0	2	0	0	0	3
Only application form data available	3	4	3	23	3	21	57
Total number of unique students	39	30	22	46	40	42	219

Appendix 5. CLASS survey analysis

Chemistry

In Chemistry, the responses of eight of the ten students who completed both surveys showed a shift to a more expert-like view, whilst two students showed a shift to a more novice-like view

Figure 2. The change in percentage of CLASS statements where respondents in the Chemistry hub agree with the expert view (n=10)

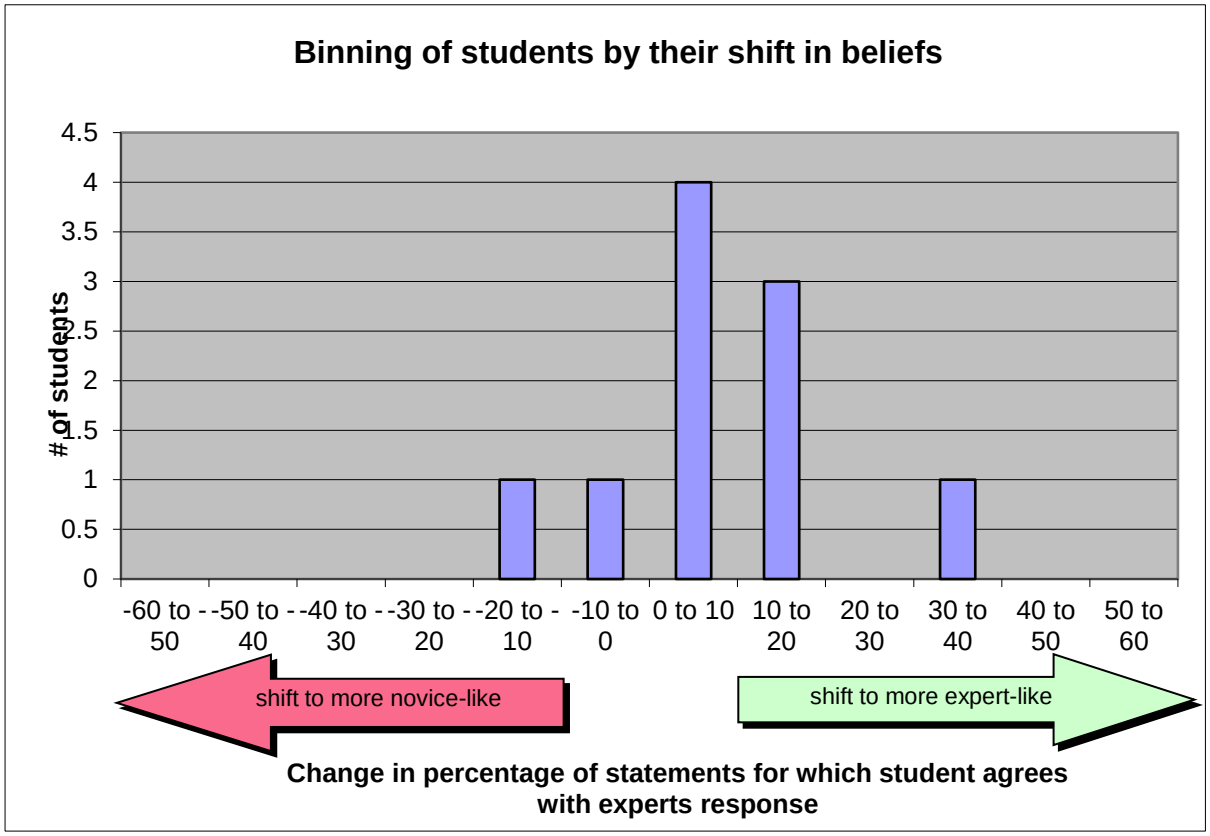


Figure 3 and Table 5 show the change in percentage of statements at baseline and end of programme surveys where respondents agree with the expert view (favourable) or disagree with the expert view (unfavourable). Students were able to select a neutral option so favourable and unfavourable responses do not add to 100%. Changes in overall responses are shown as well as for individual categories. Table 5 highlights categories where the change is significant,. For the category of Real World Connection, the percentage of respondents agreeing with the expert view (favourable) changed very little (57.5% to 60%) whereas the percentage disagreeing with the expert view (unfavourable) decreased significantly (from 22.5% to 15%). With the Problem solving General category again the favourable change is not significant (80% to 84%) but the shift to unfavourable (4% to 8%) is significant. In this case the percentage of respondents having a more novice-like response has increased.

Figure 3. The shift in responses to CLASS statements from respondents from the Chemistry hub. The blue symbols show responses from the baseline survey, the red symbols show the responses from the end of programme survey.

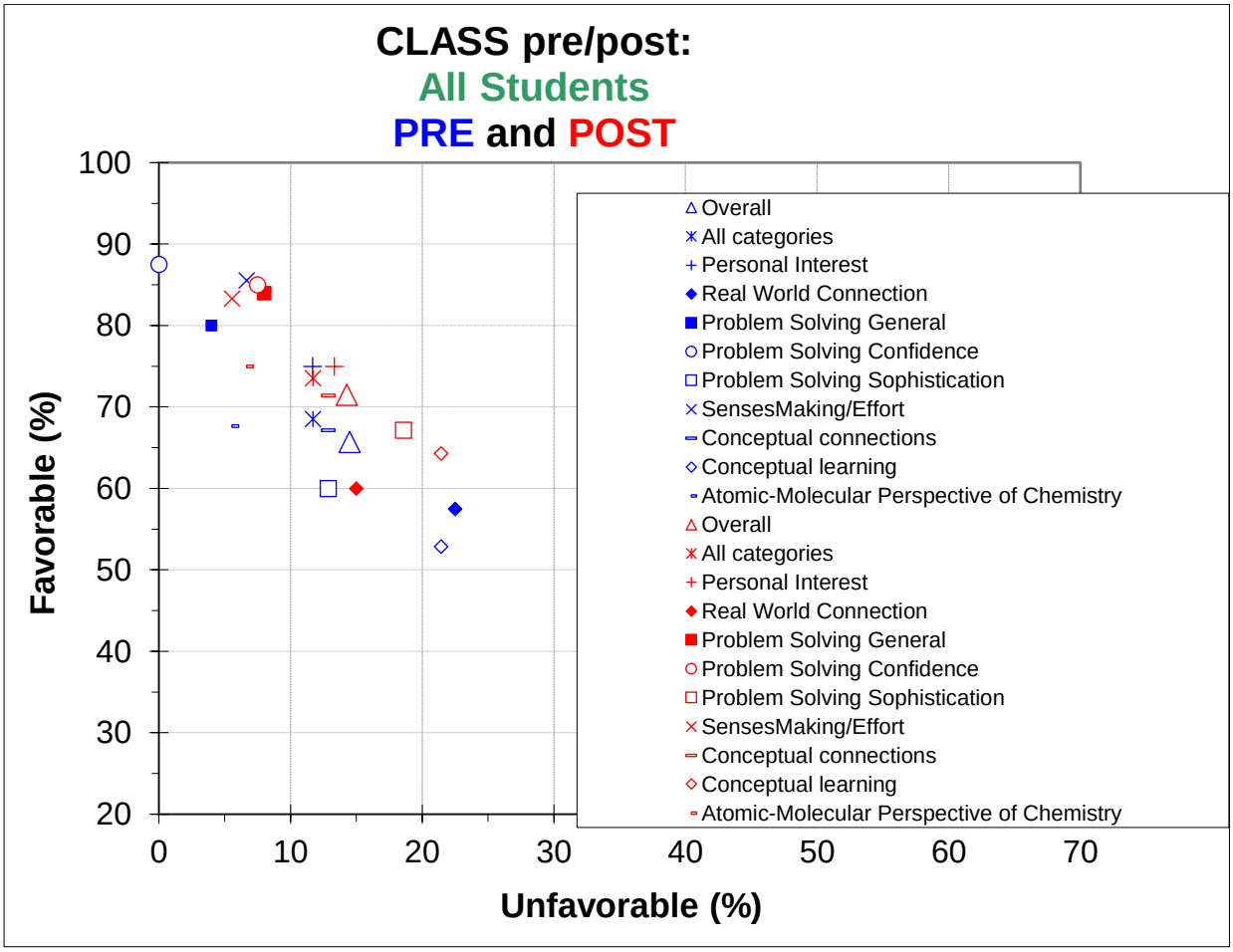


Table 5. The percentage of statements to which students on the Chemistry hub agreed with the expert view at two time points. Values in the Large Shift column show where the change is statistically significant.

Categories						
	ALL	Number:	10		**LARGE**	**Shift**
(Explained on "Categories" worksheet)		**PRE**	**POST**	**SHIFT**	**SHIFT**	**StdErr**
Overall	favorable	65.7	71.5	5.8		4.0
(All 45 Q's with expert response)	unfavorable	14.5	14.3	-0.2		1.8
All categories	favorable	68.5	73.5	5.0		4.2
(36 Q's that appear in below categories)	unfavorable	11.7	11.7	0.0		2.0
Personal Interest	favorable	75.0	75.0	0.0		6.7
	unfavorable	11.7	13.3	1.7		4.4
Real World Connection	favorable	57.5	60.0	2.5		9.0
	unfavorable	22.5	15.0	-7.5	-7.5	3.6
Problem Solving General	favorable	80.0	84.0	4.0		2.1
	unfavorable	4.0	8.0	4.0	4.0	1.5
Problem Solving Confidence	favorable	87.5	85.0	-2.5		4.3
	unfavorable	0.0	7.5	7.5		5.1
Problem Solving Sophistication	favorable	60.0	67.1	7.1		5.4
	unfavorable	12.9	18.6	5.7		4.6
SensesMaking/Effort	favorable	85.6	83.3	-2.2		5.4
	unfavorable	6.7	5.6	-1.1		2.5
Conceptual connections	favorable	67.1	71.4	4.3		7.3
	unfavorable	12.9	12.9	0.0		3.5
Conceptual learning	favorable	52.9	64.3	11.4		8.5
	unfavorable	21.4	21.4	0.0		6.4
Atomic-Molecular Perspective of Chemistry	favorable	67.7	75.0	7.3		8.0
	unfavorable	5.6	6.7	1.1		2.8

Maths

In Maths, the responses of 13 of the 18 students who completed both surveys showed a shift to a more expert-like view, whilst five students showed a shift to a more novice-like view,

Figure 4. The change in percentage of CLASS statements where respondents in the Maths hub agree with the expert view (n=18)

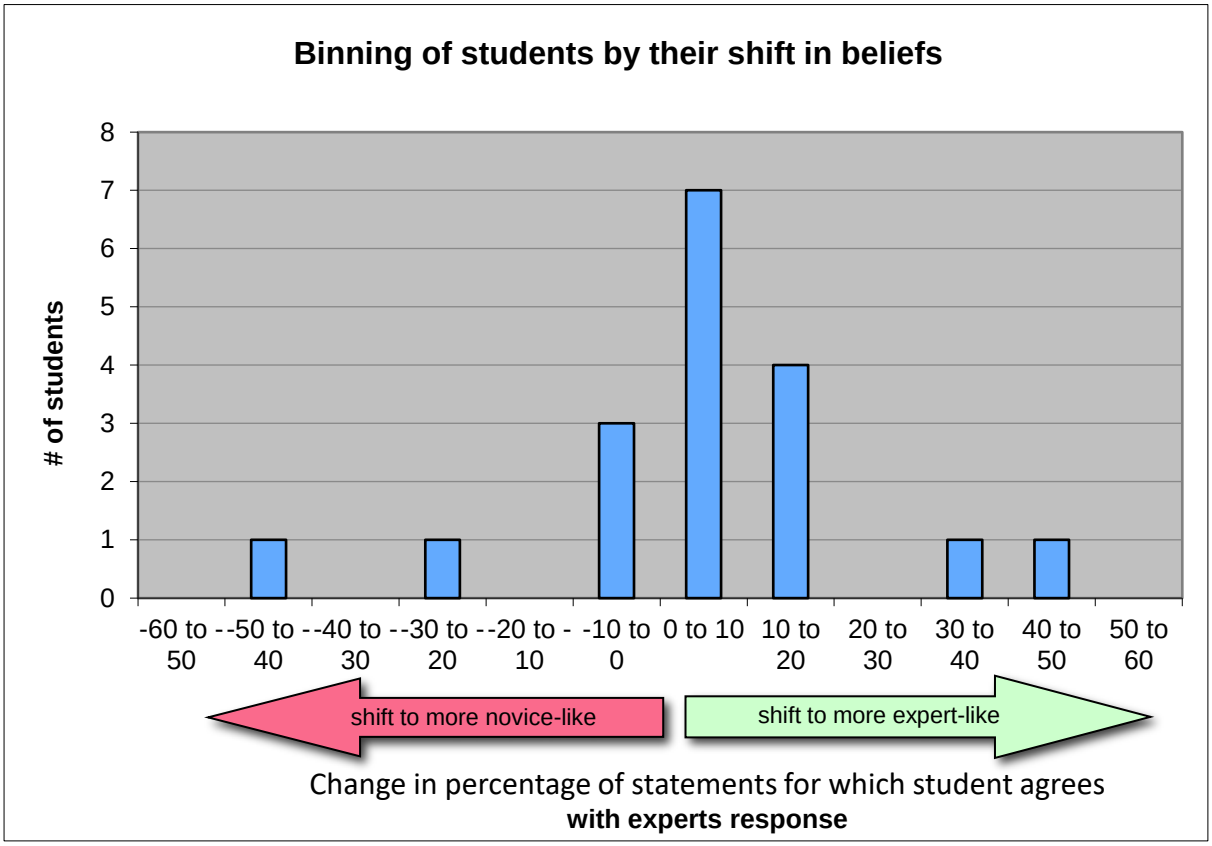


Figure 5 and Table 6 show the change in percentage of statements at baseline and end of programme surveys where respondents agree with the expert view (favourable) or disagree with the expert view (unfavourable). Students were able to select a neutral option so favourable and unfavourable responses do not add to 100%. Changes in overall responses are shown as well as for individual categories. Table 6 highlights categories where the change is significant. For the category of Real World Connection, the percentage of respondents agreeing with the expert view (favourable) changed from 61.1% to 79.2%, a significant shift, whilst at the same time the percentage disagreeing with the expert view (unfavourable) also increased (from 11.1% to 12.5%), though this change is not statistically significant. In the Sense Making/Effort category, the percentage of students agreeing with the expert view decreased, although not by a statistically significant amount (87.3% to 80.8%). However, in this category the percentage of students disagreeing with the expert view increased (0.8% to 7.1%), a statistically significant figure.

Figure 5. The shift in responses to CLASS statements from respondents from the Maths hub. The blue symbols show responses from the baseline survey, the red symbols show the responses from the end of programme survey.

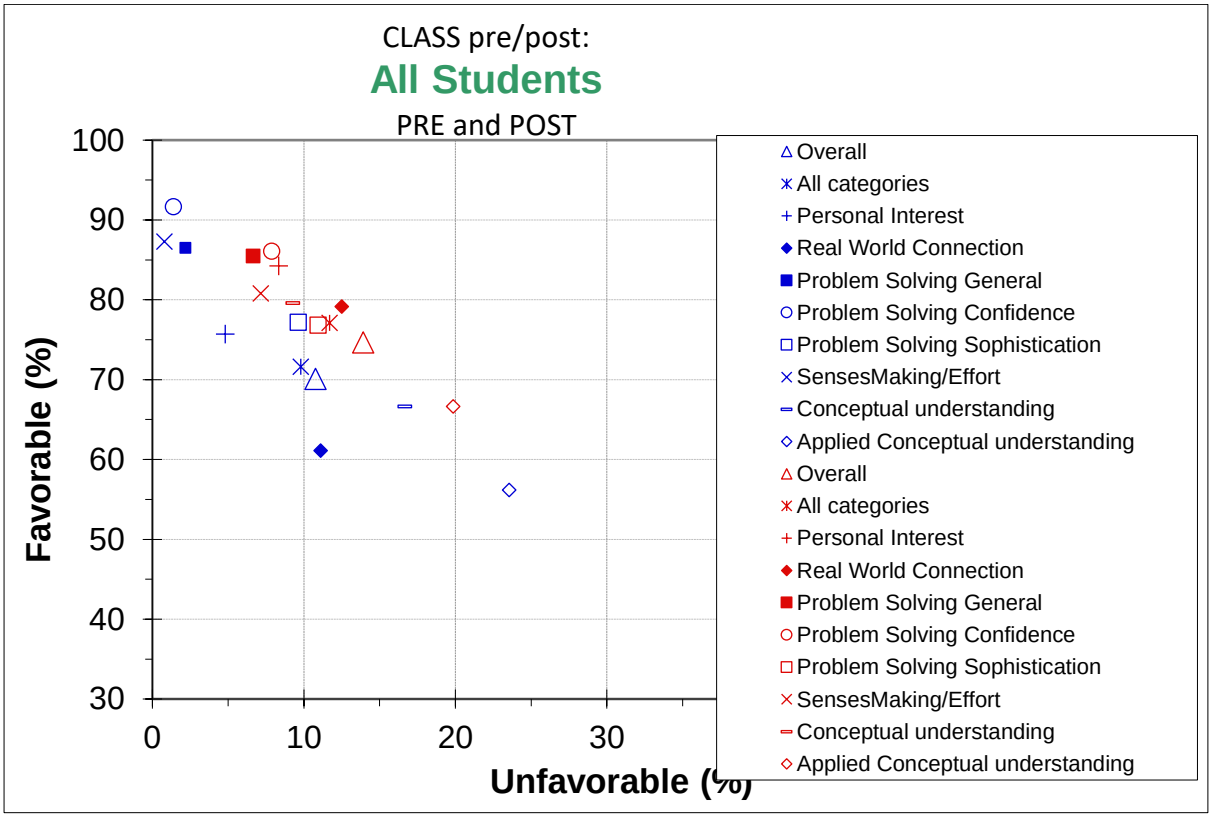


Table 6. The percentage of statements to which students on the Maths hub agreed with the expert view at two time points. Values in the Large Shift column show where the change is statistically significant. (N= 18)

Categories						
	ALL	Number:	18		**LARGE**	**Shift**
(Explained on "Categories" worksheet)		**PRE**	**POST**	**SHIFT**	**SHIFT**	**StdErr**
Overall	favorable	70.1	74.7	4.6		4.4
(All 36 Q's with expert response)	unfavorable	10.8	13.9	3.1		2.8
All categories	favorable	71.6	77.1	5.5		4.9
(26 Q's that appear in below categories)	unfavorable	9.8	11.7	1.9		2.9
Personal Interest	favorable	75.7	84.3	8.5		6.7
	unfavorable	4.8	8.3	3.5		2.6
Real World Connection	favorable	61.1	79.2	18.1	18.1	6.9
	unfavorable	11.1	12.5	1.4		3.7
Problem Solving General	favorable	86.5	85.5	-1.0		6.8
	unfavorable	2.2	6.6	4.5		4.1
Problem Solving Confidence	favorable	91.7	86.1	-5.6		7.7
	unfavorable	1.4	7.9	6.5		4.8
Problem Solving Sophistication	favorable	77.2	76.9	-0.4		9.1
	unfavorable	9.6	10.9	1.3		6.6
SensesMaking/Effort	favorable	87.3	80.8	-6.5		4.7
	unfavorable	0.8	7.1	6.3	6.3	3.0
Conceptual understanding	favorable	66.7	79.6	13.0		7.1
	unfavorable	16.7	9.3	-7.4		4.6
Applied Conceptual understanding	favorable	56.2	66.7	10.4		7.6
	unfavorable	23.5	19.8	-3.7		5.7

Physics

In Physics, the responses of 17 of the 18 students who completed both surveys showed a shift to a more expert-like view, whilst one student showed a shift to a more novice-like view

Figure 6. The change in percentage of CLASS statements where respondents in the Physics hub agree with the expert view (n=18)

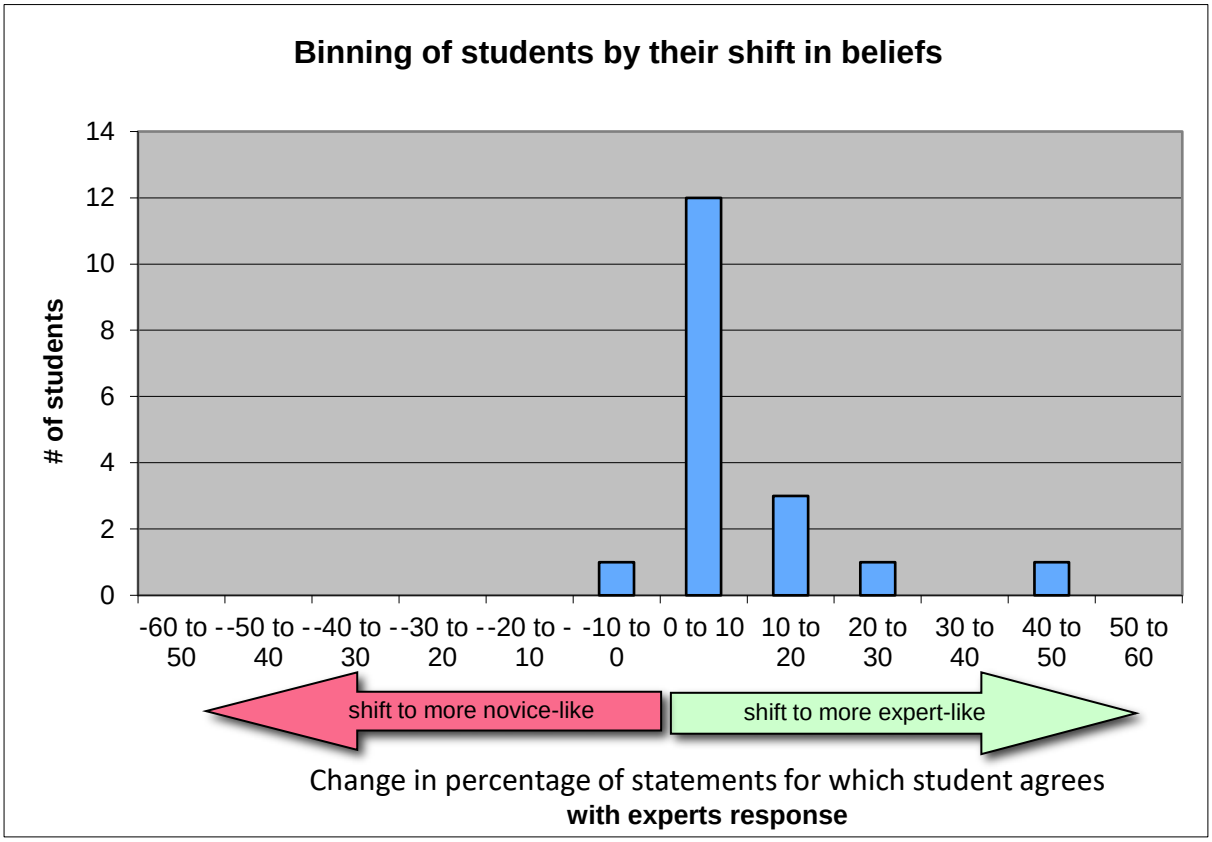


Figure 7 and Table 7 show the change in percentage of statements at baseline and end of programme surveys where respondents agree with the expert view (favourable) or disagree with the expert view (unfavourable). Students were able to select a neutral option so favourable and unfavourable responses do not add to 100%. Changes in overall responses are shown as well as for individual categories. Table 7 highlights categories where the change is significant. Overall (36 questions) there is a statistically significant increase in responses agreeing with the expert view (68.1% to 76.2%) and a statistically significant decrease in responses disagreeing with the expert view (14.1% to 10.1%). The same trend is seen on the All Categories (26 questions) section where the increase in responses agreeing with the expert view (69.9% to 78.0%) is significant as is the decrease in responses disagreeing with the expert view (12.2% to 8.3%). In the category of Problem Solving Confidence there was little change in the favourable (more expert-like) response (78.9% to 79.8%) but a statistically significant increase in unfavourable (away from the expert view) responses (1.3% to 10.5%). In the Problem Solving Sophistication category there was no change in the unfavourable response (13.2%) but a statistically significant increase in responses agreeing with the expert view (59.6% to 72.8%). In the Conceptual Understanding category there were significant shifts towards the expert like responses (50.9% to 70.0%) and away from unfavourable (novice-like) responses (22.3% to 15.1%). The same pattern is seen in the Applied Conceptual Understanding category where significant shifts towards the

expert -like view (39.8% to 69.8%) are alongside sia significant shift away from unfavourable responses (33.5% to 15.9%). Changes in all other categories, favourable and unfavourable are non-significant.

Figure 7. The shift in responses to CLASS statements from respondents from the Physics hub. The blue symbols show responses from the baseline survey, the red symbols show the responses from the end of programme survey.

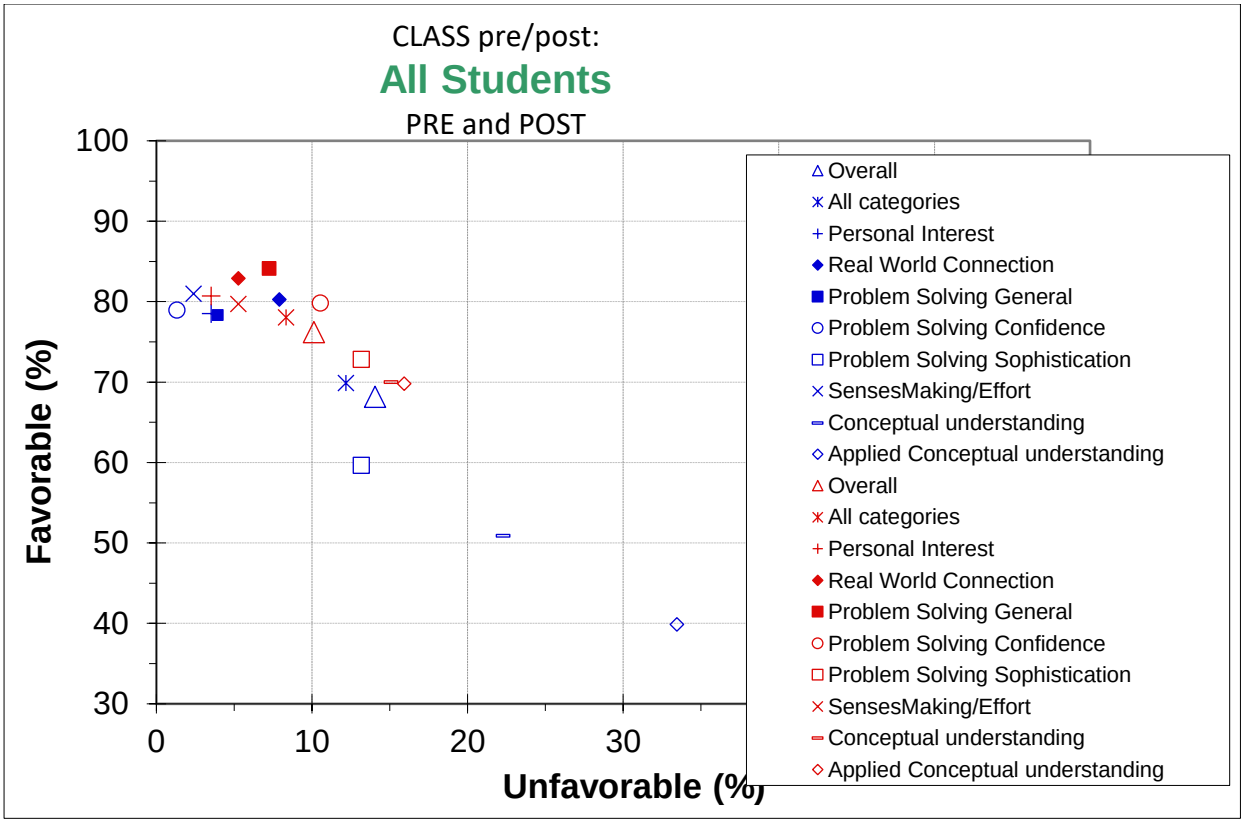


Table 7. The percentage of statements to which students on the Physics hub agreed with the expert view at two time points. Values in the Large Shift column show where the change is statistically significant. (N= 18)

Categories						
	ALL	Number:	18		**LARGE**	**Shift**
(Explained on "Categories" worksheet)		**PRE**	**POST**	**SHIFT**	**SHIFT**	**StdErr**
Overall	favorable	68.1	76.2	8.1	8.1	2.4
(All 36 Q's with expert response)	unfavorable	14.1	10.1	-3.9	-3.9	1.9
All categories	favorable	69.9	78.0	8.2	8.2	2.5
(26 Q's that appear in below categories)	unfavorable	12.2	8.3	-3.8	-3.8	1.7
Personal Interest	favorable	78.5	80.7	2.2		4.9
	unfavorable	3.5	3.5	0.0		2.8
Real World Connection	favorable	80.3	82.9	2.6		6.4
	unfavorable	7.9	5.3	-2.6		3.7
Problem Solving General	favorable	78.3	84.1	5.8		3.9
	unfavorable	3.9	7.2	3.3		1.8
Problem Solving Confidence	favorable	78.9	79.8	0.9		4.8
	unfavorable	1.3	10.5	9.2	9.2	4.2
Problem Solving Sophistication	favorable	59.6	72.8	13.2	13.2	4.4
	unfavorable	13.2	13.2	0.0		3.0
SensesMaking/Effort	favorable	81.0	79.7	-1.3		4.0
	unfavorable	2.4	5.3	2.9		2.0
Conceptual understanding	favorable	50.9	70.0	19.1	19.1	5.0
	unfavorable	22.3	15.1	-7.2	-7.2	3.2
Applied Conceptual understanding	favorable	39.8	69.8	29.9	29.9	4.0
	unfavorable	33.5	15.9	-17.5	-17.5	4.0

Appendix 6. Outcomes analysis – Quote bank

Full deductively coded findings from the student mid-point and end-point focus groups against the original Outcomes for the programme as documented in the Theory of Change Model (Appendix 1).

Table 8. Outcome 1. Increased confidence in the subject. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S2DC: I have found that we cover stuff a few weeks before I do them, then during my A Levels. And then, because we have gone closer to university level, I find the A Level content a bit easier.	S2OP: approaching the very unfamiliar and weird situations that I'd see in the programme, physics programme I'm on. It allows me to, I guess, be able to apply it into real life, in a way, because of course, in person, in real life, you'll get really weird situations that you've never seen before. You wouldn't know what's coming your way, so being able to have a foundation, be confident about, like, the physics knowledge I know, and being able to apply it, like learning to apply it, I think it's going to be really helpful.	S1DM: it has really helped to help with my confidence with maths and make sure that I can answer the questions in exams carefully and in a sensible way.
S2DC: studying chemistry at A-Level, I do find it quite hard, but then doing the sessions, and because they're all on one subject, if I've already done them in school, then it helps me start that revision. If I haven't, it means I go into that lesson more confident, so it just makes going to my lessons a bit more enjoyable.	S3DP: I just think going over more topics, so getting more comfortable for those on the A-Levels, but then also improving how I approach harder problems.	S3DM: I think it's helped me build my confidence as well. Especially working in a group. I'm now, not as afraid to share ideas. Even if you get it wrong, you're going to build off of other people as well and work on problems together.
S4DC: I actually found that my teachers were picking up that I was actually grasping content better, because I was having continuous extra learning, outside with someone that I could just ask help with.	S1DP: it has really boosted my confidence in my physics ability. It has also shown me all the possibilities, as well, so it has really helped me in widening my future. Although I already knew I wanted to do it in physics, it showed me all the different aspects, as well, in mentoring sessions, as well as the tutoring sessions.	
	S4DP: it's so useful with your A Levels because it just makes understanding the content so much easier	
	S6BP: They teach me from a different perspective. So, I got that. Definitely, it's helped me to boost confidence. So, I did home learning sheets and then, the tutorial. During the tutorial, we went through that. It was really helpful. It boosted my knowledge even more.	

Table 9. Outcome 2. Increased problem solving skills in the subject. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
	S4DP: the way I think about answering physics problems has changed a bit. I try and think outside the box and think of new ways to answer things and I think that'll be beneficial. Not just in university but then, in the future as well.	S1LM: I feel like I was able to develop skills that I wouldn't have been doing in college, like problem-solving skills, because it's more focused.
	S2OP: I think the main benefit for me is, I'd say, not only widening what I know and solidifying through having discussions and talking it with everyone else, but I think it's also improving my exam technique and, even more so, being able to approach the most unfamiliar and just, probably, weird problems	S2DM: What I think is one of the more important parts is being able to talk through your answers with other people and see what other people have to say about the problem, that you might not have seen.
		S3DM: it was quite nice to see how they tackled the problems differently because, with maths problems, there's lots of different ways to go about it. So, it's nice to see how everyone tackles it differently.

Table 10. Outcome 3. Increased confidence at having a go at problems even if they can't solve them. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
	S1BP: it also helps you- It encourages you to try out challenging questions and not be too scared of giving it a shot. Because currently, you're not only being taught stuff that you have already learnt at school, you're also being shown undergraduate level questions, which is obviously challenging at our level. So, later on, you go to uni, it wouldn't be much of a problem because you're used to tackling challenging questions. So, I'd say it definitely encourages you to try that stuff. Even if you don't end up getting it right in the end, it doesn't stop you from trying again.	T1LM: Being nice to say, "The answer doesn't matter. It's okay. You're allowed to mess up, you can mess up here 100 times and I will not care, I do not care. This is the place to mess up," being very understanding that, "This happens. It's okay." Also, letting them ask questions that aren't necessarily related to the module that's been happening, around outside of university, feeling approachable
	S5DP: when I was wrong, I wasn't completely wrong. Everybody was on the right lines, but you just have to think in a different way to approach the problem.	S2DM: It encourages you to keep on trying, keep on thinking about a problem, even if you don't think you can get to a solution easily.

Table 11. Outcome 4. Increased perseverance, resilience, willingness to try different strategies in their subject. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
	S2DP: I think a main benefit that I have received is seeing how other people think and get to the same answer. Just all of these different solutions, that is really helpful to look at, to actually extend your own knowledge of physics and different ways to get an answer. It's not just all black and white, there are different opinions	S1LM: I'm hoping to become more confident in getting started with the work and stuff, and diving straight into it instead of doubting myself and stuff. ... It's engaging when they're explaining, like when you're doing the question and trying it out, because they nudge you on and you write certain things. Other people write certain things, but that was very engaging
	S2OP: I'm very rigid, so it would be really hard for me to actually imagine something and not take things way too literally. So, I'd say one of the barriers, when I did the physics programme, is just me not being able to imagine stuff, because I'll literally take it too literally... They would say, like, "This is the right… You could do this, technically, but there is also this method that you could try and use, maybe, because it might be easier." So, basically, they would show me a different way to approach a problem, even if I would be set on something, but they were suggesting something to do instead	S2LM: When you're presented with a question, you don't just think of one way to do it. You think of many things, many ways to do it. I believe that it's answering some questions and finding different ways of answering them and not having one certain, fixed way. So, when you're at college or something and you're answering a question, then you have different ways. You can also teach other people different ways as well because you know them
	S5BP: I also learnt about a few tips and tricks on doing electricity questions through one of the sessions, and that really helped me to answer my A-Level questions really quickly.	S2DM: It's even outside of it, getting you to think about how else could I solve this problem, after I've done it. One of the things I think is the biggest is talking through the problems and also, seeing questions that you wouldn't have seen or thought about, otherwise. I found it quite engaging, having a space where we can all just share our ideas and the expectation that even if you don't have a solution, you have an idea of what could be useful to do, essentially. It encourages you to keep on trying, keep on thinking about a problem, even if you don't think you can get to a solution easily.

S6BP: The groups were small, like four or five people. So, it really helped me to discuss my idea with them, my problem with them.

Table 12. Outcome 5. Increase in students' belief in their ability in the subject. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
	S3OP: I think in the future, I feel like this grows more interest in physics for me, in general. So, I can choose particular topics which I really want to explore.	S1LM: It made me more comfortable with the maths aspect of chemistry, so I was okay with doing chemistry in university, because I knew it wasn't going to be that bad. I've already done some, like, university/harder maths.
	S3DP: I find that the topics that we've gone through on the course, I understand those ones better from doing my A-Levels, so, yes, I think they're the ones I understand the best, the ones who've gone through on this	S1LM: I would say that it helped me a lot because it gave a, kind of, glimpse as to what higher maths would be like and it made me think of maths from a different perspective. It being less structured, like how we do it in school, it was more creative and you could think of it from different points of view. So, like, the questions were different so it made me think of maths completely differently. So, I was able to apply that to my A levels, now, as well. Now I see maths differently and I find it easier at A level.

Table 13. Outcome 6. Broaden their mind regarding thinking and understanding of subject, not just correct solutions. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
T2DC: At school you learn it and forget about it until the exam. Whereas we're reminding them constantly about different things, which isn't necessarily always in line with the order they do it at school or sixth form. I think it's good	S2OP: Being able to apply the subject there is quite beneficial for me, actually, considering I'm doing engineering in the future. So, being able to confront these kinds of problems allows me to just branch out more than [things you'd see in an 0:05:01] exam. …approaching the very unfamiliar and weird situations that I'd see in the programme, physics programme I'm on. It allows me to, I guess, be able to apply it into real life, in a way, because of course, in person, in real life, you'll get really weird situations that you've never seen before. You wouldn't know what's coming your way, so being able to have a foundation, be confident about, like, the physics knowledge I know, and being able to apply it, like learning to apply it, I think it's going to be really helpful.	S1LM: It has definitely changed my view because I see it as being more creative now, from a different perspective, because I'm just seeing a different side of it with the questions we [do to it 0:05:34], so I'm enjoying it more because I'm using skills that I haven't used before when it comes to maths
	S1OP: I think it's just to go that bit extra beyond the classroom, because obviously in a classroom there's a set syllabus you have to get through, but I feel like it's just, instead of teaching us physics to pass an exam, it's to cultivate an interest in the next generation	T1LM: the students that don't understand what's going on will happily follow those steps again and again and again without knowing what they're doing, until exam day. Whereas the students that will think a bit more don't necessarily follow those steps, and then do their own way. So that's the [definite 0:13:17] thinking, of level of seeing that this programme is helping and working because it's not there to give you an A*, it's here to help you get better in life overall. And that's what's changed across the year
	S4DP: I've definitely learnt a new way to enjoy physics. It seems like a lot more fun, now that I know exactly how to answer the questions. You can enjoy the content rather than learning it just to answer exam questions. It's a lot more interesting.	S1DM: I found that it has helped us go a bit deeper into maths. My tutor is really good. He's good at explaining things if we get stuck or whatever, so I've found it useful that way.

	S1DP: I think that it's really to not only refine the knowledge that you already have, but it's also to start approaching problems, or even questions, as a physicist in that mind-set, instead of just a student to pass an exam.	S2LM: It just gives more depth into maths. I really enjoyed maths at GCSE and A-Level, but learning it in these sessions, it's even more interesting.
	S1OP: we went round in one of our group sessions and everyone got to say what they thought the most interesting part of physics- or something that they're really interested in, that's beyond this spec. Then, we went and looked at each of those things. So, you got to hear more about what you're interested in and about other people, as well	S1LM: I would say that it helped me a lot because it gave a, kind of, glimpse as to what higher maths would be like and it made me think of maths from a different perspective. It being less structured, like how we do it in school, it was more creative and you could think of it from different points of view. So, like, the questions were different so it made me think of maths completely differently. So, I was able to apply that to my A levels, now, as well. Now I see maths differently and I find it easier at A level.
	S4OP: we were able to talk about certain things with experts in the field. By being able to share our ideas, as it was mentioned, we realised that it doesn't matter if you are right or wrong. It matters, your approach, the way you see things and the way that you can change your point of view in order to get something closer to the real answer.	

Table 14. Outcome 7. Better understanding of what it may be like to study their subject beyond A-level. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S3DC: it definitely helps revise without you having to put aside extra time. Also, because when I see mentors work out the questions that they give us, you get to see the overlap between A Level and graduate level, because they are working through the same steps that you get taught.	S3BP: I think to enhance your skills in the subject. And the benefit really is that it prepares you for the university level, and it helps to- In your A Levels, you have different topics, and it helps in your revision as well.	T1LM: ... letting them ask questions that aren't necessarily related to the module ... how does a university term work? When do you have lectures? How do you do it? What do you do to study. And how are exams working? Do you have to work with other people? Well, why do you have to work with other people?" A lot of it comes down to future employment, the type of [real world 0:15:22]
S1DC: The way that there are many colleges, so it's not just one place that you go to every time. You'd have to go to different buildings for different lectures and so it's a lot of travelling, as well as learning. I thought it would be just the same place every time.	S1BP: they give us challenging questions and try to give us extended work or independent working outside of the sessions, that definitely has helped me to see how the current stuff that you learn at A Level is being applied to the real world.	S2LM: it's not an A Level standard, it's like how it would be at university, and it gets you ready for that. So, that's what I think the main aim is. And to just improve your knowledge and just work with other people and see different ways of answering different questions
	S2BP: I used to think university – studying at university – is just like very singular, it's just yourself, but I've realised there's actually a lot of group work that goes on.	S1LM: It has made me realise that with university you're going to have to constantly push boundaries within your knowledge. Like, there's always more to know, and different ways to approach questions that you're always going to have to be changing the way you think.
	S2OP: if I'm doing engineering, it's probably going to have a lot more lab work, compared to a physics degree. So, having that insight and being able to see how much pressure there might be, was really helpful to see, because at least, probably, I'll be able to mentally prepare myself for it. Other than that, you also get outside university life, like you have to think about just your general well-being and living in the university hall. So, being able to see, like, how someone manages their time around that, I think it's [very, quite helpful 0:11:45], actually.	S2LM: When I joined the Levelling Up maths programme, it increased my passion for maths. I did end up choosing maths at university, so I feel like it was a very, very good impact for me because I got an insight on what they do at uni and what they would do in maths.
	S4DP: I think that I'm a bit more used to how it'll change, from going to sixth form, to uni. I think it's bridged that gap, a little bit.	

	S1OP: with speaking to the tutors and the teachers, as well, that the programme offered, I found that I wasn't going to accept the Oxford offer because it just didn't seem like the place for me, so I chose Nottingham instead.... It was just speaking to our tutor who goes there at the moment, she said that the lab hours are really, really long and there's a lot more research, as opposed to maths-based stuff.	S2LM: I feel like we've stepped into university, [as in 0:06:24], like, because it is part of the university. Not the course, but like just how they teach or something like that. So, we've gotten into, like, the pre-reading, and the stuff that we do in the sessions, and have smaller groups and things. I feel like it will be a better step for us when we go to university, because we know what to expect, like how to do the reading, how to manage our time
	M1OP: So, in the beginning we did talk about who likes what, what did they think they were good at, how you can combine things that you're good at and things that you like, you know, the Venn diagram of where these things overlap. There were people who were very interested in very different things. So, it wasn't just physics and that's it.	S1LM: I would say that it helped me a lot because it gave a, kind of, glimpse as to what higher maths would be like and it made me think of maths from a different perspective. It being less structured, like how we do it in school, it was more creative and you could think of it from different points of view. So, like, the questions were different so it made me think of maths completely differently. So, I was able to apply that to my A levels, now, as well. Now I see maths differently and I find it easier at A level.
	T2DP: I gave them an overview of different MOOCs that can go to, like MIT do some brilliant MOOCs. I said, "Some lecturers, you'll be sat there and you just won't like their analogies. You won't like their delivery, but in the modern world, if you've got a lecturer that, perhaps, just you're not gelling with, so they're not in the style that you're used to, you can always go online."	

Table 15. Outcome 8. Increased perception that chosen subject is a useful degree. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S3DC: I really appreciate the guest talks, personally, because there is a lot of stuff that I don't actually know what the job entails. So, seeing all those people talk about what they actually do has helped in distinguishing the differences…. Between all the jobs. Because they have very- Not complicated titles, but titles that I wouldn't know what the job	S3OP: I would say especially its applications, outside. Sometimes, there is talks on real life connections to what we learn, which I think is really important to understand. Yes, that's what's really good about it.	

Table 16. Outcome 9. More confident about continue to learn subject beyond A-level. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S3DC: when I see mentors work out the questions that they give us, you get to see the overlap between A Level and graduate level, because they are working through the same steps that you get taught... it just made chemistry seem less daunting	S3OP:It's very, very interesting to be there and it gets you more into what you really want to do in the future. So, I found it really engaging and again, the home learning things have helped a lot because you get to learn more	S1LM: I was a bit unsure whether I was comfortable with maths being a big part of my course, like with chemistry, but now that I've done it I realise that I'm okay with it. I quite enjoy it, so it'll be good for me to apply to chemistry.
	S1OP: learning a bit more about, like, how STEM is at uni, through mentor sessions, has been really helpful in making up my mind as to whether that's, yes, what I want to do	S2DM: Actually, the same reasons as S2LM brought up, have had the opposite effect for me. It's actually made me want to do a maths degree more because some of my favourite parts of it, of A Level maths and further maths have been the proofs. Especially some of the harder questions, at the end, where occasionally, the textbooks will ask you, 'You said this is true. Can you prove that it's true?'
	S2OP: if I'm doing engineering, it's probably going to have a lot more lab work, compared to a physics degree. So, having that insight and being able to see how much pressure there might be, was really helpful to see, because at least, probably, I'll be able to mentally prepare myself for it	S1LM: for the future, doing hard stuff but asking someone to help you, or doing it step by step and harder questions, I'll use that in the future.
	S1OP: I think it's helped me be less intimidated by going to uni and doing physics, because… Yes, I don't know, obviously I really enjoy the subject and I think it's really challenging, but it's just helped me get around corners that I thought were a lot more challenging before and just, like, developing…not, like, an emotional resilience but a logical resilience, tackling questions in different ways and stuff.	S3DM: I think it's quite a big jump between A Level maths and then, maths at university. But I think the programme has helped bridge that gap a bit and made me more aware of it, so then I can prepare in advance.
	S4OP: Because I was able to understand how physics works at university level, from this point, it gives me the confidence in the future, when I actually go to university, to be able to approach physics from a calmer or more confident point of view. Rather than panic about the unexpected.	S1LM: So, before I did the course, I wasn't so sure about maths and if I even liked it or how difficult it was, but after doing it every couple of weeks, I realised that it wasn't so bad.

Table 17. Outcome 10. Students feel supported by programme throughout their application process. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S3DC: we got personal statement advice, like I think two of the sessions [___ 0:03:05]. And as well, specific to ___. We got to see a chemistry personal statement and what it should look like, and that was really helpful	S2DP: I would say being able to explain your solutions to a question, because it's good to think out loud. Especially prepping you for interviews in some universities. But it's just good to see how your thoughts are expressed in words, and then you can kind of catch yourself out, if you say something wrong. It's just a good way to explain how you got to an understanding. So, being able to talk and communicate with others regarding a certain problem.	S1LM: For me, with the programme, it allowed me to get a lower offer. So, I just put it into my UCAS and then I got a lower offer from my university and then I was able to get a placement.
S4DC: having that offer actually gave me security, that if I didn't get any of my medicine offers, then I could have gone onto Durham to do chemistry	S1DP: In the mentoring sessions, when we just began talking about the UCAS applications, we were all in the same boat, feeling like it's quite scary, so I think there was a great sense of community there. Even in my new group now, I can already tell it's all really welcoming	S3LM: It made me more confident, as a student. It definitely made the UCAS application a little less daunting.
S4DC: I think the mentor sessions actually gave a lot of really important information on student finance. Something that I wasn't really too sure and neither were my parents, so it was good that I actually had a place that I could ask questions, from someone who was in university themselves. That was a more holistic benefit, I think.	S4DP: I think one of the most useful mentor sessions was the one about personal statements because I wasn't quite sure of the structure and how to order things and having… It wasn't a one on one but a few people asking questions on the same subject. It made a lot more sense. To ask someone who's already wrote a personal statement and then, got into the uni that I want to get into, it was good insight into what to put, what to include.	T1DM: We managed to talk a bit about how to pick your back-up options, and how to apply smartly and not just go for the top place.
	T2OP: I did with one student that specifically asked in a session, and she just asked, "I'm filling out my UCAS, what kind of things would be sensible to put on it?" But we didn't- it may well have been, had the whole thing felt a little bit more consistent, we might have been able to put in a whole session about that, I think that would have been quite nice, where they had- they felt- but they hadn't really built up these relationships, I think, that enabled them to have those quite honest conversations in front of other people. So, no, we didn't do as much of it as I think would have been nice.	

	M1OP: So, we did have a couple of these sessions, and I think they got some sort of information out of it. Afterwards, the interview prep, I think, was the big thing, because with the physics department, I recorded a mock interview. I was already in my third year, so I did so bad that I wasn't getting into Oxford with this interview. But it was a good example of how bad an interview could go, and you can still get good feedback. I think this was the most useful thing, to be fair, just hearing about interviews from somebody who has taken them, and just being calmer. But this is very Oxford-specific, right?	
	S4DP: it's still been helpful. I did manage to get a lowered offer, because I mentioned this on my UCAS form, for Plymouth, I think. So, I think that helped.	
	T3OP: I had all the material to knock together 10-minute lectures on the history of energy, quantum mechanics, relativity and things like that. So, I was able to give them an introduction to these more advanced topics, which was great for them in preparation for university interviews and personal statements, etc, you know, that sort of thing.	

Table 18. Outcome 11. Students feel they belong on a degree in their chosen subject after participating in the programme. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S1DC: I wasn't planning on doing chemistry at university. At first, I used it more as like a help with my chemistry that I'm studying right now, but it has obviously changed that and now I've applied to chemistry already	S2BP: Before, I wasn't going to apply to Birmingham, and now I have because I quite like their course. I think it's quite a good uni and I quite like the professors that are doing the course, the programme, as well	S1DM: it has made me have more confidence that maths is what I want to do.
	S1OP: I think it has definitely broadened the just general view I have of physics. I decided to do physics at uni after starting this programme, so that has been good	S1LM: I feel like it was there to make us more comfortable with the subject and to prepare us to have the mind-set needed for the subject in terms of, like, questions and the way you have to answer the questions. It just helps you prepare for university, yes.
	S1DP: It has definitely solidified my choice in physics. It has just been really useful just all around	S2LM: When we do the questions in the programme and things like that, sometimes, like if there's a particular topic, that really gets me excited. Then I go onto different uni websites, and see if that's the module and then read ahead on it. It's really exciting. I just want to go to uni to go deeper into those topics and study special modules instead of just like an overview.
	S2DP: It hasn't changed my thoughts really, but just solidified that I want to study physics at university. It has given me more confidence in that regard, that I know what I want to do, this is definitely the career path for me	S2LM: When I joined the Levelling Up maths programme, it increased my passion for maths. I did end up choosing maths at university, so I feel like it was a very, very good impact for me because I got an insight on what they do at uni and what they would do in maths.
	S2OP: I think the purpose of the Levelling Up programme is, for one, so if you go into university, it might help you decide whether physics is the right degree for you, which it helped me in that instance. Secondly, just to cultivate the interest in physics and let it grow [then 0:02:27], more than just a subject in the classroom that teachers teach and everything	S3DM: I was torn between computer science and maths and the programme has led me more towards maths because I think it was fun, just to work through problems that link different areas of maths together. It was a whole lot more interesting to look at different science problems as well, in the tutoring session.
	S4OP: I was torn between chemical engineering and physics before I started the programme. Now, the programme has influenced me towards choosing physics, actually... Something that's hard to find in the A Level physics content in class is the connections between certain topics and how we can take them forward. But through the programme, we	

	were allowed to take certain things forward. Especially through the mentoring sessions. Therefore, that was the thing that directed me towards choosing physics at university because that was the course that would give me the freedom to take all these things that I'm passionate about, forward	
	S3BP: It did provide me with a very good insight into what physics is like at university, which got me to apply to a physics-based course, which I didn't think I would do without the insight. ... With the home learning tasks that we did, they provided a lot of extra information and a lot of physics that I've not done in A Level. So, it's more like at university, this is what physics would be like, which got me more interested.	
	S4BP: I did a lot of work experiences for the engineering side, and I did things like this for physics. And this kind of helped me realise that what I wanted to study was physics, rather than engineering. So this has been very useful	
	S4DP: it's helped me to pinpoint the topic that I want to pursue, rather than… Before I did the programme, I just, kind of, wanted to do all of physics, where now it's narrowed it down a lot and I feel like I've got my career in my mind.	

Table 19. Outcome 12. Students feel they belong in the university community after participating in the programme. S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Chemistry	Physics	Maths
S3DC: I think all the talks we have had about university life and, like S3BP said, the stuff about study skills and stuff like that, it's going to make it seem a lot less alien, because they have already introduced what it means to be a student.	S2DP: The mentor sessions are really useful, because you get to talk to a university student and you understand more about university life. But also the tutorials will help you understand subjects and help you revise with your A Levels, but also extend your knowledge.	T1LM: From my perspective, it would just be to improve the student's understanding of university life, academia, their mathematical content, as I just said, but also help them prepare and think about it, because these students necessarily do not have the advantageous backgrounds that lots of people normally do. They have the networking skills of- know what to do. For example, my parents are migrant workers. [For 0:03:02] hardworking families, [all] they say to you, "You've got to study hard to get into university," but they cannot help you how to study, and they cannot help you get into university. These are steps there which are flawed. So being a first-generation person, the workload is incredibly hard, and you are disadvantaged compared to other students
S2DC: I think the mentor sessions, where they talk more about university life, have been the most interesting, and developing my understanding of university.	T1DP: they hear me talking about the [non Levelling Up University], and obviously, they've got the connection to Durham, and hopefully it makes them just think a little bit higher for themselves. And if I can aspire that through my conversation with them and making them believe that it's worth a go, then that's good.	T1LM: As a university student, they can ask me questions that they hadn't thought about on day one. And after knowing them and knowing me for a period of time, they feel more comfortable and get to see things
	S3BP: speaking to the undergraduate mentors really helps you to pick into some… It really inspires you. You know what I mean? And the way they come across, they're very ambitious and they're really comfortable in uni, studying their course. So, I think that helps... I think it helps a lot in the university aspects, different university aspects. For example, study skills or social life or revising, because it really enhances those skills.	S1LM: we were talking to him about the work-life balance and he, kind of, gave his advice on how to manage time and a social life. It made me feel better, because if he could do it, as a student, then I probably could do it, too. So, now I'm less scared about the balance and I think I could probably figure it out.

	S1BP: I have learned what kinds of activities you get to do at uni, it's not just all about studying your course. There are multiple clubs and societies that you can take part in, whether that be linked to your course or not... you get to speak to undergrads from the university and you get to ask them about what it's like to study at said university, any challenges they face with the degree, what they enjoy about it, etc.	
	S3DP: I'd say to help prepare us for university, so whatever the course we're applying to, and then also university life because of the mentor sessions.	
	S1DP: Work with my 0:10:22] mentor and things has shown me like the complexity of physics, but it has also shown me what I can do outside of physics, which has been really nice because at the moment, with school and everything, you just focus on your subject. You don't really go into depth about university life. It's just the getting there that they're trying to do, but my mentor has really helped me in the fact that she has set out and shown me all the different societies I could join, all the people I could go to, and how I could meet new people. So, that has been really nice.	
	S4BP: Being able to talk to other students about university life, without teachers breathing down your neck or the university faculty being there, was really helpful. In terms of being able to openly ask questions and for them to be able to openly answer to you, as well. .. finding out what university life is like, finding out tips and tricks, to help, when you do start university, or how to prepare for exams, that kind of practical knowledge, rather than the academic knowledge, is what I take away most from this programme.	
	S5BP: I got an insight on how university students balance their work and social life. That was one thing I was really confused about, because there's going to be a lot of workload during university, so how am I supposed to balance it. Yes, I got that insight.	

	S3BP: I would say that it had given me a head start into not only what it's like studying physics at university, but it gave me an overall aspect of university. It gave me that feel of what university life would be like, socially and subject-wise and just how it will flow.	
	S4OP: I think the thing that I have enjoyed the most was being able to speak to someone that is doing their PhD in physics and having the opportunity to share my ideas with that person and developing them in the mentoring sessions.	
	T2DP: I give them this whole spiel, being like, "I went to uni and did physics. I was 18. It was only 18% women at [non Levelling Up University]. I'd never used a computer before, and I was up against people who'd been programming since they were 13. I managed to get a 2:1, and I came from a comprehensive background. You can do it. I did it. You can do it."	

Appendix 7. Suggestions for improvements – Quote bank

The following section presents quotes from students, tutors and mentors collected in the end of programme survey, mid-point and end-point focus groups in relation to suggestions for how the Levelling Up programme could be improved in the future.

S = Student quote, T = Tutor quote, M = Mentor quote, 1-4 indicated the focus group number, D=Durham, B = Birmingham, L = Leicester, O = Oxford. Red text indicates quotes from the end-point focus groups.

Subject difficulty level/content

Start easier

Easier starter questions : Leicester - Maths, Student

Further Maths

Further maths students may have already finished and sat an exam for A-level maths, so it might be useful to have a separate level-up group that deals with the pure section of further math problems : Leicester - Maths, Student

Perhaps more topics from further maths or mechanics could be covered. But I'm also aware that this wouldn't be relevant to everyone taking part. : Durham - Maths, Student

T2DM: it almost feels as if we're missing a trick by not including any Further Maths. I don't know how everyone else feels, clearly not all the students applying to do Levelling Up actually take Further Maths. But I remember at A level thinking that Further Maths was the thing I was really interested in, and normal maths really fell to the background

More challenging content

Provide challenging assignments tailored to students' needs and reflect A level syllabi (rather than those provided by IOP). : Birmingham - Physics, Student

More challenging questions in both the home learning and tutorial sessions to allow students to constantly test their knowledge and problem solving skills. : Durham - Physics, Student

Maybe make the work more challenging and less of a recap of what we've done in school? : Durham - Chemistry, Student

I think that the content of the homework and work covered in the tutoring sessions was less challenging than work that we do in school, so more complex questions, and topics outside of the A-level specification would be interesting to learn about. : Oxford - Physics, Student

Split Maths and Physics tutorials

Do one [tutorial] for maths and one for physics : Birmingham - Physics, Student

Be clear on the alignment to A level content

helps with A level physics content from exam boards : Birmingham - Physics, Student

Even though some parts definitely did, I thought it might support the Physics A Level more directly than it did, but I found it was more focused on extra ideas and taking things a bit further than the A level, sometimes asssuming you had the prior knowledge when you maybe hadn't done that topic

yet. I think the aspect of going beyond the A level is a positive thing to continue, but maybe the fact it is more of a main part than material directly supporting the A level course could be made more explicit in the description of the programme before applying. : Durham - Physics, Student

Introduction to undergraduate content

Perhaps more of an introduction to undergraduate chemistry content in tutorials.: Durham - Chemistry, Student

S1LM: adding A level content, as well, in the beginning, just to smooth the transition into the harder, university-level stuff, would be better. You can link what you've learned to what they're teaching you, which would be good.

Differentiating content level

T3OP: I think we need to cobble together specific sessions geared towards those specific students. That will really help with retention as well. So, T1DM was just saying that this person got what they wanted, or they felt that it had now gone beyond their ability. So, it was difficult. I don't know if it's possible to do differentiation within a group of about four or five, so they're doing slightly different work. That's going to be difficult.

Frequency and timing of sessions

Increase frequency

More frequent tutorial sessions: maybe 2 to 3 per week. : Birmingham - Physics, Student

More frequent sessions : Birmingham - Physics, Student

Weekly tutorial sessions and mentoring sessions twice a month as tutorial sessions will help students improve at their subject. : Durham - Physics, Student

Everything was amazing! However, I would love more sessions possibly : Oxford - Physics, Student

Make more availability : Oxford - Physics, Student

…more frequent shorter sessions : Durham - Maths, Student

more tutorials : Durham - Chemistry, Student

Timing of the session

Suitable time: so everyone can participate (preferably on weekends). Do one for maths and one for physics. : Birmingham - Physics, Student

… make sure everyone is able to attend every session and stick to the same routine throughout the programme. : Birmingham - Physics, Student

Fewer sessions

I struggled to keep up the second year, so it could maybe be a shorter programme or have less frequent meetings if continued over 2 years. : Durham - Physics, Student

Schedule

T2OP: I think possibly we needed more structure. What I mean by that is, from the very beginning, these are your lessons for the year, with the dates.

M1DP: When you're applying for university, in first term it goes from October, when the applications start, to mid-December. Then next one was in January time, so it's like you've already applied now. We've not had much interaction in that chance of… I can't support them every step of the way, if you see what I mean, so maybe something where they just know that they can message you, because I would be happy to answer any questions in between those times.

S4LM: Sometimes the sessions were long so I lost concentration, and also my teacher was not ready at the given time, so we had to wait in the Teams call for a while

In person sessions

Have more in-person sessions. : Leicester - Maths, Student

Hopefully in the future it can be done onsite I think being face to face would be better. : Leicester - Maths, Student

Do much more in person stuff, let students contact each other outside group tutorials, more frequent shorter sessions, more guest lectures ! : Durham - Maths, Student

Face to face tutorial sessions : Durham - Maths, Student

On site visits would have been nice, I think they were not possible due to Covid. : Durham - Maths, Student

It being in person, where possible/for some sessions. Connection issues made the sessions quite hard to focus in, sometimes. : Oxford - Physics, Student

T1BP: I guess in an ideal world, I would like to hope or think that it doesn't really matter where the student is sat, in North East England, South West Cornwall. If they're going on this programme, they would get a very similar experience, because otherwise you could end up actually widening some of these gaps, as opposed to narrowing them.

Tutoring and Mentoring content

Mentoring

In the mentor sessions we covered roughly the same point about student finance for 3 weeks, which i don't think we needed to do as by the second week on it I understood it very well. : Durham - Chemistry, Student

Oxbridge specific sessions

Maybe it can be quite evened out in a sense that, those who didn't apply for Oxbridge get to do something whilst the ones who did apply for Oxbridge will do something relevant for them. : Oxford - Physics, Student

Timing of content

"T2DP: They were all doing – well, they were doing two different examining boards, so of them had done particle physics in AS Level. The other ones, OCR don't do particle physics until the second half of second year. Particle physics, it's like learning a new language. If you don't have the vocabulary, forget it, so it was really… One lad was flying because he was doing AQA. The other three didn't have a clue, because it's like me walking in and trying to speak in Portuguese. It's not going to happen. I

think what they said to me is they would prefer the tutorial, to go over the tutorial and go over the topics, and then have the homework based on that tutorial. They also would have liked me to mark their homework. "

Customisation of content

T3OP: I would say, let them customise it right at the beginning and say, "What elements are we going to include?" Then, we'll review this every X sessions. So, you can say, "Right, we've done a fair amount of super-curricular, exciting stuff. What do you want to do next? Right, you want to do lots of MAT questions for the next two sessions," or, "You want to do this or do that." I think they are self-motivated enough that they don't need to do preparation in advance, and second, they should have an active part in choosing from a menu what they

Voting for topics to cover in the following tutor session instead of having a set timetable : Durham - Chemistry, Student

Balance of tutoring to mentoring

I did not find the tutor sessions hugely useful however found the mentor sessions much more useful and enjoyed them more so perhaps an increased proportion of mentoring sessions : Oxford - Physics, Student

The program should be more mentor-based rather than tutor based, as the mentoring was infinitely more helpful, and the mentor sessions were incredibly interested when they had focused on real-world research and exciting physics opportunities. : Oxford - Physics, Student

M1OP: these people have a lot on their plates. So, I would say either the mentoring has to be presented as a smaller section of the course, and not on the same level as the tutoring. So, have tutoring as the main thing and the mentoring as a side thing for additional help of another sort.

T3DP: I don't know how they valued their mentoring time, but an alternative plan could be you did an hour of tutorial and then they went straight into half an hour with the mentor, but then there would be some overlap. You'd see each other and it would, kind of… There are so many solutions that can make it more joined up.

Recording of sessions and session notes

Record sessions and send out actual session notes to students so they can improve and work on some problems in their spare time : Leicester - Maths, Student

Perhaps have a (onedrive) folder with all homework, additional research, recorded sessions etc., so it is much easier to access educational materials. These can often be lost in Teams!! Please keep on recording the sessions though, this was really invaluable to me (and I'm sure others when life gets in the way of things). Thank you. : Durham - Physics, Student

I often struggled to rewatch the meetings : Durham - Chemistry, Student

Tutor (Chemistry - Durham): One thing I wouldn't particularly like [as a student] is having to go back and watch tutorials over and over again if I miss something or didn't understand it. I think one way it

could be improved is by designing [written] materials that can go hand in hand with the actual tutorial session, just to make it easier to not have to go over the recording again.

T2DP: Like even with some of the Isaac Physics questions, you only to get video prompts. Some of them still can't do it, so you do need the video solutions. So, I'd say, for the future programmes, if someone wants to do video solutions for all of the extensions, and then all the tutors can use those

More interaction in sessions

More contribution by students during the sessions : Leicester - Maths, Student

More frequent tutorial sessions: maybe 2 to 3 per week. Suitable time: so everyone can participate (preferably on weekends) Do one for maths and one for physics Provide challenging assignments tailored to students' needs and reflect A level syllabi (rather than those provided by IOP). Use whiteboard rather than PowerPoint Give students the opportunity to ask questions during/at the end of tutorials : Birmingham - Physics, Student

S4OP: I'm not sure if it would be useful for it to be weekly but in order to enforce the idea of teamwork and for the people in the programme to actually work together, it would be nice to have these kind of tasks, in which the people in that group would actually have to work together. Rather than all of them listening and responding to their older mentor.

S1DM: we all just sit very quietly, writing the answers on boards, and don't really talk to each other or the mentor. If you do try and talk to him, then, because everyone else is so silent, it puts you off a bit... it'd be nicer to talk about the questions in more detail, rather than just go, "That's the answer. Let's move on."

Technology

More frequent tutorial sessions: maybe 2 to 3 per week. Suitable time: so everyone can participate (preferably on weekends) Do one for maths and one for physics Provide challenging assignments tailored to students' needs and reflect A level syllabi (rather than those provided by IOP). Use whiteboard rather than PowerPoint Give students the opportunity to ask questions during/at the end of tutorials : Birmingham - Physics, Student

Sort out a efficient platform to use and make sure everyone is able to attend every session and stick to the same routine throughout the programme. : Birmingham - Physics, Student

Perhaps have a (onedrive) folder with all homework, additional research, recorded sessions etc., so it is much easier to access educational materials. These can often be lost in Teams!! Please keep on recording the sessions though, this was really invaluable to me (and I'm sure others when life gets in the way of things). Thank you. : Durham - Physics, Student

S6BP: Maybe use Whiteboard or pen and not PowerPoint.

S3BP: I would say that they should stick to one platform and one that works and that they can use throughout the session because I know that they had to change platforms and then, some lessons would be missed.

Clarity on university offers

Make it clear that completing the programme does not give you lower entrance grades for your offer. I don't have a lower grade option due to this : Durham - Physics, Student

Homework/prework

Do the home study after a session, so you can recap what you have been taught : Durham - Physics, Student

I think there could be some more questions on the pre-reading - perhaps some that are more difficult because sometimes there was quite a jump in the difficulty of the pre-reading questions and the session questions. : Durham - Maths, Student

S2DC: Perhaps after a tutoring session, they could leave a link to, I don't know, like a document with lots of practice questions and then the answers at the bottom, just something to, say, after a few days from learning a topic, to be able to go back to it and see how much you've actually learnt.

S4DC: I think, for the first half of the programme we were doing these diagnostic questions, so after the session we'd then get questions related to what we did in that topic, and the tutor would then mark it. I think since September that kind of stopped, but I thought that was actually quite useful

S4BP: The three-week cycle. The last week was self-learning, that basically did nothing for anyone, in my opinion, because I don't think anyone would really take away anything from it. No-one really actually learned much from it, unless you went and did the work yourself. Which was, on top of people's A Levels and university applications, I don't think people went and did that, used that time to do that.

S6BP: Like where we had physics. Sheets they used to send me, home learning. Some of the things were not relevant to A Level. So, maybe you can change that…

Closing session

I don't believe there was a closing session that incorporated all participants like the opening session did. This meant the end of the programme felt a bit sudden and or disjointed. This is of course not a major issue though, but it would have been nice in some ways to have a better end to what was quite a long programme. : Durham - Maths, Student

Consistency

I had to change my group from Year 12 to year 13, due to my tutor not having enough time anymore to carry on with the program. I would have preferred to not had to move groups because I felt I was able to participate more in my first group. : Durham - Chemistry, Student

Community

Social aspect with other students(e.g. getting student permission to create a group chat), to make the mentor/tutor sessions more comfortable to participate in. : Durham - Chemistry, Student

more tutorials ? a better system for students taking part to communicate with each other. : Durham - Chemistry, Student

S4DP: having a bit more communication with your tutor during the self-study week, because I know that we were given one week to do the content ready for the tutorial, but some questions, I got stuck on but then I couldn't really communicate with my tutor until the actual tutorial.

S1LM: You don't really know each other, so I think it would be good to build a relationship between the students, so maybe, like, an icebreaker thing so we could get to know each other... when we were doing the questions, we would help each other and build up on each other's knowledge, which was quite good

S1DM: We have a session every two, three weeks, and that's it. We don't have any work to take away or anything like that, and we don't get to talk to the other students. It feels like not really that much is happening. So, it would be nice if we had extra work to do that we were able to discuss with the other students, or even if we were just able to discuss schoolwork with them and what we're planning to do at university.

S2LM: To be honest, because we do maths, we can discuss our own education, like our own A-Levels, and find tips on how to revise and things like that... we weren't able to [do that]. That's why we need more communication and, like, a chat group.

S1DM: The biggest thing that needs worked on is definitely that we should be allowed to talk to each other.

Guest lectures

Continue to hold events like the guest lectures into year 13. Maybe make the work more challenging and less of a recap of what we've done in school? : Durham - Chemistry, Student

Do much more in person stuff, let students contact each other outside group tutorials, more frequent shorter sessions, more guest lectures ! : Durham - Maths, Student

Possibly more guest lectures form different fields. : Durham - Chemistry, Student

S1DM: Last year, we seemed to have quite a lot of guest lectures that I was really enjoying, like 'The Maths of Chocolate Fountains' and all of those. They were really interesting, but we haven't had one since, like, August last year. What happened to those, (Laughter) because they were probably the best part of the programme? They just seemed to stop, with no warning or explanation.

Attendance

S4BP: I think enforcing participation, to be able to make the most of your peers. Because it was really awkward, I guess, when there were only two of you or one of you, and a teacher. You don't really have too much to say or you didn't really know what to say. There wasn't that level of comfort. Whereas it's like, "Oh, there are other people here, there are other people," to be able to ask the same questions that I want. That kind of thing.

To cite this report:

Cramman, H., Gray, H., & Chavana, M.A. (2022). *Evaluation of the National Levelling Up Widening Participation Pilot Programme.* UK: Durham University. http://doi.org/10.15128/r18910jt623