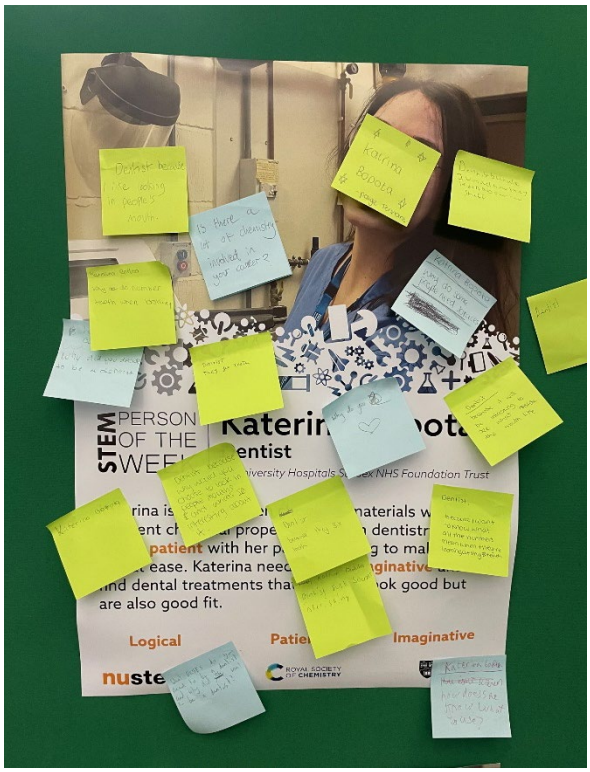
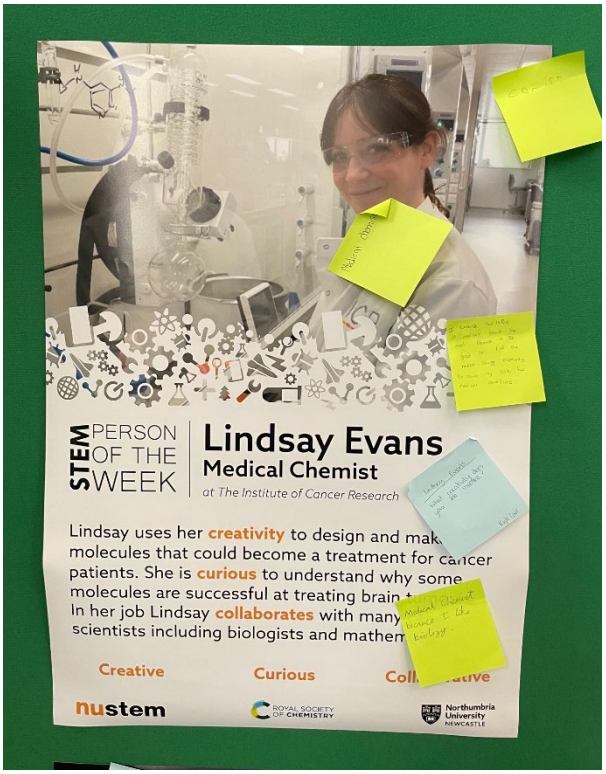
Careers Learning in Chemistry

Evaluation Report

March 2024





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Executive Summary

Intervention Introduction

Careers Learning in Chemistry (CLIC) was a schools engagement project funded by the Royal Society of Chemistry and developed by staff from NUSTEM and Department of Applied Sciences at Northumbria University. It took place between during January 2022 and December 2023. Students in Year 7 and 8 from two North East schools participated in chemistry-focused careers-linked activities as part of their school science lessons via assemblies, careers-resources, and a University visit.

Assessment of Intervention Activities

The CLIC project delivered all planned activities to the target audiences within the allocated timeframe. The evaluation found that nearly all project activities and resources were valuable. Teachers valued the Chemistry Person of the Week resource and intended to continue using it beyond the timeline of the CLIC project.

Evaluation Outcomes

The CLIC intervention was evaluated against 5 outcomes aligned to the Royal Society of Chemistry's Chemistry for All Theory of Change. The evaluation found the strong evidence for some outcomes but inconsistent or limited evidence for others.

Outcome 1: Increase students' awareness of chemistry careers	Some evidence suggesting an increase in students' knowledge of chemistry-related jobs.
Outcome 2: Increase students' knowledge of the pathways to these careers	Evidence of some improvements in students' knowledge, though not statistically significant. Students' feedback comments supported an increase in this outcome. One teacher said they would like to have seen pathways to careers addressed more fully in the programme.
Outcome 3: Support students' view of themselves as 'chemists'	Qualitative evidence shows the intervention supported some students to develop confidence, aspiration and relatability for chemistry-related careers. Teachers felt the attributes approach helped students learn about themselves.
Outcome 4: Career guidance more accurately reflects chemistry-related options	Evaluation found evidence of good take up of careers-resource and an appetite to embedding careers information in chemistry lessons among teachers.
Outcome 5: Improved intention and aspiration	The evaluation found some evidence to support an increase in intention and aspiration for chemistry careers. Quantitative evaluation found a statistically significant decrease in intention measures, and an increase for aspirations for STEM jobs at a broad level.

The project report also draws out the lessons learnt in terms of project targeting, implementation and evaluation.

Introduction to CLIC Project

Careers Learning in Chemistry (CLIC) was a schools engagement project with two schools in the North East of England. It was developed by staff from NUSTEM and the Department of Applied Sciences at Northumbria University and was funded by the Royal Society of Chemistry's Chemistry 4 All scheme. It took place between January 2022 and December 2023.

CLIC offered Year 7 and 8 students in the schools a sustained programme of chemistry-focused, careers-linked activities delivered as part of their school science lessons. The aims of the project were to:

1. increase students' awareness of chemistry careers
2. increase students' knowledge of the pathways to these careers
3. support students' view of themselves as 'chemists'.

In the first year of the CLIC project (Jan 2022 -July 2022) Year 7 students took part in 'Meet the Chemist' assemblies and 'Chemistry Person of the Week' activity. The same cohort of students continued to take part in activities in Year 8 (Chemistry Person of the Week; Chemistry worksheets) and Year 9 (Chemistry visit to Northumbria University). This group is referred to as Cohort 1.

In the second year of the project (Sept 2022 – July 2023) a second cohort of Year 7 students joined and took part in Year 1 activities. This group is referred to as Cohort 2.

A range of parental support materials around careers was made available to schools.

Overview of CLIC Activities

Northumbria University staff developed and coordinated CLIC project activities and liaised with external organisations, but the majority of activities were delivered by teachers (Chemistry Person of the Week, Worksheet) or people working in chemistry-related roles (Meet the Chemistry assemblies).

Reach and Scope

Overview

The intervention target was to work with 300-400 pupils each year.

Table 2: Intervention Numbers

Schools	FSM %	No. Engaged
School 1	35.6%	Approx. 355 students 5 science teachers
School 2	27.9%	Approx. 300 students 4 science teachers

Schools Engaged

The CLIC project worked with two secondary schools from within NUSTEM's existing network of partner schools.

- School 1 is a co-educational secondary school serving children 11-16 in an urban area of North Tyneside. The percentage of students eligible for free school meals is considerably higher than the national average.
- School 2 is a co-educational secondary school serving children 11-18 in Northumberland and is part of a large multi-academy trust. The percentage of students eligible for free school meals is slightly above the national average.

Students Engaged

The CLIC project worked with whole year groups in two cohorts: Cohort 1 took part when were in students Year 7 – 9, and Cohort 2 took part when they were in Year 7. In total approximately 650 students took part in the project. A pre-project survey asked students how much they agreed with statement, 'my parents/guardians think science is interesting', used as a simple proxy for students' science capital. 36% of students agreed said their parents think science is interesting.

The majority of activities took place during science lessons or as whole year group assemblies and were aimed at students of all science abilities and backgrounds. The schools each chose 40 students from Cohort 1 to attend the University Chemistry Days.

Teachers Engaged

The project worked primarily through a lead teacher in each school. This teacher coordinated project activities for delivery with students with other science teachers in the school.

Outputs and Deliverables

Activity	Cohort (year group)	School 1	School 2
Year 1 (Jan 2022-July 2022) activity			
Meet the Chemist Assembly 1: Graeme Turnbull	1 (7)	7 APR 22	14 MAR 22
Chemistry Person of the Week: Set 1	1 (7)	JUN - JUL 22	JUN - JUL 22
Year 2 (Sept 2022–July 2023) activity			
Worksheet	1 (8)	NOV - DEC 22	NOV - DEC 22
Meet the Chemist Assembly 2: Akzo Nobel staff	1 (8)	27 MAR 23	17 MAR 23
Meet the Chemist Assembly 1: Graeme Turnbull	2 (7)	28 NOV 22	5 DEC 22
Chemistry Person of the Week: Set 2	1 (8)	MAY – JUN 23	MAY – JUN 23
Chemistry Person of the Week: Set 1	2 (7)	MAR 23	MAR 23
Year 3 (Sept 2023-Dec 2023) activity			
Visit to University Chemistry Dept.	1 (9)	28 SEPT 2023	19 DEC 2023
Meet the Chemist Assembly 3: Aminah Shafiq	2 (8)	23 NOV 2023	*

*cancelled due to unforeseen circumstance

CLIC Activities

Meet the Chemist Assemblies

The Meet the Chemist assemblies used a model for assemblies developed by NUSTEM[1]. The NUSTEM Encounters model provides a structured process through which an external speaker engages in interactive discussions with students in a school. Schools were sent a short video two weeks in advance of the assembly, where the Chemist briefly introduces themselves and what

[1] https://nustem.uk/nustem-encounters/

they do. Students were encouraged by teachers in classes to pose questions they would like to have answered (see Fig.1 for examples). The answers to these questions are then incorporated into the assembly.

The assemblies were given by:

- Assembly 1: Dr Graeme Turnbull – Lecturer at Northumbria University
- Assembly 2: Jessica Vidales, Mark Cracknell, Sarah Harrison – chemists from Akzo Nobel
- Assembly 3: Aminah Shafiq – Analytical Chemist, Organon Pharmaceuticals

Fig. 1: Students questions for Assembly 1 given by Graeme Turnbull

Teacher Feedback

Teachers in both schools said that the encounters assembly model worked well, particularly when the resulting assembly incorporated interactive elements for the students. However, where the assembly was longer and included unexplained technical phrases, the students found it harder to remain focussed.

Reflection

The encounters assembly model of asking students to provide questions that set the outline of the presentation assembly, works well. However, there is also a need for further support for presenters who do not regularly engage with young people to ensure their presentations are appropriate for the age and attention span of the audiences.

Chemistry Person of the Week (CPOTW)

Chemistry Person of the Week (CPOTW) was developed from NUSTEM's popular and well used STEM Person of the Week[2] resource. CPOTW is a five-week teacher-led activity which uses postcards to introduce students to people who work in chemistry-related jobs and their personal characteristics. Each set includes five people who use chemistry in their work, alongside their job title, the company they work for and a short description of their job (Fig. 2). Teachers introduce one person each week. During the lesson students use the back of the postcard to describe situations where they had used the same characteristics as the Chemistry Person of the Week. This resource helps students understand they share characteristics with chemistry professionals and to develop their own chemistry-identity.

Chemistry Person of the Week: Set 1

Chemistry Person of the Week: Set 2

Fig. 2: Chemistry Person of the Week Sets 1 and 2

Teacher Feedback

Both lead teachers reported value in the CPOTW resource. They reported that it was easy to embed into their lessons at a time that suited them and helped to embed careers resources into the curriculum that was being asked from them by their schools.

"It's well pitched ... I think bang on what they need to be and quite straightforward. They explain what the keywords are. And then the bits on the back where they've got to fill in and they've [students] got better and better over the past two years, they have got at my class." School 1, Year 1

[2] https://nustem.uk/stem-person-of-the-week

Teachers used the CPOTW in different ways: as a lesson starter, or later in the lesson after content recall questions. However, one teacher said they would appreciate further guidance on how the CPOTW could be tied more closely into curriculum content. One teacher reported on the added benefit of using the same role model from the Encounters assembly in the CPOTW set 1 and found that this really helped bring them alive for pupils.

Reflection

The resource worked well in both schools, with both schools saying they planned to use it beyond the end of the CLIC project.

Chemistry Worksheet

The chemistry worksheet introduced the career of an astrochemist, bringing a real-life role-model and description of what astrochemists do (Fig. 3). The worksheet was chosen because it had already been developed by Royal Society of Chemistry[3] and introduced students to the topic of meteorites and asked them to explore some chemistry-related questions about meteorites. NUSTEM staff created a front-sheet which gave teachers more information about the job of astrochemist and meteorites. Schools were also given meteorites to show students during lessons.

Fig. 3 Astrochemistry front-sheet

Teacher Feedback

The schedule of the CLIC project meant that the worksheet did not always align directly with the planning of the school, or how the topic was being taught. However, one teacher said they valued being able to show the meteorite to the students during a space topic. A second challenge raised with the worksheet was that it was not differentiated to allow students of all abilities to access the chemistry content.

Reflections

Further consideration is needed to understand how teachers use might worksheets and what they would find valuable for them. The project team did liaise with the lead teachers around the chemistry curriculum content and timing of the worksheets, but future work could provide a range of worksheets that were more closely tied to different sections of the curriculum to allow closer alignment with teaching order. Differentiation of questions for different students could also be included.

[33] https://edu.rsc.org/resources/the-chemistry-of-a-meteorite-11-14-years/4014175.article

Chemistry Visit Northumbria University

A visit to Northumbria University was offered to 40 Cohort 1 students from each school. Teachers selected students with an interest in science and/or chemistry. The days visit combined talks, interactive lab activities, campus tours and the opportunity to meet chemistry students. This provided the opportunity for students to see pathways for chemistry beyond school.

Student Feedback

Students reported finding the University 'welcoming' and 'friendly' and 'big'. Most students described their visit positively: 'interesting', 'fun', 'exciting' and 'entertaining', 'cool' and 'good', some described in academic terms 'educational' and 'intellectual', however some described the visit as 'boring'.

Students said they learnt about the topics covered in the workshops 'hydrogel is very absorbent' and 'UV light gives skin cancer', but also more about what a university is and does.

Reflection

The University visit was found to meet the ambitions set out in the design stage, in broadening students' experiences of university, particularly around the study of Chemistry.

Parent activities

Originally NUSTEM planned to send out Royal Society of Chemistry careers booklets 'Chemistry After School' to all parents in schools but because of sustainability considerations, we received a smaller number of copies of the resources from RSC that could be made available to students and their parents by the school. The use of parent resources was not evaluated.

Evaluation Overview

The evaluation used a pre- and post-intervention survey that incorporated Likert scale items from the Royal Society of Chemistry's Chemistry 4 All evaluation framework, alongside other items targeted more specifically to the CLIC intervention.

Phase 1 (Jan 2022 -July 2022)

Whilst waiting for ethical approval of the project's evaluation plan from Northumbria University Research Ethics Committee the project team carried out a pilot of the evaluation instruments. As a result of this pilot, the survey length was reduced, and the language was simplified.

Interviews with lead teachers in the two participating schools were conducted to reflect on the first year of the project and how it could be improved. Data from these interviews is included in this report.

Phase 2 (Sept 2022 – July 2023)

Cohort 2 pupils (Year 7) students completed a survey before and after they took part in the Chemist Person of the Week (CPOTW) activity.

The pre-intervention survey (T1) asked students to rate their agreement with a number of statements (aligned to chemistry identity, self-confidence, utility value, intentions & aspirations, and shared characteristics) and their affinity with 5 chemistry-related attributes (communicator, curious, logical, open-minded and observant). The post-intervention survey (T2) asked students to rate these measures again, as well as asking further questions about the CLIC activities themselves.

Given that Cohort 1 pupils had already taken part in project activities in Phase 1 of the project and therefore baseline data could not be collected, a pre- and post-intervention design was not appropriate as a measure of changes related to the project for those students. As a result, only the questions in the post-intervention survey and the University visit feedback are included for Cohort 1, to provide student voice on the activities. Quantitative data in this report is for Cohort 2 only unless stated otherwise.

Table 1: Survey Responses

	Pre survey (T1)	Post survey (T2)
Cohort 1	-	104
Cohort 2	297	290

Both lead teachers were invited to take part in an interview at the end of Year 2. An interview was conducted with the lead teacher in school 1, however the teacher from school 2 was absent during this time.

Phase 3 (Sept 2023)

40 students from Cohort 1 attended a chemistry day visit to Northumbria University and as part of this students completed post-it notes aligned to the CPOTW posters. Students were asked:

- What would you want to know more about these jobs. Pick a "person". What question would you ask them?
- Which one of the 10 jobs interests you the most? Why?

Following their visit students were given a short survey to complete about their visit, and final reflections on the project to be completed in school and returned.

OUTCOME 1: Increase in students' awareness of chemistry careers

Mechanism for Change	Different aspects of the CLIC Project presented examples of real people working in a variety of chemistry-related careers, including CPOTW.
Evaluation Instrument	This outcome was evaluated via the student surveys, and teacher interviews.
Evaluation Evidence	Some evidence suggesting an increase in students' knowledge of chemistry-related jobs.

Student Survey Data: Knowledge of chemistry and chemistry careers
Three survey items made up the knowledge of chemistry careers scale ('I know what chemistry is', 'I know what chemists do in their work' and 'I think chemists have interesting jobs.). Analysis found no significant difference in scale means between T1 and T2 (Table 2).

Table 2: Median values of knowledge of chemistry careers among cohorts

	T1 median	T2 median	P Value
Cohort 2	3	3	.460

Looking at individual items (Table 3) an increase was found for students' knowledge of what chemistry is, but a decrease in students thinking that chemists have interesting jobs.

Table 3: Knowledge of Chemistry-related jobs items T1 and T2

Survey Items	Cohort	T1 % agreement	T2 % agreement	Difference	P value (X)
I know what chemistry is	Cohort 2	39	44%	+5%	-
I know what chemists do in their work	Cohort 2	26	35%	***+10%***	.021
I think chemists have interesting jobs	Cohort 2	49%	39%	-10%	.018

The post-intervention survey also asked students to what extent they agreed with the statement 'Chemistry Person of the Week has given me a greater understanding of what chemists do'. Overall, 36% of students agreed with this statement.

Student Survey Data: Knowledge of chemistry-related jobs
Students were asked to 'write as many jobs as you can think of that might use chemistry'. Students could name on average 2 jobs related to chemistry in both the pre and post surveys. However, there was a decrease in the percentage of students who were unable to name any chemistry job after the intervention by 7% from pre to post survey.

Table 4: Median number of chemistry jobs named and percentage of pupils who could not name any chemistry job T1 and T2

	T1 median	% no jobs named	T2 median	% no jobs named
Cohort 2	2	23	2	16

Fig. 3 Word frequency for jobs that use Chemistry (Post Survey)

A word frequency analysis and cloud (Figure 3) was created showing of students' open responses naming different jobs that use chemistry in the post surveys. This indicated that post intervention Chemistry Person of the Week job names were included within the list. We can see 'dentist' 'analytical chemist' 'development' and 'technician' in reference to the Set 2 CPOTW.

Teacher Feedback

The lead teacher in one school expressed concern as to whether the evaluation surveys used would capture changes in the learning of the students, but the teacher did feel that there would be an improvement in students awareness of chemistry careers, *"if you ask them, do they now understand, you know, a few careers that are need a few attributes that are needed for this and have they identified ways that they, you know, can you be creative, can you do this? Can you do that? They might say yes they can now."*

OUTCOME 2: Increase students' knowledge of the pathways to these careers

Mechanism for Change	CPOTW includes information about different chemistry careers. Teachers can use the cards to talk with pupils about what education or training pathway might lead to that job. The Meet the Chemist assemblies asked presenters to talk about the routes they took in their careers. The chemistry visit (for Cohort 1 pupils) to Northumbria University aimed to broaden knowledge of what chemistry at University might look like.
Evaluation Instrument	This outcome was measured via the student survey, University visit day feedback (Cohort 1) and interviews with teachers.
Evaluation Evidence	Evidence of some improvements in students' knowledge, though not statistically significant. Students feedback comments supported an increase in this outcome. One teacher said they would like to have seen pathways to careers addressed more fully in the programme.

Survey Data: Knowledge and Perceptions of Pathways
There were two survey items linked to students' knowledge and perceptions of pathways to chemistry careers. After the intervention more students reported that they had enough information about chemistry careers, and that studying chemistry would help them get a good job.

Table 5: Knowledge and Perceptions of Chemistry Pathways

	T1 % agreement	T2 % agreement	Difference
I have enough information to decide whether a career in chemistry could be for me	17%	22%	+5%
Studying chemistry would help me get a good job	52%	56%	+4%

Student Feedback: Chemistry Visit

In the post University visit survey, 'What did you learn from your visit to Northumbria University?' Cohort 1 students identified learning about pathways to university,

"*that you need to focus in school to get accepted into universities. That you make new mates*", "*that you can go do Uni with basic qualifications*" and "*research takes place, you can do foundation years*".

The visit also supported students to find out more about university and what it might be like to attend, "*that I can learn all kinds of subjects at the University*" and "*how a university campus feels and works*" and "*University isn't that bad*".

Teacher interviews:
In interviews with teachers, one school said that they would have liked to see more in terms of pathways, *"A link I admit that I would like to see is the qualifications that brought the people to their job."* School 2, Year 1

OUTCOME 3: Support students' view of themselves as 'chemists'

Mechanism for Change	CPOTW uses an attributes approach to highlight the personal characteristics that students share with people who work in chemistry-related jobs. The intervention first taught students to understand the vocabulary of attributes, then explore how they used the attributes in their own lives. The back of the postcard asks students to reflect on when they have used these attributes in their own lives, drawing connections to the role-model.
Evaluation Instrument	This outcome was measured via the student survey, University visit day feedback and interviews with teachers.
Evaluation Evidence	Qualitative evidence shows the intervention supported some students to develop confidence, aspiration and relatability for chemistry-related careers. Teachers felt an attributes approach helped students learn about themselves.

Survey data: Attributes

The five attributes were grouped into an attributes scale. Analysis found changes did not show an increase in students rating the attributes as 'most like themselves'. We found no difference in the median score for T1 and T2 (Table 6).

Table 6: Median number of attributes rated as 'most like me' T1 and T2

	T1 median	T2 median	P Value
Cohort 2	3	3	.051

Analysis of the individual attributes shows that there were increases and decreases in level of agreement (Table 7).

Table 7: Percentage of students agreeing that each attribute was 'most like me'

	% agreement		Diff	X
	T1	T2		
Communicator	44	38	-6	-
Curious	62	52	-10	.011
Logical	42	43	+1	-
Observant	42	42	-	-
Open-minded	73	66	-7	.047

There was a significant drop in Cohort 2 boys describing themselves as 'curious' (T1=66%, T2=54%, p=.041). No statistically significant changes were observed among girls.

Survey data: People like me

The post-intervention survey asked students to rate their agreement with the statement '*Chemistry Person of the Week showed me people like me who were working in chemistry*'. Analysis revealed that 29% of students thought CPOTW had showed them people who were like them.

In the post-intervention survey students were asked, '*What difference does it make to know there are people like you who study chemistry or work in jobs that are to do with chemistry?*'. 66% of students answered this question, but of those that did there were approximately equal numbers of those who said that it wouldn't make a difference (47%) and those who said it would (46%).

Those that said it would make a difference emphasised the difference in terms of wanting to continue with chemistry, confidence in chemistry, reliability with professionals and knowledge about available careers (Table 8).

Table 8: How using a 'people like me' approach makes a difference to students

Categories	% mentioned out of all comments	Indicative quotes
Confidence in chemistry and chemistry jobs	16%	"It could make you more confident because you know you could have the potential." "Good because if I decided I would like a job in chemistry I know I could do it" "It makes me more confident in doing chemistry." "It makes me think I can do it as well" "Showing that we could do it too"
Continue with chemistry	15%	"Knowing they are similar to me makes me more likely to become a chemist" "It makes me know that I could study chemistry if I wanted to" "It makes me want to do it a bit more" "I can think more if I would like to take a chemistry related career as an option. It is unlikely though."
Relatability	9%	"That they have the same traits as you" "That anyone can learn chemistry and get a job to do with chemistry" "You can relate to them"
Knowledge of available jobs	6%	"I have an understanding of what they do and if I want to continue studying it." "It can tell you some jobs you can do"

Survey data: Self-confidence in chemistry

Two items in the surveys considered self-confidence in chemistry: *'I am good at chemistry'* and '*If I wanted to, I could become a chemist*'. Analysis of pre- and post-intervention data showed no significant changes in these items.

University visit feedback from students

At the visit day at Northumbria University Cohort 1 students were asked 'what questions would you ask these Chemists Of The Week. Students' responses showed they were thinking of the people in terms of their personalities and attributes, "*Why did you choose that job and how do you have courage to speak to people*?", "*How successful are you with experiments*?"

Following the visit to the University, students were asked to rate their agreement with the statement 'I could be a chemist if I wanted to'. 40% of students agreed with the statement, while 48% gave neutral responses.

Teacher Interviews

When asked what students were learning from the CLIC project during the Year 1 interviews, teachers reported that the project was helping students to learn more about themselves and their skills, which was important for students to appreciate their own strengths and potential.

> *"[Students] have learnt some new terminology and what those skills mean. They have probably also learnt some things about themselves, that I can do this and I can do that."* School 1, Year 1

> *"They wouldn't have automatically related stuff they can do with stuff that professional chemists can do. There is a big relation to the real world there. It also makes it achievable as every one of those skills is something that someone can or has achieved already."* School 1, Year 1

> *"So, I think they're maybe more confidence (sic) in themselves because they were able to identify areas from their lives when maybe at the start they weren't so actually. Think a bit more resilience as well because like I did, force them to really think about something and actually go into it and you know, some of them who said they couldn't think of anything at the start would now be filling in all three boxes".* School 1, Year 2

Teachers saw the benefits of the attributes approach, "*every single one of those skills was something that everyone can achieve or has achieved at some point in their life so everyone could fill out.*" School 2, Year 2.

However, teachers also recognised there were still challenges to overcome with changing identities, particularly with girls, **"***There's still some barriers with girls 'cause they're still saying science is hard",* School 2, Year 1.

Reflection:
In terms of implementation, interviews with the science teacher revealed that the CPOTW resource had been implemented differently compared to previous iterations of STEM Person of the Week. The teacher was not using the attributes during the lessons to praise students as they displayed these attributes in subject learning. It may be that this is not appropriate for a secondary environment. Reflecting on the finding that post intervention 29% of all pupils said that the chemists were like them, the students who did not think the chemists were like them may have seen CPOTW role-models as different from them for many reasons, for example that the people included in the cards are older and have jobs, whereas the students are younger and are still in school.

The age of students in the evaluation was 11 – 12 years old and they were therefore still developing an understanding of secondary school science. The way that science is taught in the first three years of secondary school (as 'science', rather than separate subjects), can make it difficult for students to differentiate between the different disciplines of science. Therefore, students in this intervention were still developing their science identities, of which a chemistry identity is a part. As students have been asked to name their use of attributes over five weeks, they are used to thinking in terms of attributes in their own lives. We don't have evidence yet but we surmise that over time, this attributes approach can support students to understand the attributes they share with people who do chemistry-related jobs.

OUTCOME 4: Career guidance more accurately reflects chemistry-related options

Mechanism for Change	The CLIC project brought people and the stories of their work in chemistry-related roles and embedded this into secondary classrooms. Teachers in participating schools were given the resources needed to link chemistry-related careers within to the curriculum.
Evaluation Instrument	This outcome was measured through interviews with teachers.
Evaluation Evidence	Evaluation found evidence of good take up of careers-resource and an appetite to embedding careers information in chemistry lessons among teachers. Evaluation methods did not allow for triangulation.

Teacher interviews:

Interviews with teachers during Year 1 indicated that the CLIC project was well aligned with the ambitions that schools had for careers,

"*I guess it's a real discussion in school at the moment. You know about letting our students know what the employment opportunities in the region and there are there a lot of industrial, especially industrial chemistry employment opportunities in the industry. So just kind of, it's not just my job to cover their curriculum to kind of come to that. End goal of exams, but it is also my job to kind of inform them about the employment opportunities and I know that's becoming more and more important.*" School 2, Year 1

However, the teacher within the other school indicated that the project was the first time that they had included careers learning into the curriculum with this age group (11-12) and that careers information is normally delivered to older students.

One lead teacher thought it would be better for the CPOTW to draw out closer links to the curriculum and identify appropriate occasions were these could be used, "*so maybe if you could give us advice next time of how to get that linked in with the curriculum*". However, the lead teacher in the other school said that because it was science taught to this age group rather than biology, chemistry, and physics, it was better for the resource to be more general so it could be used across the subjects.

One school said that work on the CLIC project was part of the school practice that was reviewed and commended by OFSTED in their recent review. The students' books were reviewed and their CPOTW postcards were stuck in, "*We had OFSTED in the other week and that was something that that did get mentioned that there is career stuff in the books because those, The CPOTW cards have been stuck in the books, so there is that you know that evidence of careers linked [learning*]"

Teachers said that they would be continuing to use the Chemistry Person of the Week resources in 2023/2024, and they would also be using other STEM Person of the Week resources from the NUSTEM website.

Reflection:
This intervention produced resources that allow the delivery of this project in the school following the completion of the funded project. Therefore, the project has built an appetite for embedding careers information in chemistry lessons, by showing how easy it can be.

OUTCOME 5: Intention and Aspirations

Mechanism for Change	One of the longer-term outcomes from the CLIC project to increase aspiration for further study in chemistry and career aspirations to chemistry or STEM related careers. The mechanism for this was by building understanding of the careers, and by highlighting the relatability of people who work in chemistry.
Evaluation Instrument	This outcome was measured through the student survey and student University visit feedback.
Evaluation Evidence	The qualitative evaluation found some evidence to support an increase in intention and aspiration for chemistry careers. However, quantitative evaluation found a statistically significant increase for aspirations for STEM jobs at a broad level but a decrease in intention measures.

Student survey data: Aspirations

Students' aspirations reported in the pre, and post surveys were cleaned and coded and matched to the Standard Occupational Classification (SOC) 2020 for the UK[4], which allocated each aspiration a SOC code. The codes were then matched to a WISE definition of STEM jobs (which includes physical and natural sciences, medical sciences and STEM-skilled trades[5]), and a broader definition of STEM jobs (including finance, mathematics, IT and data science, and veterinarians). In the absence of a standard definition of chemistry-related jobs we also mapped the responses against 4 other SOC codes (chemical scientists, 2111; Biochemists and biomedical scientists, 2112; Chemical and related process operatives, 8113; Laboratory technicians, 3111; Science, engineering and production technicians, 3119).

Table 9 shows that there was little difference in the % of Cohort 2 students reporting aspirations for chemistry-related careers in the pre and post surveys. None of these differences were significant.

Table 9: STEM Aspirations T1 and T2

	T1	T2	Diff
STEM Jobs	22.4%	19.7%	-2.7
Broad -STEM Jobs	30.7%	37.1%	+6.4
Chemistry-related Jobs	2.9%	2.1%	-0.8

Student survey data: Intentions

Analysis of the survey data finds a significant drop in agreement with these statements from pre to post intervention. The intervention did not achieve this outcome at a cohort level.

Table 16: Intention items T1 and T2 for cohort 2 students

	T1 % agreement	T2 % agreement	Difference	P value (X)
I am interested to find out more about chemistry	66	46	-20	.001
I would like to continue learning chemistry at school	49	40	-9	.020

[4] ONS Standard Occupational Classifications 2020

[5] WISE 2022 Workforce Statistics, https://www.wisecampaign.org.uk/updated-workforce-statistics-august-2022/

University visit feedback from students

Although the cohort 2 data did not indicate an increase in intention to study chemistry, quantitative data from the University visit did indicate an increase at an individual level. Cohort 1 students with non-chemistry aspirations could see how knowledge of chemistry might be useful within their chosen career path. Students said they could see the value of chemistry for, "*when I study dentistry in the future*", "*to be a midwife*" and *"hairdressing (my career)"*

Lessons Learnt

Age of students

This intervention targeted students in the early stages of their secondary schooling at a time, when they were beginning to build knowledge and understanding of what chemistry is as a subject. Even in Year 7 and 8, because of the way science is timetabled and taught, it can be difficult for students to differentiate between the different science disciplines. Therefore, students in this intervention were developing their science identities of which a chemistry identity becomes a part. We surmise that the aims of building chemistry identity and aspiration, were probably too ambitious for the age group, and point of schooling.

This point was also raised by one of the teachers interviewed,

> *"I would be surprised if there is actually any more aspirations in chemistry or things like that, but if you ask them, do they now understand, you know, a few careers that are need a few attributes that are needed for this and have they identified ways that they, you know, can you be creative, can you do this? Can you do that? They might say yes, they can now. And actually those are related to the careers."*

Continuity

Continuity of role-models across the various activities was an unintended part of the project and was welcomed by teachers in both schools. The teachers agreed that using the same role-model across two different engagement activities had positive impacts in terms of engagement:

> *"When we did STEM Person of the Week In the lesson, they remembered him and were all lots more enthusiastic about that card than the other ones. It was really reassuring that they remembered him well after a few months." School 2, Year 1*

> *"Because they'd seen that guy before and suddenly he was on one of the resources they were using, so they, you know, it's clearly memorable for them." School 1, Year 1*

Working with Secondary School Timelines

Working with secondary schools can be challenging because they have a great deal of pressure in their timetables and find it difficult to take students away from curriculum. To accommodate this, the intervention used shorter activities of around 15 minutes instead of 50 min workshops. Teachers could embed the CPOTW activities into their lessons at a time which suited them. The assemblies were generally short. This project highlighted the importance of keeping in regular contact with schools. Some teachers would be working on the project under their own steam but not reporting back, others needed regular prompts. Teachers reported that they would welcome project activity in tight blocks, indicating that it built continuity and engagement.

Delivery vs Coordination

NUSTEM's role in this project was in development and coordination rather than delivery, with teachers in schools and people working in chemistry roles doing the delivery. This was a move away from NUSTEM's usual delivery methods. For the most part this worked well with lead teachers taking ownership of the intervention and buying into the ethos of the project. However, teachers sometimes struggled to gain buy in and mobilise other teachers within their school. We had sent an introductory PowerPoint about the project to schools, but the teacher in one school

said it would have been better to have a face-to-face session from NUSTEM in school for all teachers delivering the CPOTW to gain buy-in. The teacher also said it would have been nice to have a similar introduction session for students, so that they knew they were part of the project, and knew they were doing it when they were doing it.

Evaluation

Teachers said that some students struggled to complete the evaluation surveys. The teacher in one school found them to be too targeted at measuring a change in knowledge of careers and thought they were unlikely to capture the change that he had seen among students. A qualitative evaluation to uncover unplanned outcomes and incorporate pupil voice was thought to be more beneficial.

"I'm not sure whether this is actually going to be, will be beneficial in helping you understand whether the projects working or not because I don't. A lot of their opinions will change or it changes day by day, and I think you know one day they go. Do I enjoy science? Well, I've enjoyed it today, but I'm enjoying filling out a survey. Probably not, so they'll just put, you know, and I don't think, do I?"

This type of qualitative evaluations suggested would work best in an intervention that was introduced to students at the beginning, so they knew they were taking part in an external project.