nustem

6 Year Impact Report

2014-2020

Northumbria University
NEWCASTLE

Foreword

The vision of NUSTEM at Northumbria University is for a vibrant and sustainable STEM sector which meets the needs of learners and employers, reflecting the diversity of wider society.

Established in 2014, NUSTEM represents a radical rethink of university outreach. Built on robust research and shaped by a comprehensive Theory of Change, the group provides sustained, collaborative, inclusive and career-informed interventions with children and young people from early years onwards, and with their key influencers - their families and teachers. We empower young people and their supporters to make informed choices about their individual futures.

Diversity is at the heart of what we do. The NUSTEM members have a range of different backgrounds, including people from both a STEM and non-STEM background. This brings different viewpoints to our work, and ensures that we are able to consider those who are either inactive or not interested in science[1]. Our school partnerships are another contribution to the diversity of the project. The Primary Science Coordinators Forum meets on a half-termly basis and have either set the direction, or co-created a number of the teacher facing resources that have been developed.

The original three-year project was a partnership between ten organisations: Northumbria University, Institute of Physics, Life Science Centre, Durham Local Education Authority, Gateshead Local Education Authority, North Tyneside Learning Trust, Newcastle City Council, North Tyneside Council, Solar Capture Technologies, Kielder Observatory. Over the past six years NUSTEM has worked with many other organisations including subject and sector organisations, cultural venues and industries, with NUSTEM hosting the STEM Engagement Network bringing together organisations interested in school-based STEM engagement in the North East. The different viewpoints and practices help both NUSTEM and the other organisations to strengthen STEM engagement in the region.

In this report we have brought together details of the impact that NUSTEM has made regionally, nationally and internationally over the past six years.

Carol Davenport
Director, NUSTEM

[1] This categorisation is based on the audience model used by the British Science Association. https://www.britishscienceassociation.org/our-audience-model

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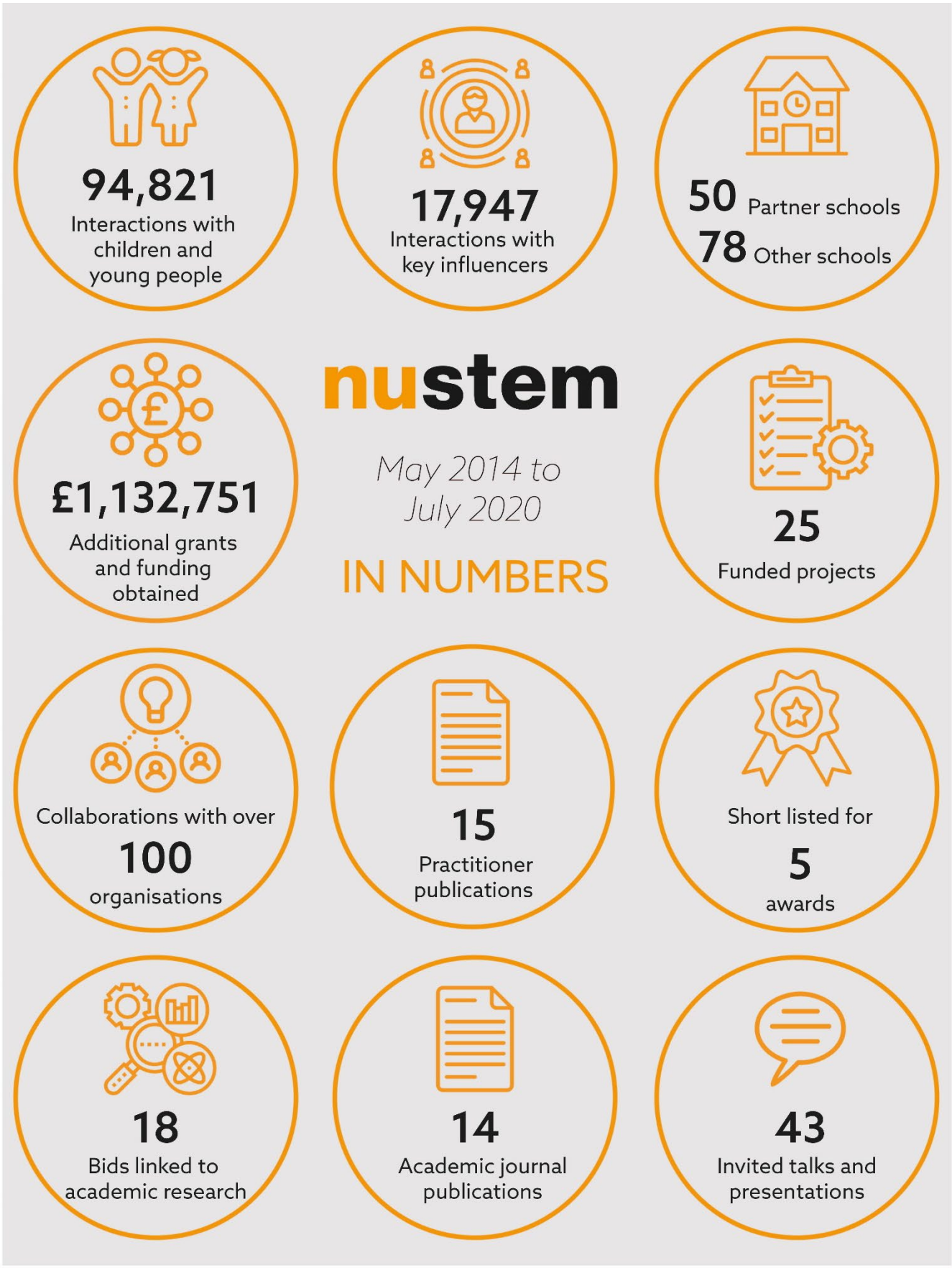

94,821
Interactions with children and young people
17,947
Interactions with key influencers
50 Partner schools
78 Other schools
nustem
May 2014 to July 2020
IN NUMBERS
£1,132,751
Additional grants and funding obtained
25
Funded projects
Collaborations with over
100
organisations
15
Practitioner publications
Short listed for
5
awards
18
Bids linked to academic research
14
Academic journal publications
43
Invited talks and presentations

The NUSTEM Vision and Theory of Change

Do young people like science?

Generally, yes.

Do young people think they'll use science in their future careers?

Generally, no.

NUSTEM works to change that.

There is a big discrepancy between liking science and wanting a career which involves science. There have been many attempts to 'fix' this. Much government and industry funding over the past 40 years has been spent to encourage young people to choose a career in science, technology, engineering or maths (STEM), and particularly to increase diversity in the type of people who choose STEM careers. But on the whole, science and engineering are still done by white, middle-class males.

Some STEM subjects, at least up to undergraduate level, do buck the trend: biology, chemistry, medicine, veterinary medicine and dentistry all have 40% or more females taking the subject at university. However, the percentage of the undergraduate population who are female or from a lower socio-economic background in physics, computing and engineering hasn't changed very much in the past 30 years.

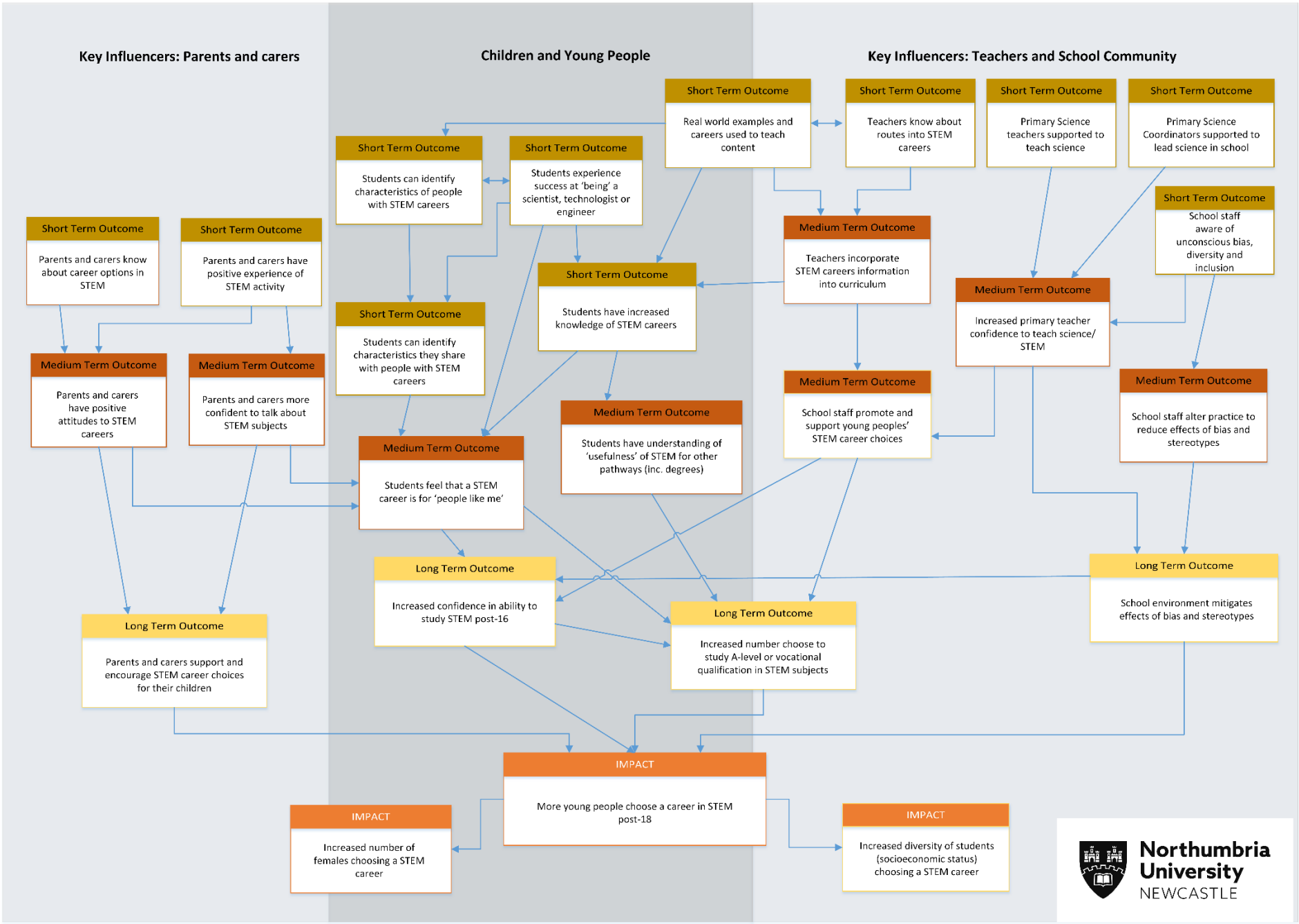
NUSTEM has a vision and Theory of Change for how to address this challenge. We have close and sustained partnerships with primary and secondary schools in the North East of England who help us put our Theory of Change into practice, and test and evaluate how it works.

NUSTEM's vision is for a vibrant and sustainable STEM sector which meets the needs of learners and employers, reflecting the diversity of wider society.

Our Theory of Change provides the theoretical underpinnings and context for the complex mix of interventions necessary to lead to a significant change in the number and diversity of those choosing STEM careers. Key causal pathways from the Theory of Change will be identified throughout this report.

Find out more

+ A Theory of Change for Improving Children's Perceptions, Aspirations and Uptake of STEM Careers, Davenport, C., Dele-Ajayi, O., Emembolu, I., et al. (2020). *Research in Science Education*, 1-15. https://doi.org/10.1007/s11165-019-09909-6



Northumbria University NEWCASTLE

What is NUSTEM doing to address widening participation and diversity in STEM?

In the past six years, NUSTEM has built close working relationships with 34 partner primary and 16 secondary schools in the North of England. The majority of our partner schools have a percentage of pupils receiving free school meals which is higher than the national average. We offer partner schools a tailored menu of workshops, whole school projects, family workshops, and teacher CPD and networking opportunities.

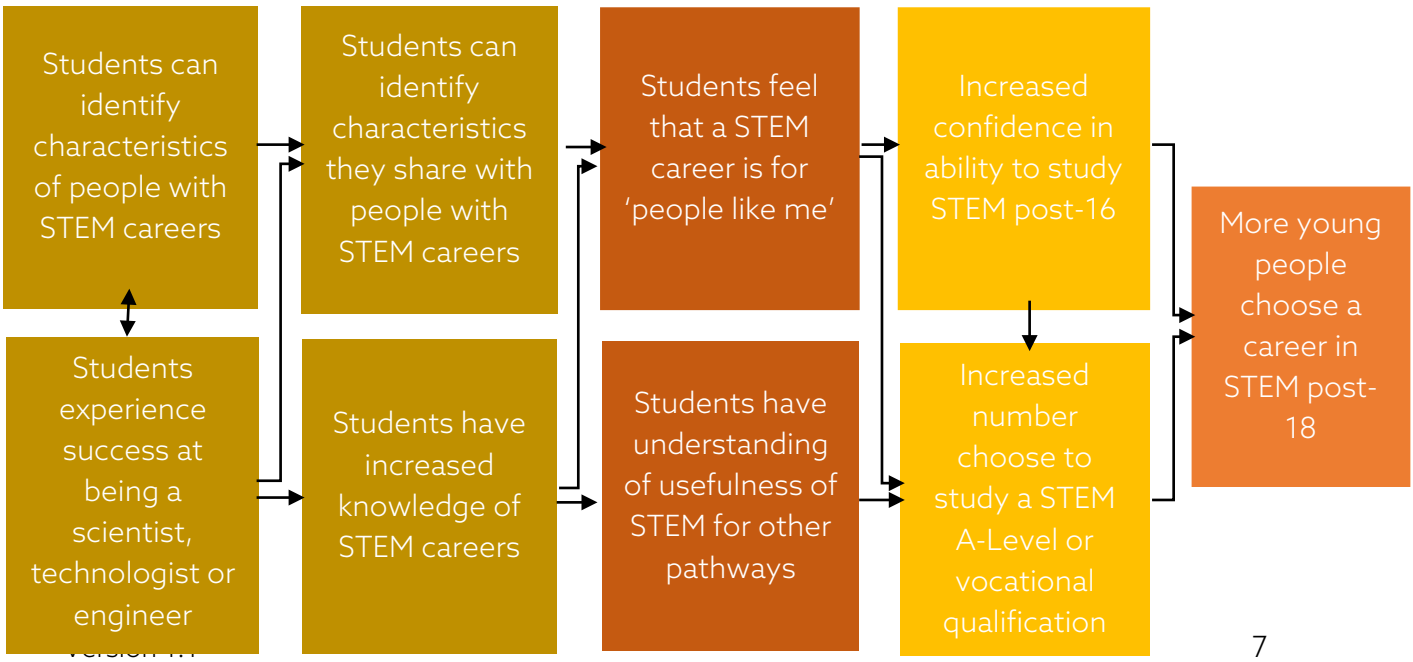
We believe that by supporting children, families and teachers to identify how their personal characteristics align with the characteristics of people that work in STEM, children (and their influencers) will feel more confident that a career in STEM is for 'people like them'. Alongside this, NUSTEM shows the breadth and application of STEM in the world around us. Together these should lead to an increase in the number and diversity of young people choosing a career in STEM once they leave compulsory education.

We know that the earlier intervention starts, the better. That's why NUSTEM works with children from pre-school right through to post-16 education, and with their key influencers throughout these education stages.

Working with children & young people

Our engagement model is one of regular interactions with children and young people over a period of years, to provide a 'drip-feed' of our ethos and ideas. These interactions might be with NUSTEM directly – through workshops and events – or indirectly, via their teachers, or through NUSTEM materials. Where we ask schools to nominate a smaller number of students to take part in activities, we request equal numbers of girls and boys. Some of our activities in secondary school, have been aimed specifically at girls.

Our activities and resources are designed to help children and young people recognise the pathways that can follow from studying science. Our Theory of Change shows the changes we believe are necessary to improve children's confidence with, and future participation in, STEM.



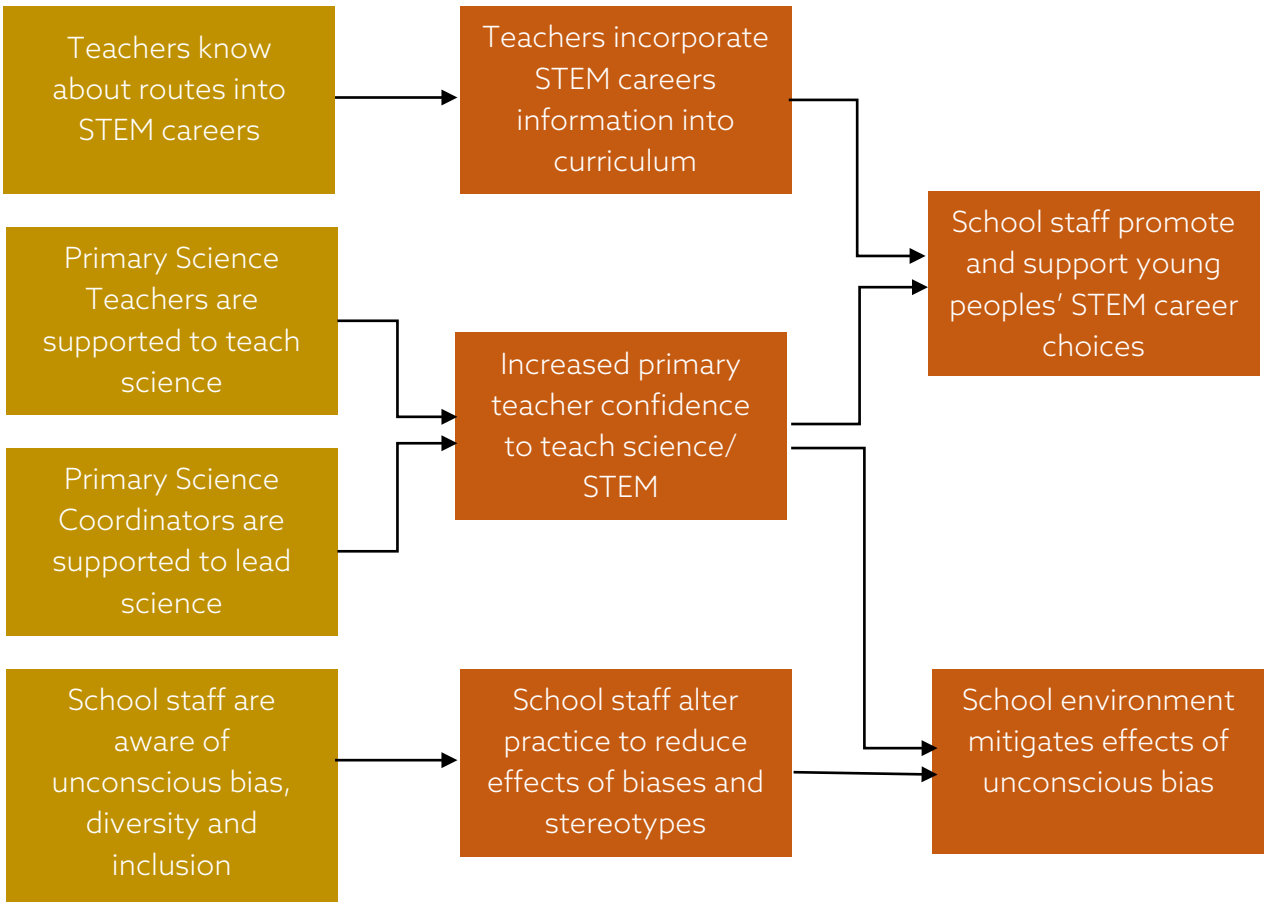
Working with key influencers

Children and young people do not make decisions in isolation. Those around them, particularly key adults such as parents, carers and teachers, have a strong influence on the choices they make, including what would be a suitable future job for them. That's why, at NUSTEM, we also work with these key influencers.

Working with teachers

To support teachers, particularly in primary schools, we lead professional development (CPD) on a regular basis. This CPD might be about different ways to teach topics in the science curriculum, bringing STEM careers into the classroom, or the effects of unconscious bias and stereotypes. We also develop easy to use resources that empower teachers to include careers-related ideas in their everyday teaching. We run a regular and popular forum for Primary Science Coordinators for networking, skills development, and now with a new focus of co-creating science projects and interventions.

Our Theory of Change shows the interventions and changes we believe are necessary among teachers, for them to support and encourage children and young people's future participation in STEM.

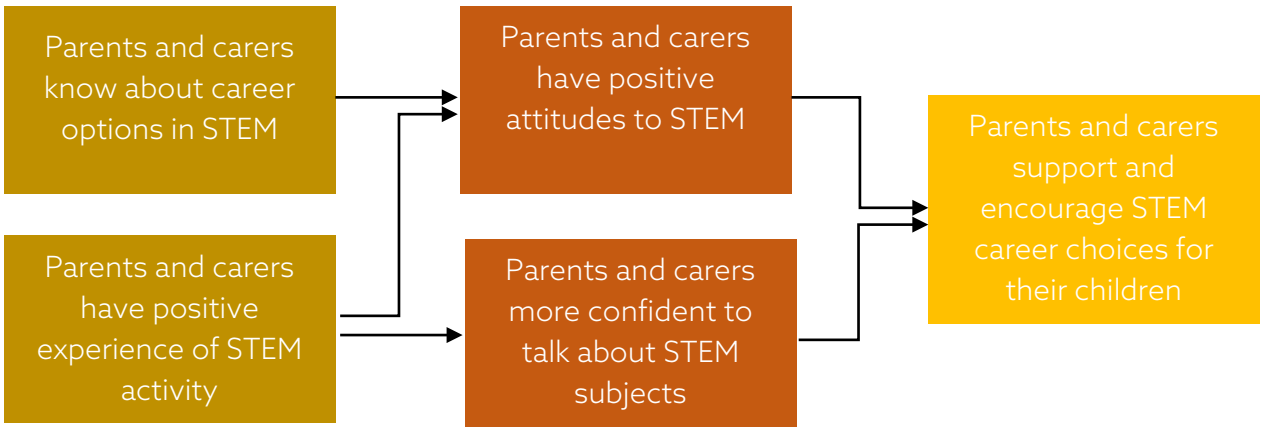


Working with parents and carers

To support parents and families, we have developed and delivered a number of after-school family learning programmes and workshops which introduce STEM ideas and activities in a relaxed and enjoyable way. We've also trained teachers to run these workshops themselves in their own schools. Where appropriate all workshops with parents and carers include careers-links.

We are also expanding the links between science and literacy with our range of STEM story-time projects with children and families in early years, and are exploring how we can support these families in more informal venues.

Our Theory of Change shows the necessary interventions and changes we believe are necessary among parents and carers to support and encourage children and young people's future participation in STEM.



Strength in partnership

NUSTEM was founded on the value of partnership working and this commitment hasn't changed. We continue to grow both the number and strength of our partnerships regionally, nationally and internationally.

School Partnerships

Over these six years we've worked with 50 partner schools in the North East. We started in 2014 with 8 partner primary and 7 partner secondary schools and this number has continued to grow, and change over the years. Some of the schools have been with us from the very beginning, and others have joined our partnership on various projects in the last year as can be seen from the table below. Where there is an all-through academy we have worked with the primary and the secondary phase.

	2014/2015	*2015/2016*	*2016/2017*	*2017/2018*	*2018/2019*	*2019/20*
Primary schools	**8**	**13**	**14**	**14**	**32**	**33**
All-through schools	**0**	**1**	**2**	**2**	**2**	**1**
Secondary Schools	**7**	**14**	**14**	**13**	**13**	**9**

Partnerships with Regional and National Organisations

From the initial 10 founding partners of Think Physics, NUSTEM have continued to collaborate with over 100 regional and national organisations and bodies.

Dr Carol Davenport, as Director of NUSTEM, is also the Chair of the Great North Maths Hub Strategic Board, and a member of the STFC Wonder Initiative Steering Group, the Reading Agency 'Reading Sparks' project Steering Group, and the 'Tomorrow's Engineers Code' Advisory board (initiated by Department for Education and led by Engineering UK).

We have strong collaborations on funded projects with:

- North East Local Authority Partnership (NELEP) on *Careers in Initial Teacher Education (CITE).*
- Museums Northumberland on *Our Past, Your Future* and *Union Chain Bridge Learning Package.*
- Life Science Centre on *connect.*

Academic Research Partnerships

We collaborate with research groups in Northumbria University, and further afield, to enhance the quality and applicability of outreach. Examples include partnerships with:

- Colleagues across Extreme Environments (Solar Physics Research Group and the Cold and Palaeo Research Group) on *Imagining the Sun*; *Exploring Extreme Environments*; and *Geography: Past, Present and Future* and *Solar Net*.
- Engineering colleagues in the Smart Materials & Surfaces Laboratory and Renewable Energy Technologies Group on *Think Engineering*, *Tales of Engineering* and *Think Week*.
- Colleagues in Computing and Information Sciences (Digital Learning Lab) on *connect;* and *NUSTEM/STEMRes* to improve students' digital literacy and the embedding of technology-enabled learning within classrooms.
- Professor Trevor Cox, Salford University, and Dr Helen Bridle, Herriot Watt University, on their respective successful EPSRC Public Engagement Fellowship applications.
- Following a joint conference session at the BIG Event 2019, NUSTEM co-wrote a research paper about long-term STEM engagement programmes with public engagement professionals and academics from 8 other organisations.

Find out more

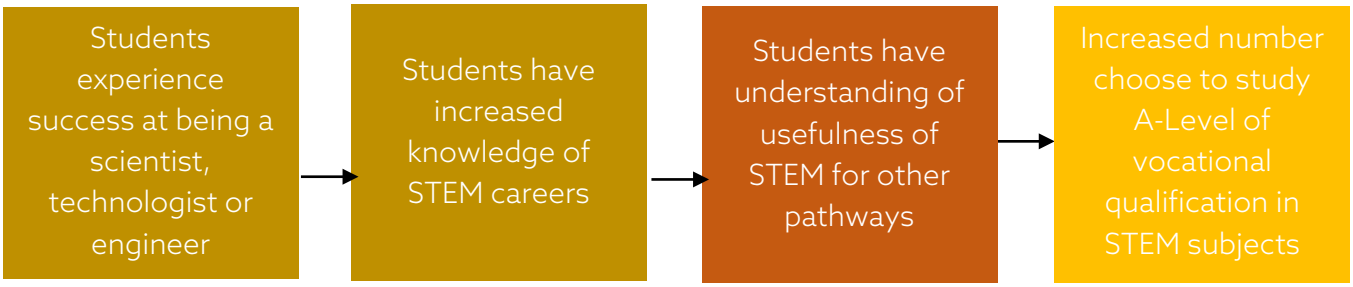
+ Cold and Palaeo Research Group: research.northumbria.ac.uk/coldandpalaeo/
+ Solar Physics Research Group: northumbria.ac.uk/about-us/academic-departments/mathematics-physics-and-electrical-engineering/research/solar-physics/
+ Smart Materials Surface Laboratory: northumbria.ac.uk/about-us/academic-departments/mathematics-physics-and-electrical-engineering/research/smart-materials-surface-laboratory/
+ Renewable Energy Technology and Materials Group: northumbria.ac.uk/about-us/academic-departments/mathematics-physics-and-electrical-engineering/research/renewable-energy-technologies-and-materials/
+ Digital Learning Laboratory: northumbria.ac.uk/about-us/academic-departments/computer-and-information-sciences/research/digital-learning-laboratory/
+ Going beyond the one-off: How can STEM engagement programmes with young people have real lasting impact. Archer, M., DeWitt, J; Davenport, C; Keenan, O; Coghill, L & Christodoulou, A. (accepted for publication, 2020).

Improving children's career aspirations for STEM

How are NUSTEM supporting the development of STEM career aspirations?

NUSTEM's approach to STEM engagement is strongly careers linked. Most interactions with children, or their families, link science (and STEM) topics with a related career. In nursery and reception young children can 'try out' different STEM careers using loans boxes, classroom-based workshops introduce the characteristics of people working in different STEM careers, whilst resources such as the 'Primary Careers Tool' make it easy for teachers to include STEM careers within each science lesson.

This pathway through the NUSTEM Theory of Change describes the key interventions and stages needed to broaden children's career aspirations for STEM.



What evidence do we have that this approach is working?

NUSTEM have broadened primary school children's aspirations for STEM jobs, especially in engineering and the physical sciences, and particularly amongst girls. Compared with the baseline cohort, in schools which had received 2 or more years of NUSTEM intervention the children were more likely to consider:

- The 13 STEM related jobs within STEMKat tool (+ 12%)(*2015=37%, 2017=49%, 2019=41%*), with an increase of 12% among girls, and 8% among boys;
- Jobs in the physical sciences (+ 14%) (*2015=37%, 2017=50%, 2019=44%*);, with an increase of 17% among girls and 12% among boys;
- Careers in engineering (+ 27%,p=.001) (*2015=37%, 2017=63%, 2019=44%*), with an increase of 31% among boys (p=.001) and 23% among girls (p=.001);
- Digital technology careers (17%) (*2015=44%, 2017=61%, 2019=53%*), with a bigger effect for girls (+ 20%), in comparison to boys (+ 9%).

Teachers confirm the merits of NUSTEM approaches in broadening children's aspirations for STEM careers,

> *"NUSTEM has helped us hugely in raising aspirations in science and STEM aspects. Whenever NUSTEM come to work with the children they very much put their work into context and they always relate it to a career and a future progression that the children can then see themselves going into. Because of the effect of NUSTEM we are seeing more and more boys' and girls' aspirations heading towards STEM careers"*
>
> Julia Bourne, STEM coordinator, New York Primary School

"Children now ask thoughtful and inquiring questions about the STEM careers to extend their own understanding, can discuss in more detail different careers that are available and compare them to one another creating a deeper, richer conversation around the STEM careers that are available locally and globally."
Mark Storey, Science Coordinator, Carville Primary School

"I was using the 'STEM person of the week' resource from NUSTEM to generate a 10-minute discussion on a Friday afternoon about the types of careers available. The children found this fascinating and it was amazing to see a room full of children so enthused about careers that they previously didn't even know existed. I am confident that as this is rolled out more systematically throughout school, and the wider partnership, it will leave a lasting impression on our children." David Gregory, Newsham Primary School.

"My son now wants to be a civil engineer."

Parent, Engineering for Families Course

How we have measured these impacts?

We collected baseline data in our 5 research primary partner-schools in 2015 and collected repeat data in 2017 and 2019 using our '*STEM Knowledge and Aspiration Tool' (STEMKat*). STEMKat asks children to sort a list of 30 jobs firstly into those 'known' and 'not known', and then sort the known jobs into whether they would like to do them in the future or not. The 30 jobs included in the STEMKat tool are a broad mix of STEM and non-STEM jobs. The year 5 cohort in 2015 who had received no interventions at the time of data collection was used as a comparison group for the year 5 cohort in 2017 who had participated in the intervention activities.

Find out more

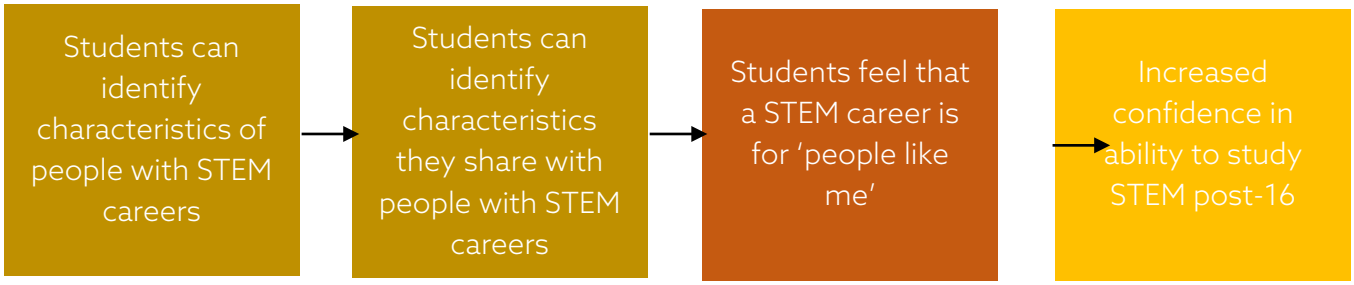
+ "Using Action Research to Design and Evaluate Sustained and Inclusive Engagement to Improve Children's Knowledge and Perception of STEM Careers", International Journal of Science Education (2020) doi.org/10.1080/09500693.2020.1729442
+ Teacher Julia Bourne describing the impact of NUSTEM: https://vimeo.com/241523884
+ Careers Capital, Ogden Trust: https://www.ogdentrust.com/about-us/news/careers-capital

Changing the way children talk about scientists, engineers, and other STEM workers

How is NUSTEM supporting children to improve their perceptions of STEM workers?

Children can have stereotypical perceptions of scientists and engineers, and so NUSTEM resources challenge these stereotypes and introduce positive attributes to describe scientists and engineers. We achieve this by using diverse role-models and examples, and through specific targeted interventions such as STEM Person of the Week.

This pathway through the NUSTEM Theory of Change describes the key interventions and stages needed to improve children's perceptions or scientists and engineers and how this supports children to view STEM as for them.



What evidence do we have that this approach is working?

In partner primary schools which had received 2 or more years of NUSTEM interventions the perception of scientists has improved amongst girls, in particular the perception that scientists need to be 'very clever' has reduced.

Girls were:

- Less likely to rank scientists as clever (- 24%) than children of the same age in the baseline cohort (*2015=72%, 2017=45%, 2019=48%*). This difference was statistically significant (p=.016).
- More likely to rank scientists as kind (+ 17%) than children of the same age in the baseline cohort (*2015=4%, 2017=10%, 2019=21%*). This difference was statistically significant (p=.001).
- More likely to rank scientists as sensible (+ 19%) than children of the same age in the baseline cohort (*2015=41%, 2017=48%, 2019=60%*). This difference was statistically significantly different (p.015).

In each case changes in boys' attitudes were not statistically significant.

Similarly, we have seen a change in perceptions of scientists amongst pupils in secondary schools, which have received 2 or more years of NUSTEM intervention in their school.

Pupils were:

- Less likely to report that 'people who use science in their jobs are very clever' (-19%) than pupils of the same age in the baseline cohort (p=.001) (*2015=76%, 2017=71%, 2019=57%*), with a reduction of 24% among girls (p=.001) and 13% among boys (p=.001).

How have we measured these impacts?

Our research tool '*Most Like a Scientist*' asked children to rank nine attributes into a 'diamond nine formation' to identify attributes they thought were most like, and least like, a scientist. The nine attributes children ranked were clever, cool, creative, friendly, fun, hardworking, kind, sensible and strange. We collected baseline data in our 5 research primary partner-schools in 2015 and collected repeat data in 2017 and 2019 using our tool 'Most Like Me/Most Like a Scientist' tool. The year 5 cohort in 2015 who had received no interventions at the time of data collection was used as a comparison group for the year 5 cohort in 2017 who had participated in the intervention activities.

In secondary research partner-schools we collected baseline measures in 2015 using our '*science and you*' survey, and took repeat measures in 2017 and 2019. The year 9 cohort in 2015 who had received no interventions at baseline was used as a comparison group for the year 9 group in 2019 and 2011 who had participated in intervention activities.

Using counter-stereotypical role models of STEM workers within NUSTEM outreach

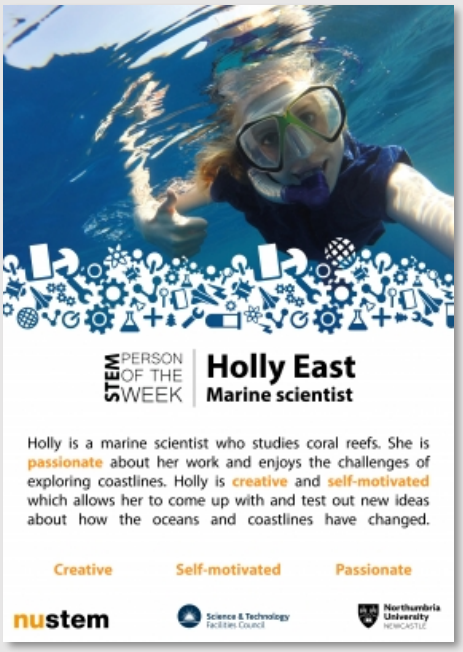
Find out more

+ Innovative methods for evaluating the science capital of young children (2016) IEEE Frontiers in Education Conference (FIE), Erie, PA, USA, 2016, pp. 1-5. doi: 10.1109/FIE.2016.7757680

Case Study: STEM Person of the Week

'STEM Person of the Week' (SPOTW) is a five-week teacher-led programme of subtle careers education, developed in partnership with primary teachers.

Our research shows that when asked to describe scientists, children use a limited and very stereotypical vocabulary. When asked to write down 6 words to describe a scientist, over 40% of the total words used were some sort of stereotype: crazy hair, explosions, lab coats, genius, etc. 'STEM Person of the Week' was designed to counter this vocabulary through a more nuanced set of attributes that scientists and other STEM workers use to describe themselves and their characteristics.



Each week, a school introduces a STEM role model via presentations and postcards (example, right). The work of the role model is discussed, with a focus on three personal attributes which help them in their jobs. In science lessons the attributes are explored, with teachers commending the children for demonstrating them.

What evidence do we have that it works?

- The intervention has a strong effect on children's vocabulary when describing scientists. Impacts remained detectable a year after the intervention. Children used fewer stereotypical words to describe scientists directly after the intervention and this reduction continued to be significant 1-year later when the number of 'general stereotypes' used had fallen by 18% ($p<.001$).
- STEM Person of the Week has gained the attention and appreciation of organisations and funders, and is now included in 'Exploring Extreme Environments' (STFC), funded 'Our Past, Your Future' (North of Tyne Combined Authority), 'Union Chain Bridge' (Heritage Lottery Fund), Ogden Trust training programme and the British Science Association National Science Week resource pack for 2021.
- SPOTW resources on the NUSTEM website have had 2366 views since 2017.

How have we measured these impacts?

We examined whether 'STEM Person of the Week' could lead to a positive change in childrens' perception of scientists. Words associated with scientists were collected before and after (directly, one month, one year) the intervention from a tracked sample from one primary school (n = 118), then thematically analysed and categorised to assess changes. Statistical significance was measured using the Chi-Squared test.

Find out more

+ STEM Person of the Week nustem.uk/stem-person-of-the-week/

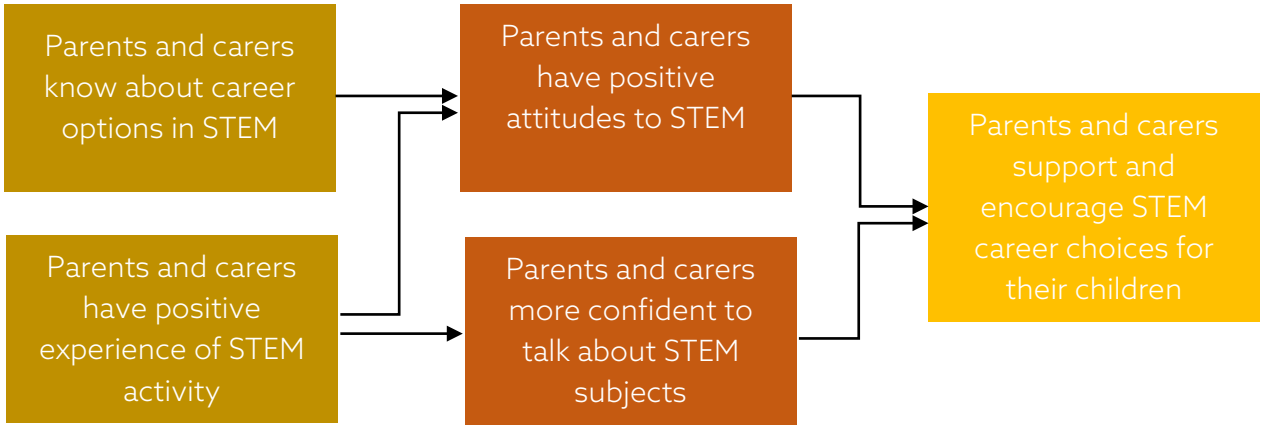
+ Scientist of the Week: the long-term effects of a medium-term, teacher-led STEM intervention to reduce stereotypical views of scientists in young children (in review)

Changing the way that children and their families engage with STEM

How is NUSTEM improving parent's confidence with STEM?

Children's subject decisions and career choices are heavily influenced by their home environment. Supporting caregivers is therefore important. NUSTEM has developed a range of twilight courses in which family groups explore topics and careers in a range of STEM fields. The courses deliberately adopt exploratory, 'tinkering' and confidence-building approaches, and help to normalise family discussion on STEM topics. Our science pop-up shops visit empty shops and libraries to bring science to the local communities of our partner schools. A second strand of family support links reading with STEM topics, delivering storytelling sessions for toddlers and their carers. These are aimed at normalising science conversations and improving literacy levels; the latter a strong predictor of future success in school.

This pathway through the NUSTEM Theory of Change below describes the key interventions and stages we believe necessary to improve parents support and encouragement for the STEM career choices of their children.



What evidence do we have that this approach works?

In the post-survey evaluation of Family Space Explorers, a space story time workshop, 60% of parents and carers who attended the Family Space Explorers workshops said they now felt more comfortable exploring space and science topics with their children. 96% of parents and carers reported their intention to read space and science books again with their children.

We have trained schools and local authorities to deliver STEM courses for families:

> *"With Science for Families we worked with some of the hardest to reach families, where low literacy is sometimes a barrier but participants were fully able to engage with the designed activities. The flexible format met the needs of parents and schools, ensuring parents were always keen to attend."*
> Paul Surtees, North Tyneside Learning Alliance

Partner schools have valued the support provided with parental engagement programmes,

> *"NUSTEM has helped hugely in raising aspirations and profile of STEM for staff, pupils and parents, and in parental involvement overall."*
>
> Julia Bourne, STEM Coordinator, New York Primary School

> *"We have a lot of parents who we've struggled to reach previously. It's been lovely to see all these parents coming through. Parents have been a lot more open and confident about sharing the activities they have been doing with children at home. Communication on See-Saw has increased as parents are keen to show us what their children have been doing linked to the sessions."*
>
> Joanne Smith, EYFS Teacher, Battle Hill Primary School

The value and utility of NUSTEM's approach to working with families is recognised by funders. We have received a Royal Academy of Engineering Ingenious Grant for *Tales of Engineering*, two rounds of funding from the UK Space Agency for *Family Space Explorers,* and funding from the SHINE Trust for *Me, You and Science Too (MYST).*

Participants of the 'Engineering for Families' course describe how it supported them to learn together:

"Using cheap and easily accessible resources has been a great idea and certainly encouraged me to think about engineering projects we can do at home. It has really encouraged us to do more things at home as a family."

Participant, Engineering for Families Course

How have we measured impact?

Impacts of NUSTEM on families are currently measured and reported on a project by project basis. Links to the final reports for Family Space Explorers, and Engineering for Families can be found below. Our Tales of Engineering and Me, You and Science Too (MYST) projects are still running and final reports will be published on the NUSTEM website on completion. MYST adopts an action research methodology and is exploring the most effective ways of securing family involvement in interventions.

Find out more

+ Final Report: Family Space Explorers: nustem.uk/family-space-explorers/
+ Engineering for Families Evaluation Report: nustem.uk/engineering-for-families
+ Me, You and Science Too: nustem.uk/myst/
+ Tales of Engineering: nustem.uk/tales-of-engineering/

Case Study: Family Space Explorers

'Family Space Explorers' was a UK Space Agency funded project developed by NUSTEM in 2017 and delivered in local libraries and cultural venues. Over 240 families read STEM-related story books together and then played with simple activities to extend the ideas in the stories. A second round of funding was secured from the UK Space Agency to develop the programme further in 2020.

For Family Space Explorers NUSTEM developed two different activity sessions linked to the UK Space Agency: the ISS and robotic exploration of Mars. The ISS session was based on 'Goodnight Spaceman' and the robotic exploration on 'Are we nearly there yet?', written by NUSTEM's Carol Davenport about the story of 'Little E', the rover heading to Mars as part of the ExoMars 2020 mission.

What evidence do we have that Family Space Explorers works?

Encouraging shared reading and activities using STEM-related literature increased parents and carers level of knowledge of, and confidence to talk about, space and science with their young children.

- The majority of adults (60%) reported that their confidence to talk about STEM with their child had increased as a result of the session.
- 96% of parents reported their intention to read the books again with their child.
- Some participants reported their appreciation of their link between the story and the activity, and that the session provided a model for future interactions at home. One mentioned the value of "*learning to build around a story*".
- All participants who received a telephone interview (selected at random) said they would be happy to attend a similar science story-time in the future.

How have we measured impacts?

All participants attending the sessions were asked to complete short pre- and post-session surveys and invited to take part in a follow-up interview. The pre-session survey explored participants' knowledge of space exploration and UK Space Agency, and levels of comfort talking about science or space with their child(ren). In post-event surveys participants were asked to reflect on the memorable aspects of the session, their intention to read the books again, and how their feelings and knowledge had changed.

Find out more

+ Family Space Explorers Final Report: nustem.uk/family-space-explorers/

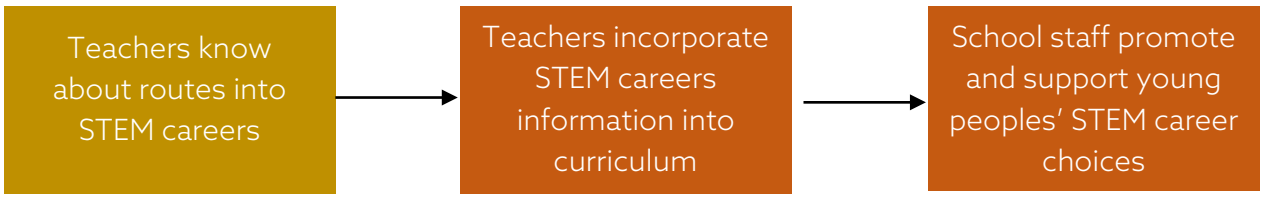
Supporting teachers to embed STEM careers in their lessons

How is NUSTEM supporting schools to embed careers within their lessons?

We have developed resources for primary and secondary teachers to use in the classroom, and supported schools to develop and design their lessons and curriculum to incorporate careers. One example of this model is the NUSTEM Primary Careers Tool: an online STEM jobs database where jobs can be sorted according to topics in the Science or Maths National Curriculum. It is carefully tailored to support and encourage primary school teachers to easily embed relevant careers as part of their regular classroom teaching.

At secondary school level we have developed careers-linked curriculum worksheets, a STEM sector database of employers, and STEM careers cards. In the Careers in Initial Teacher Education programme (CITE) we have been working with trainee-teachers to embed careers in their initial teacher training.

This pathway through the NUSTEM Theory of Change below describes the key interventions and stages we believe necessary for the successful embedding of STEM careers within lessons.



What evidence do we have that this approach works?

NUSTEM has supported three primary partner schools to re-write their curriculum vision for science, resulting in school science policies that incorporate STEM careers links and more practical teaching of science.

NUSTEM's careers work was shortlisted in the UK Career Development Awards 2020 for best career-related learning in Primary Schools.

NUSTEM's resources are meeting teachers' needs for careers-related learning,

> *"We want as a school to raise aspirations and expose children to different careers and a barrier has been how to do this without a budget but the resources shown today will help this."*
> Participant, Careers in Initial Teacher Education Programme (CITE)

The quality of the Primary Careers Tool is reflected in both the high usage statistics from NUSTEM website data (8624 views) and the feedback from teachers and Head Teachers in participating schools:

"The tool gives me exactly what I need, in the most straightforward way possible. There are no distractions or extraneous information so I can use it routinely in my lessons." Teacher, Milecastle Primary School

"The Primary Careers Tool has been instrumental in helping us to implement a careers drive through the curriculum". Headteacher, Chopwell Primary School

The Primary Careers Tool has been embedded in the physics training of The Ogden Trust, a charitable trust promoting the teaching and learning of physics. Between September 2018 and December 2019, 402 teachers from 296 schools across the country have received training including the PCT from Ogden which includes the use of the Primary Careers Tool.

"The Primary Careers Tool is an excellent addition to the primary teacher training that we offer at the Ogden Trust. Introducing careers ideas at primary is a subtle problem and the tool carefully and deliberately avoids potential pitfalls, offering something that can be of genuine benefit in classrooms. It's taken real expertise to develop a tool that allows large numbers of classroom teachers to broaden the careers language and ambition of their students."
Jackie Flaherty, National Teaching and Learning Lead, Ogden Trust

The Primary Careers Tool, although not deliberately targeted at secondary schools, was featured in an episode of the Physics Teaching Podcast. The topic breakdown for the National Curriculum is similar across all age-groups from 6 – 16 which means that secondary science teachers can also use the resource as a straight-forward way of including careers links in their lessons.

At secondary level, NUSTEM's Physics Careers Postcards have gained the support of the Institute of Physics and have been distributed nationwide as part of their 'Classroom Physics' newsletter to affiliated schools (approximately 1600 schools). The Postcards have also been adapted and used by 11 other universities.

How have we measured impact?

NUSTEM's close working relationships with primary partner schools allows us to monitor changes that take place e.g. science curriculum development. In addition, we run focus groups with Science Coordinators at our Primary Science Coordinators Forum, and in-school with teachers to gain feedback and insight about NUSTEM projects and activities. We monitor engagement with tools and resources on the NUSTEM website by tracking downloads, repeat visits and click-through, and where possible, capture the reach and audience of our resources used by external audiences.

Find out more

+ Primary Careers Tool: nustem.uk/primarycareers/
+ Secondary Careers: nustem.uk/careers-postcards/ and nustem.uk/careers-worksheets/
+ CDI 2020 Awards Shortlist: www.thecdi.net/Awards-Shortlist-2020
+ Physics Teaching Podcast: the.physicsteachingpodcast.com/2019/'09/12/37'

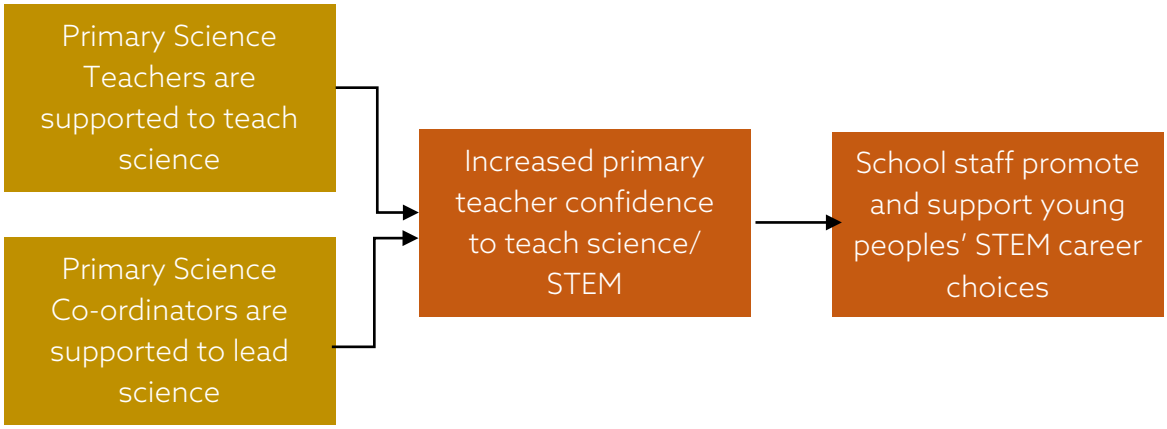
Building teachers confidence to teach science/STEM

How is NUSTEM working to develop teachers' confidence with STEM?

NUSTEM has invested in building strong partnerships with a number of North East schools. Sustained engagement over six years through school workshops, family workshops, the Primary Science Coordinators Forum, Continuing Professional Development, and school science forums has enabled close working relationships with Head Teachers, Science Coordinators and class teachers. Teachers within partner schools are incorporating the NUSTEM model into their practice. At secondary level we support Physics teachers to build confidence in practical work through our A-Level Physics Required Practicals: online training films about practical work in physics.

NUSTEM also work with the North East PE SCITT, Careers in Initial Teacher Training Programme (CITE) and Northumbria University's Primary Teaching Degree to support trainee teachers to build confidence with STEM. Further afield NUSTEM are working with STEMRes (an NGO in Nigeria) working directly with state governments, schools, teachers and children to develop and deliver STEM programmes.

This pathway through the NUSTEM Theory of Change below describes the key interventions and stages we believe necessary for building primary teachers confidence to teach science.



What evidence do we have that this approach works?

NUSTEM has supported 5 partner primary schools to establish new regular science CPD working groups for their staff which help teachers plan their science lessons.

Two Science Coordinators in our partner-primary schools have gone on to win an 'Outstanding Primary Science Teacher' award in the Primary Science Teaching Awards. One winner of this award describes the support of NUSTEM,

> *"NUSTEM has supported me in my role as class teacher, science coordinator and STEM SLE [Specialist Leader of Education]. Science for Families has had huge impact with us, currently being in the third cycle of parents. For us,*

parental involvement in science was an issue prior to our links with NUSTEM. Parents who had previously been scared about coming into a classroom setting and carrying out science, are now enthusiastically engaging with school."

Julia Bourne, Science Coordinator

NUSTEM's A-Level Required Practical Films are popular with teachers in the UK, and around the world. The films have been viewed collectively over 125,000 times on YouTube, and the website pages more than 114,000. A comments from one user highlights the value of these films:

"Love you guys, Really thanks for the Practical videos, they're really helpful! Waiting for the next one."

Teacher training work with STEMRes in Nigeria has supported teachers' in Ondo and Ekiti states to have a greater focus on teacher CPD and has developed teachers and children's confidence in practical skills using STEM education kits.

"At STEMRes we basically model the educational structure, strategies, method and materials of NUSTEM in teaching practical science in the classroom here in Nigeria. We work with over 40 schools and over the last two years we have been able to reach over 10,000 students and 2000 teachers. By coming with the NUSTEM model, we bring inquiry based activities to students, who saw the life in science and day by day clamoured for more knowledge and understanding of science concepts. Among teachers who were not initially receptive, when they saw the body language of the students they were teaching, how excited they were and their anticipation to learn more practical science, they had to change and come onboard to participate and encourage students. In fact the teachers even started looking for ways to adopt our technique in their normal class lectures."

Oluwafemi Alufa, Director STEMRes

Find out more

+ Primary Science Coordinators Forum https://nustem.uk/blog/events/primary-science-coordinators-forum-3-1/
+ A-level Physics Practical Films: Youtube playlist
+ NUSTEM and STEMRes: nustem.uk/stemres

Case Study: Primary Science Coordinator's Forum

Part of NUSTEM's offer to primary schools in the North East is our Primary Science Coordinators' Forum (PriSciCoFo). Each half term, science leaders from primary schools across the region come to Think Lab at Northumbria University for two hours of skills sharing, networking and high-quality STEM CPD.

Within a session the science leaders receive professional development, look at and discuss recent research findings or evidence reviews, share their creative science ideas and resources they have found useful, or get hands on with new educational technologies. The forum has been running for 5 years and continues to thrive. It has expanded to incorporate new schools, with a new focus of co-creating science projects.

What evidence do we have that this approach works?

The forum is regularly attended by science leaders from over 20 schools and on average science leaders attend over half of all sessions offered.

Within research-led focus groups at partner schools, teachers regularly cited the opportunities for networking and CPD and one of the key benefits and rewards of working with NUSTEM.

> "*The opportunity to meet with other Science Coordinators and share ideas and practice has helped me in my role as Science Coordinator*".
> Holy Trinity CE Academy
> Another Science Coordinator described it as, "*one of the best CPD – delivered in my style*". Battle Hill Primary School

Following an idea developed at a Forum meeting, NUSTEM Director Carol Davenport, Carville Primary Science Coordinator Mark Storey, and Northumbria University researcher Kate Winter presented a seminar on 'Careers and the Curriculum' at the Primary Science Education Conference 2019.

How have we measured impacts?

We monitor attendance at the Primary Science Coordinators Forum. Our research team run regular focus groups with Science Coordinators at the Forum and in-school with classroom teachers to gain feedback and insight on NUSTEM's programmes.

Find out more

+ Primary Science Coordinators Forum https://nustem.uk/blog/events/primary-science-coordinators-forum-3-1/
+ PSEC: https://primaryscienceeducationconf.sched.com/event/Lpkx/careers-and-the-primary-science-curriculum

Influencing others through the NUSTEM Theory of Change

How is NUSTEM influencing policy and strategic direction with the Theory of Change?

NUSTEM works with other organisations in the North East to strengthen the strategic STEM engagement community and is influencing the strategic direction and frameworks of educators and policy makers nationally and internationally. NUSTEM's Theory of Change (ToC) approach is gaining interest among other organisations and has been adopted as the framework and values of new funding calls, funded STEM initiatives, and into the practice of other organisations.

What evidence do we have this approach is working?

Twenty public engagement projects utilising NUSTEM's ToC have been funded, with a combined value of over £1 million pounds. This shows that the ToC and research based activity is valuable to and admired by public engagement organisations and funders.

The success of the ToC approach is also reflected in its adoption and use to shape the North of Tyne Combined Authority's (NTCA) STEM and Digital Skills programme.

> *"The NUSTEM Theory of Change provided a unique overview of how to interact with different stakeholders (children, parents and teachers) to support an increase in the diversity and number of young people studying STEM post-18. The Theory of Change shaped the engagement practice of our outreach work which is part of our approach in tackling the economic challenges in the North of Tyne region. NUSTEM's extensive experience of STEM engagement was also useful in shaping the commission for an external evaluation of the STEM and Digital Skills programme, thus shaping the means by which we measure success of this initiative. We are now exploring how to use our experience of the STEM and Digital Skills programme and the NUSTEM Theory of Change as the basis for further programmes of this type."*
>
> Maria Antoniou, Principal Economy & Strategy Manager, NTCA

The BRIDGE project with Gateshead/Derby Colleges adapted NUSTEM's ToC to create greater diversity in HE construction programmes. Between 2016 and 2018 this resulted in an increase of female students from 0 to 39% (Derby) and 8 to 23% (Gateshead).

NUSTEM worked with Museums Northumberland to reflect the ToC approach in their education and teacher support work. This was integral to the STEM learning component of their successful £3.2m National Lottery Heritage Fund grant (Union Chain Bridge, awarded September 2019).

The NUSTEM ToC was influential in changing the audience focus of the Reading Sparks project from children to that of families. The Reading Agency project is funded by STFC and the Arts Council. NUSTEM Director, Carol Davenport, was invited to become a member of the Reading Sparks Steering Group.

NUSTEM have provided consultancy to other organisations and initiatives. We supported two successful EPSRC Public Engagement Fellowships: one led by Professor Trevor Cox, Salford University (NUSTEM as partner), and one by Dr Helen Bridle, Herriot-Watt (NUSTEM as consultant). We are also delivering training and consultancy on ToC approaches, and have supporting other organisations such as the Common Room of the North and Success 4 All to develop their own Theory of Changes.

How have we measured impacts?

We keep track of when and how we engage with other organisations, and record the details and outcomes of funded projects. Where we have made a material impact we ask for testimony from organisations we have worked with.

Find out more

+ NUSTEM Projects: nustem.uk/about/projects/
+ North of Tyne STEM and Digital Skills Programme: https://www.northoftyne-ca.gov.uk/stem-and-digital-skills-programme
+ Union Chain Bridge: https://www.heritagefund.org.uk/news/future-historic-union-chain-bridge-secured
+ Reading Sparks: https://readingagency.org.uk/news/media/science-and-reading-a-powerful-combination-that-will-create-opportunities-for-the-uk.html

Appendix 1: Funded Projects

Funded projects led by NUSTEM or with strong NUSTEM involvement

Project Name	Funder	£	Date
Think Physics Catalyst Fund	HEFCE	2,322,758	2014
Maker Lab and Summer Schools	Reece Foundation	59,990	2014
Space Ambassador Year 1	STEM Learning	10,500	2015
Imagining the Sun	STFC	9998	2016
Supporting Physics Practical Work	The Ogden Trust	10,719	2016
Engineering for Families	Community Foundation	12,918	2016
Space Ambassador Year 2	STEM Learning	4500	2016
Giant Waves in the Ocean	Maths Forsees Network	10,000	2016
Ogden Science Officer	The Ogden Trust	23,133	2017
British Gear Association	British Gear Association	7200	2017
School Careers Support materials	NECOP (HEFCE)	90,785	2017
Family Space Explorers	UK Space Agency	21,108	2017
Think Engineering Primary 1	Reece Foundation	80,000	2018
Exploring Extreme Environments	STFC	122,710	2018
Ogden Science Officer	The Ogden Trust	73,959	2018
STEM Learning Framework Consultancy: Union Chain Bridge	Northumberland County Council	7949	2018
Think Engineering Primary 2	Reece Foundation	179,000	2019
Tales of Engineering	Royal Academy of Engineering	17,791	2019
Family Space Explorers 2	UK Space Agency	8955	2019
Me, You and Science Too	SHINE Trust	60,761	2019
Careers in Initial Teacher Education (CITE)	NELEP / Careers and Enterprise Company	70,402	2019
Our Past, Your Future (with Museums Northumberland)	North of Tyne Combined Authority	395,006	2019
Connect (with Life)	North of Tyne Combined Authority	214,160	2019

Trevor Cox (Inventive Podcast)	EPSRC	21,052 (153,889)	2020
Union Chain Bridge STEM Learning Consultant	NCC	41,293	2020
Helen Bridle (Engineering Science Capital)	EPSRC	7274 (150,618)	2021

Academic funding which includes NUSTEM consultancy on outreach activities

Academic Funding Source	Overall Amount	Date
Dr Guillaume Zoppi *EPSRC*	£98k	1/7/16 – 31/12/18
Dr Sergio Gonzalez Sanchez, *EPSRC*	£105k	10/7/17 – 09/7/19
Prof. Richard Fu *EPSRC*	£346k	2/7/17 – 1/7/20
Prof. Glen McHale *EPSRC*	£429k	10/7/17 – 9/7/20
Dr Rodrigo Ledesma Aguilar *EPSRC*	£98k	1/10/17 – 31/5/19
Dr Gary Wells *EPSRC*	£99k	1/12/17 – 31/5/19
Dr Paul Mann *NERC*	£239k	1/7/18 – 30/6/21
Prof Glen McHale *EPSRC*	£347k	26/11/18 – 25/11/21
Dr Richard Morton *European Union Horizon 2020 – SOLARNET*	€13,484k	1/1/19 – 31/12/22
Dr Ciro Semprebon *EPSRC*	£347k	1/10/19 – 30/9/22
Dr Terrence Liu *EPSRC*	£215k	18/11/19 – 17/11/21
Prof Glen McHale *EPSRC – RENU Centre for Doctoral Training*	£5,476k	1/4/19 – 30/9/27
Dr Bronwyn Whitney *NERC*	£75k	7/10/19 – 6/2/21
Prof Jane Entwistle (UNN Lead) *Newton Fund*	£270k	1/2/20 – 31/1/21
Dr Richard Morton UKRI Future Leader Fellowship	£1.2 M	1/7/20 – 30/6/24

Appendix 2: Loans Boxes

Early Years and Foundation Stage

- Makedo
- CubettoSpace
- Paleontology

Key Stage 1 and Key Stage 2

- Makedo
- Evolution
- Electricity
- Levers
- Light
- SAMLab
- Sound

Find out more

+ NUSTEM Loans Boxes: https://nustem.uk/loans-boxes/

Appendix 3: NUSTEM Awards

- [2020] Airbus GEDC Diversity Award for engineering education 2020: Finalist
- [2020] Educate North Awards 2020, Community Engagement Award – University sector: Shortlisted
- [2020] UK Career Development Awards 2020 Career-related Learning in Primary Schools: Shortlisted
- [2019] WISE Awards 2019, Outreach and Engagement award: Finalist
- [2019] Educate North Awards 2019, Social Mobility Award – University Sector: Shortlisted
- [2017] Two Maker of Merit blue ribbons for Technology Wishing Well and Pendulum
- [2016] Maker of Merit blue ribbon for Light Wall

Appendix 4: NUSTEM Publications

Academic Publications

Padwick, A., Davenport, C., Horan, M, Shimwell, J, & Strachan, R. (2020).Tackling the digital and engineering skills shortage: Understanding young people and their career aspirations. In 2020 IEEE Frontiers in Education Conference (FIE). IEEE.

Davenport, C., Dele-Ajayi, O., Emembolu, I. et al. (2020). A Theory of Change for Improving Children's Perceptions, Aspirations and Uptake of STEM Careers. Res Sci Educ. https://doi.org/10.1007/s11165-019-09909-6

Archer, M., DeWitt, J; Davenport, C; Keenan, O; Coghill, L & Christodoulou, A. (pending publication, 2020). Going beyond the one-off: How can STEM engagement programmes with young people have real lasting impact.

Emembolu, I., Padwick, A., Shimwell, J., Sanderson, J., Davenport, C., & Strachan, R. (2020). Using action research to design and evaluate sustained and inclusive engagement to improve children's knowledge and perception of STEM careers. *International Journal of Science Education*, 1-19.

Emembolu, I., Strachan, R., Davenport, C., Dele-Ajayi, O., & Shimwell, J. (2019, October). Improving diversity and uptake of Computer Science among young people: Using a games design intervention based on an integrated pedagogical framework. In 2019 IEEE Frontiers in Education Conference (FIE) (pp. 1-8). IEEE.

Dele-Ajayi, O., Strachan, R., Pickard, A. J., & Sanderson, J. J. (2019). Games for Teaching Mathematics in Nigeria: What Happens to Pupils' Engagement and Traditional Classroom Dynamics? IEEE Access, 7, 53248-53261, doi: 10.1109/ACCESS.2019.2912359.

Dele-Ajayi, O., Ayodele V., Alufa O., Anderson E., Strachan R., & Emembolu I. (2019). Barriers and Identified Solutions to the Integration of Digital Technologies in the Classroom: A Case Study of Teachers in Nigeria. In 2019 IEEE Global Engineering Education Conference (EDUCON) (pp. 953-958), doi: 10.1109/EDUCON.2019.8725160.

Strachan, R., Peixoto, A., Emembolu, I., & Restivo, M. T. (2018). Women in engineering: Addressing the gender gap, exploring trust and our unconscious bias. In 2018 IEEE Global Engineering Education Conference (EDUCON) (pp. 2088-2093), doi: 10.1109/EDUCON.2018.8363497.

Dele-Ajayi, O., Strachan, R., Pickard, A., & Sanderson, J. (2018). Designing for All: Exploring Gender Diversity and Engagement with Digital Educational Games by Young People. In 2018 IEEE Frontiers in Education Conference (FIE) (pp. 1-9), doi: 10.1109/FIE.2018.8658553.

Dele-Ajayi, O., Shimwell, J., Emembolu, I., Strachan, R., & Peers, M. (2018). Exploring digital careers, stereotypes and diversity with young people through game design and implementation. In 2018 IEEE Global Engineering Education Conference (EDUCON) (pp. 712-719), doi: 10.1109/EDUCON.2018.8363301

Padwick, A., Davenport, C., Strachan, R., & Shimwell, J. (2017, June). The NUSTEM Approach: Tackling the Engineering and Gender Challenge Together from Early Years to Sixth Form and beyond. In *Proceedings of the Conference on New Approaches to Engineering in Higher Education*. IET and EPC.

Padwick, A., Dele-Ajayi, O., Davenport, C., & Strachan, R. (2016). Innovative methods for evaluating the science capital of young children. In *2016 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.

Dele-Ajayi, O., Sanderson, J., Strachan, R., & Pickard, A. (2016). Learning mathematics through serious games: An engagement framework. IEEE Frontiers in Education Conference (FIE) (pp. 1-5). doi: 10.1109/FIE.2016.7757401

Dele-Ajayi, O., Strachan, R., Pickard, A., & Sanderson, J. (2015). Girls and science education: Exploring female interests towards learning with Serious Games a study of KS3 girls in the North East of England. In 2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL) (pp. 364-367), doi: 10.1109/IMCTL.2015.7359620.

Practitioner Publications

'Designing effective evaluations for applying scientific academic research to career-based interventions for younger children', *The Evaluator*, Autumn 2019, 14 – 16, I.C. Emembolu, R. Strachan, C. Davenport (2019).

'Growing into careers in primary education', *Education in Science*, 276, 11 – 12, C. Davenport (2019).

'Using career contexts to teach science', *School Science Review*, 100, 373, 19-21 C. Davenport (2019).

'Careers in the curriculum – the difficult fourth benchmark', *Education in Science*, 276, pp 14, C. Davenport (2019).

'Careers advice and changing stereotypes in the primary classroom', *Primary Science*, 157, 29 – 30, C. Davenport, J. Shimwell (2019).

'Endpoint: Teachers, stop ignoring careers information, and include it in your teaching.' *Education in Chemistry*, 56, 2, C. Davenport (2019).

'It's time to talk careers', *Education in Chemistry*, 28 February 2019, Available at: https://eic.rsc.org/endpoint/its-time-to-talk-careers/3010039.article, C. Davenport (2019).

'Why should you care about careers?' *Education in Chemistry*, 22 November 2018, available online at https://eic.rsc.org/feature/why-should-you-care-about-careers/3009776.article, C. Davenport (2018).

'How to tackle careers guidance' *Education in Chemistry*, 9 November 2018, available online at https://eic.rsc.org/analysis/how-to-tackle-careers-guidance/3009712.article, C. Davenport (2018).

'Including Careers in the curriculum' *Education in Chemistry*, 18 September 2018, available online at https://eic.rsc.org/ideas/including-careers-in-the-curriculum/3009375.article, C. Davenport (2018).

'Linking science with design and technology in a stimulating approach to teaching about levers.', *Primary Science*, 139, C. Davenport (2015).

'Engineering: it's a family affair', *IET Partner News*, 33, Summer 2017 NUSTEM (2017)

'What can science tell us about the star of Bethlehem', *The Conversation*, 23 December 2015, C. Davenport (2015) available online at https://theconversation.com/what-can-science-tell-us-about-the-star-of-bethlehem-51773.

'Parents can't answer everything children ask about science – and that's OK', *The Conversation*, 10 November 2015, C. Davenport (2015) available online at https://theconversation.com/parents-cant-answer-everything-children-ask-about-science-and-thats-ok-50419.

'Can a new University close the gender gap in engineering?', 11 March 2015, *The Conversation*, C. Davenport (2015)available online at https://theconversation.com/can-a-new-university-close-the-gender-gap-in-engineering-38453.

Appendix 5: NUSTEM Conference Presentations and Practitioner Workshops

A. Portas, P. McMahon, R. Hall, R. Fletcher-Wood (2020) Engaging younger children in science and engineering: a practitioner's view. BIG Conference, Online, 23 July 2020

L. Archer, C. Harvey, C. Davenport (2020) Science Capital. Virtually Social, online, 3 July 2020

R. Strachan (2020) Invited Speaker: Inclusive and Creative Leadership, Public Lecture, Taras Shevchenko National University of Kiev, Ukraine, 4 March 2020.

C. Davenport (2020) 'Careers in primary science', Harlow Primary Science Conference, 27th April 2020, Online.

C. Davenport (2019) 'Working with under-represented groups in the North East'. RASReach, 5th December 2019, International Centre for Life.

C. Davenport (2019) 'Science capital in primary schools', Havering Primary Science Conference, 11th November 2019, CEME Conference Centre, Surrey.

R. Strachan (2019) Invited Panel Member: Barriers to Leadership and Solutions, Women in Engineering Leadership Conference, Inclusive Boards, London, 22 October 2019.

C. Davenport (2019) 'Changing Children's stereotypes of Scientists' ResearchEd Annual Conference, 7th July 2019, Chobham Academy, London.

C.Davenport (2019) 'STEM person of the Week' INTERACT 2019, 4th July 2019, UCLAN, Preston.

M. Archer, C.Davenport, J. DeWitt, L Hou (2019) 'Beyond the one off... get with the programme' BIG conference, 18th July, Dynamic Earth, Edinburgh.

C. Davenport and J. Shimwell (2019) '21st Century Science Teacher', ASE Futures Conference, 5th July 2019, Sheffield Hallam University.

C. Davenport, A. Portas (2019) 'Careers from physics', IOP Day for Everyone Teaching Physics, 4th July, Durham University.

J. Shimwell (2019) 'Scientist of the week: breaking down STEM stereotypes' Primary Science Education Conference, 8th June 2019, Edinburgh International Conference Centre.

C. Davenport, M. Storey, K. Winter (2019) 'Careers and the primary science curriculum' Primary Science Education Conference, 8th June 2019, Edinburgh International Conference Centre.

Emembolu, R. Strachan, C. Davenport (2019) 'Designing effective evaluations for applying scientific academic research to career based interventions with young children.' United Kingdom Evaluation Society, 15 – 16 May.

C. Davenport (2019) 'Using career contexts to teach science', ASE Conference, 11 January, University of Birmingham.

C. Davenport, J. Shimwell (2019) 'STEM person of the Week: Supporting careers in primary science' ASE Conference, 10 January 2019, University of Birmingham.

Portas, A. (2018) "Work Experience week for the busy academics" – Three Rivers Conference, 16 July 2018, Newcastle University.

Portas, A. (2018) "Jobs in and from Physics - developing simple career resources for teachers" – Ogden Outreach Officers meeting, 16th January 2018, Leeds University.

Portas, A. (2019) "Jobs in and from Physics – KS3 STEM careers postcards" – Ogden Outreach Officers meeting, 5th September 2019, UCLAN.

Emembolu I, Dele-Ajayi O, Strachan R (2018). Exploring Career Stereotypes and Aspirations: A Case Study of Young People in Nigeria. British Education Research Association (BERA) Conference. 11th-13th September at Northumbria University.

Emembolu, I. (2018) Roundtable Discussion titled ''Round Table - Addressing the Gender Gap / Exploring Trust and our Unconscious Bias' at the 2018 IEEE Global Engineering Education Conference (EDUCON). Video available online at https://www.youtube.com/watch?v=do-rpSk6Ous

C. Davenport (2018) 'Careers in the Curriculum', ASE Conference, 5th January, University of Liverpool.

C. Davenport (2017) 'Girls jobs and boy jobs?', ResearchEd2017, 9th September, Chobham Academy.

Article about the talk 'Primary boys know more about jobs that girls' available online at https://schoolsweek.co.uk/wp-content/uploads/2017/09/SW-112-digi.pdf , 2017, edition 112, pg. 22.

C. Davenport, A. Lloyd, B. Ross, N. Wallworth (2017), 'Normalising Science in Informal and Formal Education', The BIG Event, 21st July, Centre for Life, Newcastle.

C. Davenport (2017) 'Imagining the Sun: bringing art and science together', Northumbria Teaching and Learning Conference, 26th April, Northumbria University.

R. Strachan, C. Davenport, J. Shimwell, A. Padwick, J. Sanderson, O. Dele-Ajayi (2017) 'NUSTEM: A blueprint for engaging and improving the uptake of STEM by young people, particularly females and other under-represented groups', HEA Annual Conference, 5th July, Manchester University.

C. Davenport, J. Sanderson, D. Syrop (2016) 'Strategy, Practice and Challenges for Young Peoples' Engagement: Lessons from engineering projects', ENGAGE conference, 30th November, Bristol.

C. Davenport, J. Shimwell, J. Sanderson (2017) 'STEM clubs for families' INTERACT 2017, 14th September, Birmingham University.

C. Davenport (2016) 'Unconscious Bias', ResearchEd York, 9th July, Huntington School, York.

C. Davenport (2016) 'Gender Equity in Schools', Telegraph Festival of Education, 24th June, Wellington College.

C. Davenport (2016) 'Think Physics: Embedding Careers in the Classroom', Primary Science Teaching Trust International Conference, 10th June, Belfast.

C. Davenport (2016) 'Unconscious Bias' Yorkshire and Humber Science Learning Partnership Subject Leader Day, 3rd March, National Coal Mining Museum.

C. Davenport (2016) 'Teaching Physics at KS2' Yorkshire and Humber Science Learning Partnership Subject Leader Day, 3rd March, National Coal Mining Museum.

J. Shimwell, D. Wilkinson (2016) 'Science Pop up Shops Talk, HEA STEM Conference, 1st February 2016.

C. Davenport, J. Shimwell (2016) 'Science for Families', Association for Science Education Annual Conference, 9th January, Birmingham.

C. Davenport (2016) 'Pursuing Gender Equity in Science', Association for Science Education Annual Conference, 7th January, Birmingham.

C. Davenport (2015) 'Gender Equity in Science', ResearchED 2015, 5th September, London.

C. Davenport (2015) 'Think Physics: Inspiring young people through Physics', Association for Science Education Annual Conference, 8th January, Reading.

C. Davenport (2014), 'Girls in STEM: What's the big deal?', ResearchED 2014, 6th September, London. Article about the presentation available at: L.McInerney (2014),'Why girls are shunning A-level Physics' in http://schoolsweek.co.uk/researched-2014-souvenir-edition/ pg.4.

C. Davenport (2014), 'Using Action research to improve practice', Northern Rocks 2014, 7th June, Leeds.

C. Davenport (2013), 'Action research for teachers', ResearchEd 2013, 7th September, London.