Bridging the gap: Inspiring primary school children through the Children Challenging Industry programme

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Abstract

The Children Challenging Industry (CCI) programme, created by the Centre for Industry Education Collaboration (CIEC) at the University of York, has been helping primary school children explore the world of science and industry since 1996. This article looks at how the programme has impacted children's attitudes towards science and industry, encouraging interest in STEM (science, technology, engineering and mathematics) careers. By connecting classroom learning to real-world experiences, the programme gives children hands-on opportunities, such as site visits to local companies and activities with STEM professionals (CCI ambassadors), to see how science works in everyday life.

This article provides an overview of the findings from the paper *Children Challenging Industry: Improving Young Pupils' Engagement with Science through Links with Industry,* published in the *International Journal of Science Education*. The study involves 508 pupils aged 9-11 from schools in the North East and East of England regions. Drawing on data collected during the 2019–2020[1] academic year (Bórquez-Sánchez *et al*, 2024), the study emphasises the importance of introducing children to science and industry at an early age. Through questionnaires completed before and after the programme, the findings show that children gained confidence in science, developed a greater interest in STEM careers, and enjoyed learning through hands-on activities and visits to local companies. Interacting with real scientists and engineers helped children to understand how science works in everyday life, sparking curiosity and breaking down stereotypes about who can work in STEM. By fostering connections with industry, CCI shows how schools and companies can work together to inspire the next generation of scientists and engineers. Practical recommendations for teachers and programme organisers are also shared.

Keywords

Attitudes towards science, industry collaboration, hands-on learning, science capital

Introduction

Since 1996, the Children Challenging Industry (CCI) programme, led by the Centre for Industry Education Collaboration (CIEC) at the University of York, has been bringing science to life for primary school children. By linking classroom learning with real-world industry, the initiative helps children to see how science is relevant to their

[1]For the most recent and comprehensive evaluation of the CCI programme's impact on science education, please refer to the evaluation reports available at https://www.york.ac.uk/ciec/research/

everyday lives and opens their eyes to potential careers in science, technology, engineering and mathematics (STEM). Through activities such as site visits to local companies, hands-on activities, and sessions with CCI ambassadors, children are given opportunities to experience the roles of scientists and engineers first-hand. Teachers also benefit from the programme, gaining practical strategies to enhance their science teaching and make the subject more engaging for their pupils. This article provides an overview of the findings from the paper *Children Challenging Industry: Improving Young Pupils' Engagement with Science through Links with Industry*, published in the *International Journal of Science Education*. The data presented were collected during the 2019–2020 academic year (Bórquez-Sánchez *et al,* 2024). By reflecting on these outcomes, the article aims to highlight the significance of such initiatives in inspiring children and addressing the skills gap in STEM fields.

Theoretical context

Understanding pupils' engagement with science requires considering multiple factors beyond their academic performance or conceptual knowledge. Attitudes towards science and awareness of STEM careers play a crucial role in shaping future aspirations (Archer *et al,* 2015; Osborne *et al,* 2003). Engaging children in science during their early years is crucial for shaping their attitudes, interests and aspirations. Research shows that children often form their perceptions of subjects such as science and potential career paths well before secondary school and, without positive experiences, many may view science as intimidating, irrelevant, or 'not for them' (Archer *et al,* 2010; Sheldrake & Mujtaba, 2020).

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Building science capital and positive attitudes towards science

Inspiring children to see the relevance of science in their lives helps to build 'science capital', a combination of knowledge, attitudes and connections that make science accessible and relatable (Archer *et al,* 2015). This is particularly important for children who may not have exposure to science-based careers through their family or community. CCI aims to address this by making science tangible, exciting and tied to real-world applications. Moreover, introducing children to the variety of roles within STEM industries, from engineers and chemists to environmental scientists, can challenge stereotypes and broaden their understanding of what careers in science can look like (Vossen *et al,* 2023). For instance, seeing scientists and engineers who reflect diverse genders, ethnicities and backgrounds can help children to envision themselves in similar roles, breaking down barriers of perception (Archer & DeWitt, 2016). Beyond career aspirations, developing a positive attitude towards science equips children with the skills and confidence to engage with scientific issues as informed citizens (Osborne *et al,* 2003).

Gender differences in science engagement remain a significant issue. Research shows that girls often develop less confidence in their scientific abilities due to implicit gender stereotypes, parental and teacher expectations, and the perception that some science subjects such as physics are more suited to boys (DeWitt & Archer, 2015); Makarova *et al,* 2019). Many children, from a young age, associate scientists with men and view science careers as challenging, or even risky (Scholes & Stahl, 2022). These attitudes can shape subject choices and career aspirations, leading fewer girls to pursue STEM-related fields (Denessen

et al, 2015). However, hands-on learning experiences, exposure to role models and making science relevant to everyday life can encourage more girls to pursue STEM (Archer & DeWitt, 2016; Forbes & McCloughan, 2010; Oon *et al,* 2020).

In an increasingly complex world, understanding topics such as sustainability, technology and innovation is vital for making informed decisions. Early inspiration lays the foundation for lifelong curiosity and critical thinking, qualities that benefit individuals and society alike (Sheldrake *et al,* 2024). CCI takes a proactive approach to sparking this interest, ensuring that children not only learn science but also see its value and relevance in the world around them.

Children Challenging Industry programme

CCI is a science education programme designed for primary school children and teachers, in collaboration with STEM companies. It focuses on engaging 9-11 year-olds through hands-on, real-world problem-solving activities while offering professional development for teachers. The programme connects schools with local science-based manufacturing companies through site visits or by bringing industry professionals into the classroom. A dedicated advisory teacher provides support, training and classroom activities for both teachers and industry volunteers. By incorporating industrial contexts, the programme enriches pupils' understanding of scientific practices and subject knowledge aligned with the English National Curriculum. Its primary goal is to enhance pupils' attitudes, motivation and enjoyment of science while introducing them to the work of scientists and engineers. Through hands-on science activities, site visits to STEM companies, and interactions with STEM professionals from industry (CCI ambassadors), CCI helps children to see science in action, making it more tangible, relatable and inspiring. By meeting scientists and engineers from diverse backgrounds, students can challenge stereotypes about who can work in STEM, broadening their career aspirations (Archer & DeWitt, 2016). The CCI programme provides practical tools for teachers and experiences that help students to see science as something that they can belong to and succeed in.

Each school-industry partnership creates a specific blend of classroom activities and site visits. For instance, children may work on challenges from the CIEC publication *Water for Industry*[2], such as selecting materials for pipelines, filtering river water, or cooling large tanks of hot liquids (see Image 1). An example of a subsequent site visit may be one where children meet engineers, scientists and technical apprentices, and observe heat exchangers, sensors and filtration systems (see Image 2).

▼ **Image 1** *Water for Industry* classroom activity.

▼ **Image 2** Site visit following the *Water for Industry* classroom activities.

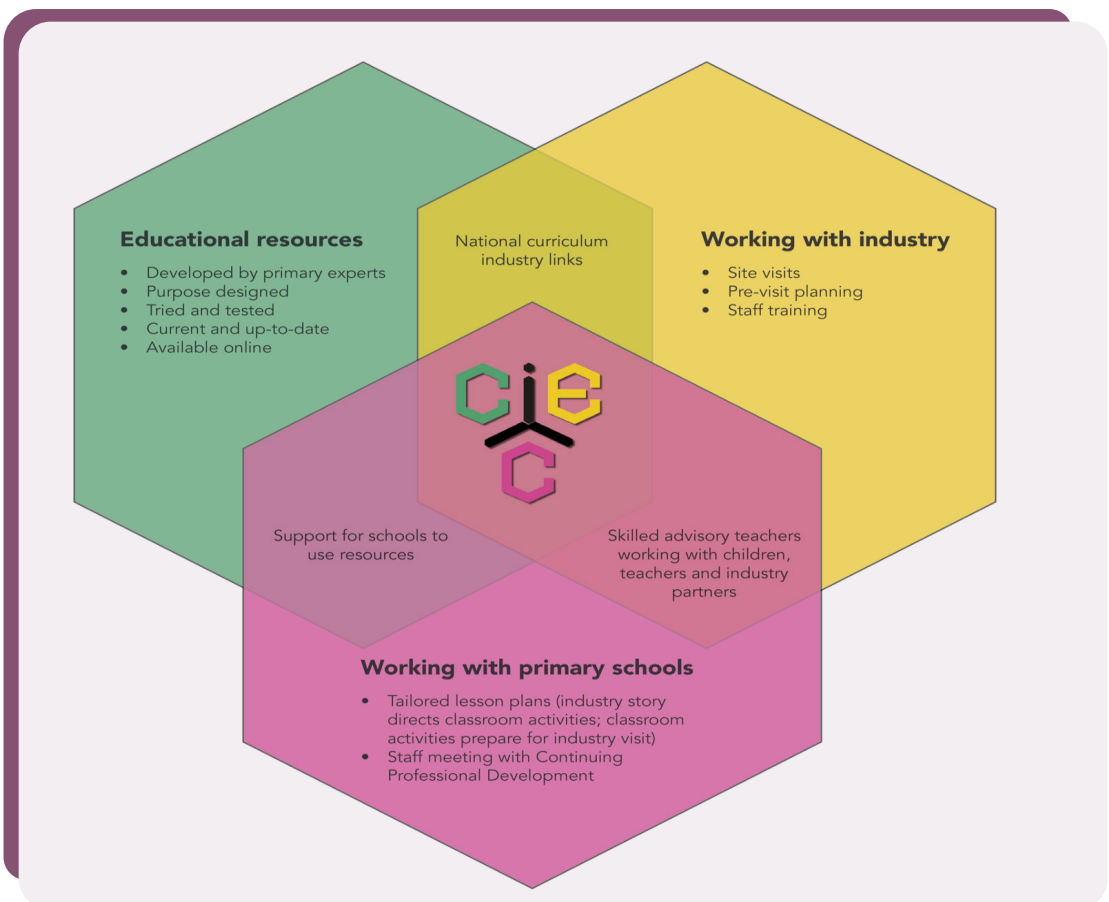
[2]Further details on Water for Industry activities can be found at https://www.york.as.uk./ciec/resources/primary/water-for-industry

This combination of activities is carefully designed by the advisory teacher, who visits the company's site in advance to determine accessible opportunities for children. Selected activities are shared with each company's CCI ambassadors as part of their training, ensuring a meaningful connection between the classroom and the workplace.

The CCI programme's structure (Figure 1) includes elements highlighted as effective practices for engaging schoolchildren in promoting industry, as noted in the *Chemistry Council Sector Deal Report 2019* (Society of Chemical Industry, 2019). It also aligns with the Royal Society's vision for science education, advocating for stronger links between professional organisations and school education (The Royal Society, 2018). To this end, the programme offers tailored teacher training, specialised materials and professional site visits. CCI ambassadors involved in the programme aim to positively shape pupils' perceptions of science, echoing research by Forbes and Skamp (2013) that highlights the role of scientists in influencing children's attitudes towards science.

Figure 1 illustrates the structure of the CCI programme, showcasing its three key components: educational resources, industry collaboration, and primary school engagement. It highlights how these elements combine to connect the National Curriculum with real-world STEM applications, supported by CCI advisory teachers and CCI ambassadors. The overlapping sections emphasise the programme's integrated approach to enhancing science education for children.

▼ **Figure 1** CCI framework: Summary of key elements and influences on curriculum-linked teaching for effective learning in science (Bórquez-Sánchez *et al*, 2024).



Methodology

Research questions

The aim of this paper is to investigate the impact of the CCI programme and its components on children's attitudes towards science and industry. Specifically, the research questions are:

1. What is the impact of the CCI programme and its components on pupils' attitudes towards science?
2. What is the impact of the CCI programme and its components on pupils' attitudes towards, and knowledge of, industry, including about STEM careers in industry?
3. Are there gender differences in pupils' responses to the programme?

Recruitment and data collection

This study focused on 23 schools in the North-East (NE) and East of England (EE) during the 2019-2020 academic year. Schools were selected based on:

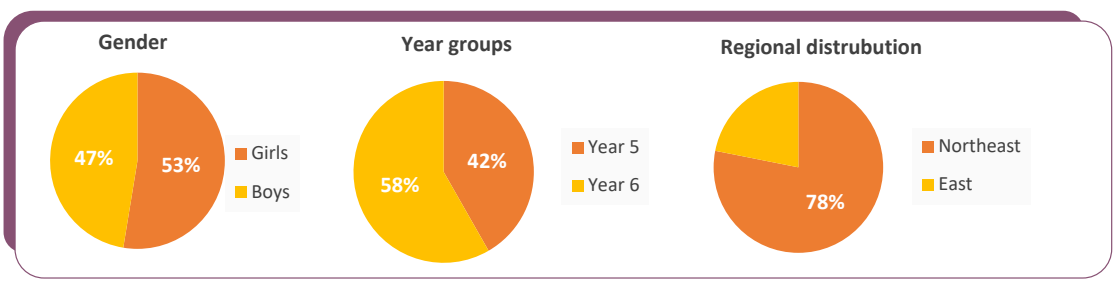
- Their level of participation in the programme since 1996; and
- Their representation of diverse socio-demographic characteristics, including children from various ethnic and socio-economic backgrounds, particularly those from disadvantaged areas.

Ethical approval was obtained, and parents were given the opportunity to opt out. Children completed online pre- and post-intervention questionnaires during school hours. Only responses from children who participated in both surveys were included in the analysis. The COVID-19 pandemic disrupted data collection from mid-March 2020, leading to refinements in programme delivery and evaluation methods. These adjustments have implications for the analysis and comparison of data.

Participant demographics

A total of 508 children from Years 5 and 6, aged 9-11, participated in the study. The gender distribution included 267 girls (52.6%) and 241 boys (47.4%). In terms of year groups, 212 participants (41.7%) were in Year 5, while 296 (58.3%) were in Year 6. Regarding regional distribution, the majority of participants, 397 children (78.1%), were from the North East (NE), with the remaining 111 (21.9%) from the East of England (EE) (Figure 2).

Figure 2 Demographic breakdown of the participants: gender, year group, and regional distribution.



Response rates varied across questions, as not all participants answered every item.

Instrument design

The questionnaire items were developed over many years, initially inspired by semi-structured interview schedules used in focus group interviews conducted between 1996 and 1999. The responses from these interviews were carefully categorised, forming the foundation for the questionnaire items. Over time, various researchers contributed to and refined these items, creating a robust tool with which to assess primary school pupils' attitudes towards science

and industry. Care was taken to avoid ambiguity and culturally inappropriate phrasing, as well as to use clear, age-appropriate language.

The design of the questionnaire was informed by multiple sources, ensuring that it aligned with established frameworks for measuring attitudes toward science, such as the science capital dimension from the ASPIRES project by Archer *et al* (2013).

Additionally, items were inspired by the ROSE project (Sjøberg & Schreiner, 2010), the Attitudes to Science and School Science project (Bennett & Hogarth, 2009), PISA attitude measures (OECD, 2016), and prior CCI reports dating back to 1996. To further refine the questionnaire and minimise bias, the structure followed Pell and Jarvis's (2001) guidelines for investigating primary school children's views on science, ensuring that Likert-scale items were developmentally appropriate for pupils aged 9-11.

The questionnaires included Likert-scale items and were refined through factor analysis to ensure reliability. The pre-programme questionnaire (20 items) measured pupils' attitudes and engagement with science and industry, while the post-programme questionnaire (26 items) included reflections on their programme experiences.

Data analysis

Quantitative responses were analysed using statistical software, focusing on changes in attitudes before and after the programme:

- Likert-scale items were scored and reverse-coded when necessary.
- Reliability of the questionnaires was assessed using Cronbach's alpha.
- T-tests and one-way ANOVAs examined changes and differences by participant characteristics.

Qualitative data from open-ended questions were analysed to identify recurring themes, providing insights into pupils' lived experiences and local social realities.

"The findings provide insights into the effectiveness of the programme in promoting interest and engagement in science-related fields."

Results

This section summarises the quantitative and qualitative data collected from children who completed both the pre- and post-intervention questionnaires. The analysis focuses on understanding children's attitudes towards science and industry, examining how the CCI programme interventions influenced these attitudes and their perceptions of STEM careers. The findings provide insights into the effectiveness of the programme in promoting interest and engagement in science-related fields.

Quantitative results

This section presents the quantitative findings from the study, examining how the CCI programme influenced pupils' attitudes towards science and industry. It explores changes in pupils' engagement, confidence and career aspirations.

■ Attitudes towards science

To evaluate how the CCI programme influenced pupils' attitudes towards science, we used a carefully designed 'Attitudes to Science' scale. A total of 453 pupils who completed both pre- and post-programme questionnaires were included in the analysis.

Our findings showed that the CCI programme had a positive impact on pupils' perceptions of science. There was a significant improvement in their overall attitudes towards science after participating in the programme. For instance, many pupils expressed a stronger interest in science as a subject, with notable increases in the number who identified science as their favourite subject, or saw themselves pursuing a career as a scientist. Additionally, pupils' confidence in their ability to engage with science improved, as fewer described science as being too difficult or overly focused on writing tasks.

Individual questionnaire items provided further insights into these changes. Statements such as *'Science is my favourite subject'* and *'I'd like to be a scientist'* saw the greatest increases in positive responses, with the former rising by 11.5 percentage points and the latter by 8.6 percentage points (Figure 3). Conversely, negative statements, such as *'We do too much writing in science'*, showed a decrease in agreement, reflecting a shift towards more positive attitudes overall (Figure 4).

Figure 3 Attitudes to science and science learning: statements representing positive concepts.

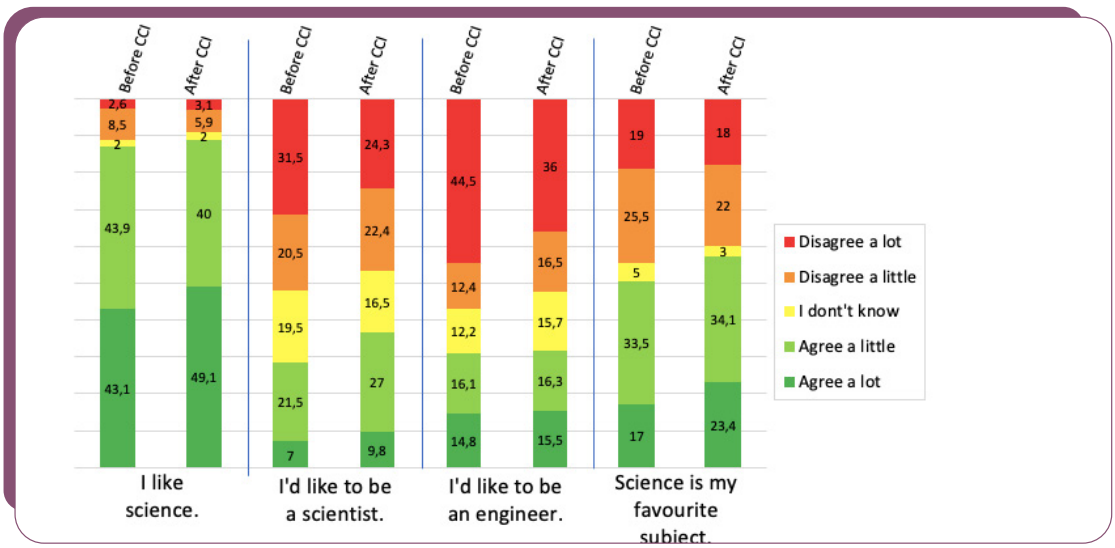
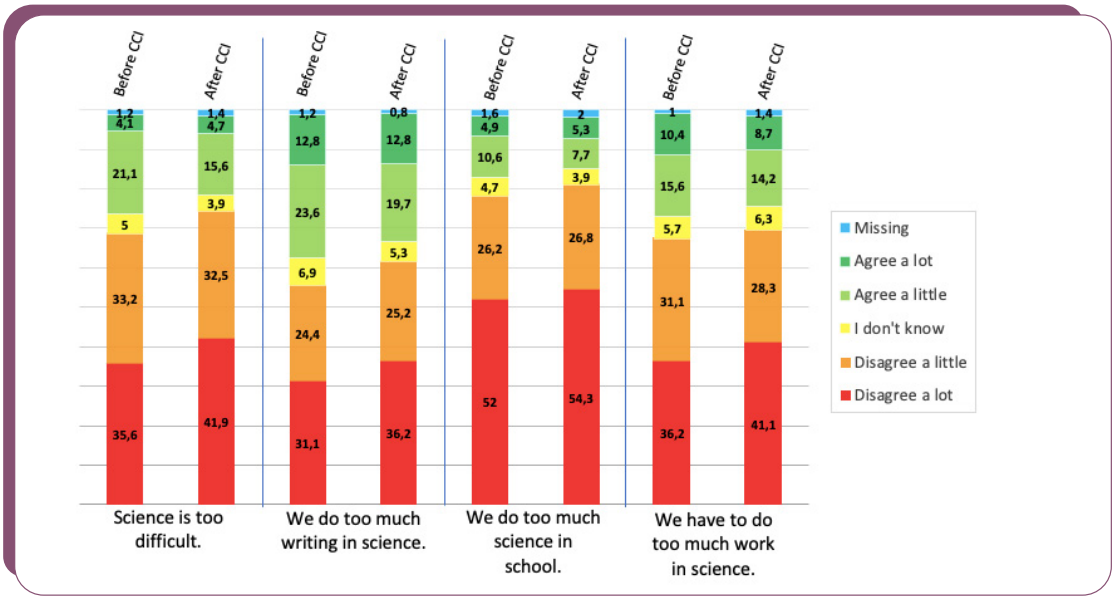


Figure 4 Attitudes to science and science learning: statements representing negative concepts.



These results suggest that the CCI programme helped pupils to not only enjoy science more but also perceive it as more accessible and engaging. Figure 4 shows how children's attitudes towards science changed before and after taking part in the CCI programme.

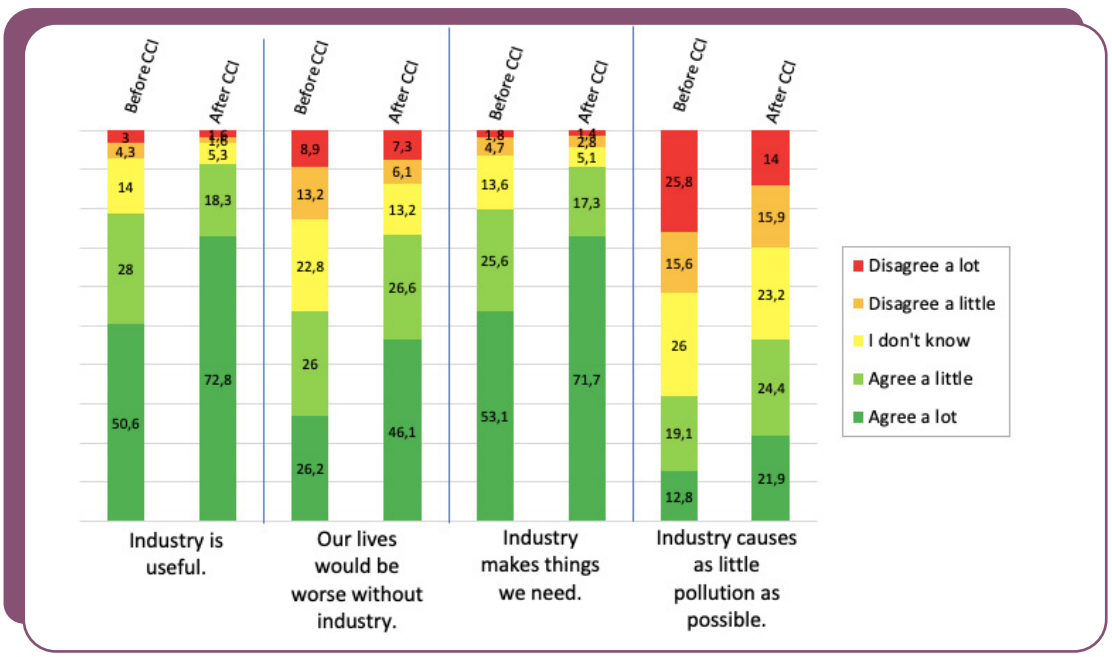
After the programme, fewer children felt that 'science is too difficult', or that 'we do too much writing in science', which suggests that the activities helped to make science feel more approachable and engaging. There were also slight improvements in how children viewed the amount of science and work that they had to do, showing that the programme might have made science feel less overwhelming and more enjoyable overall.

Attitudes towards industry

In addition to examining pupils' views on science, the programme also explored their attitudes towards industry. An 'Attitudes to Industry' scale was used, focusing on pupils' perceptions of the role of industry in their lives, its benefits and challenges, and the contributions of scientists and engineers.

The findings show that the CCI programme significantly increased pupils' awareness of the relevance of industry and its potential as a career pathway. After participating, more pupils recognised the importance of industry in their everyday lives, with responses to the statement '*Industry is useful*' increasing by 33.5 percentage points (Figure 5).

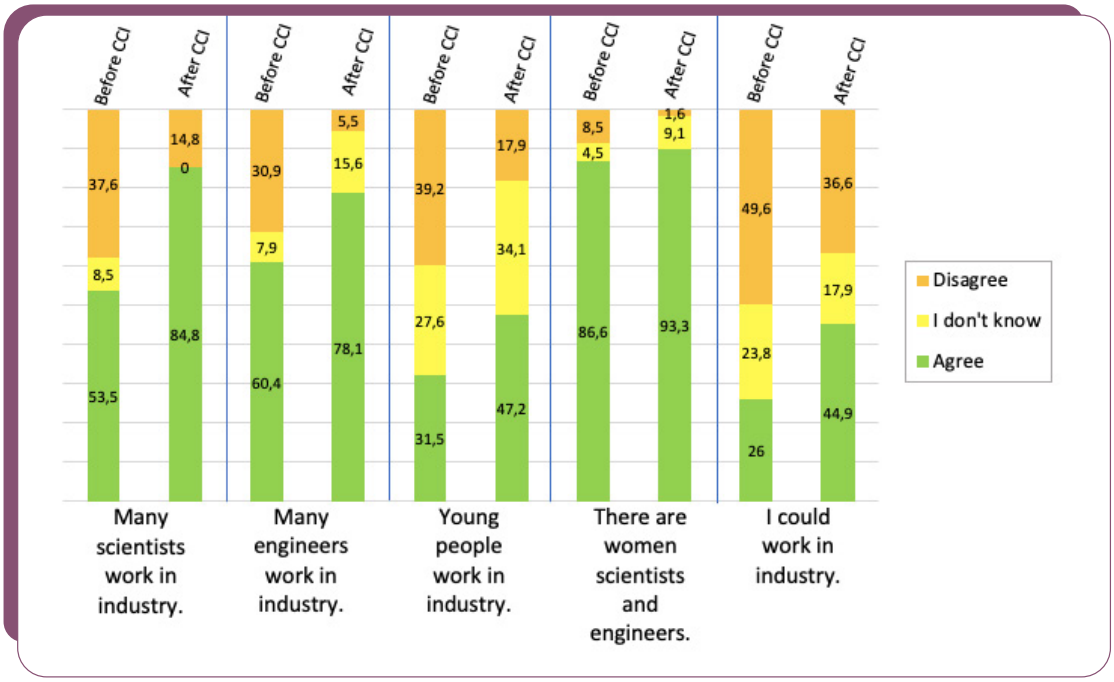
Figure 5 Attitudes towards and learning about industry (5-point Likert-scale items): statements representing positive concepts.



Similarly, the statement '*I could work in industry in the future*' saw an 18.9 percentage point rise in agreement. These changes highlight how the programme broadened pupils' understanding of industry's role and its connection to science and engineering (Figure 6).

The data also showed a significant improvement in pupils' knowledge of careers in industry. For example, agreement with '*Many scientists work in industry*' rose by 31.3 percentage points, reflecting the programme's effectiveness in exposing pupils to real-world STEM roles. The inclusion of diverse role models, such as younger professionals and women in engineering and science, appeared to challenge traditional stereotypes. This was evident in the increased agreement with statements such as '*There are women scientists and engineers working in industry*', which saw a moderate increase (Figure 6).

Figure 6 Attitudes and knowledge about the [careers in] industry (3-point Likert-scale items, before and after CCI).



Gender differences

The impact of the programme varied across different groups. Both boys and girls benefited from the intervention, but boys showed greater improvement in recognising the presence and contributions of women in STEM careers. This helped to narrow the initial gender gap in perceptions of diversity in industry. This finding is significant because it directly challenges the stereotype that STEM careers are primarily for men. While girls already had relatively high agreement with statements about women's roles in science and engineering, boys demonstrated a much larger increase in their recognition of female contributions post-programme. By exposing all pupils to diverse role models and real-life examples of women working in STEM, the programme helped to reshape boys' perceptions, making them more aware of the inclusive nature of science and engineering.

Regional differences were also observed. Pupils in the East of England, who had less exposure to industry before the programme, showed the largest improvements. For example, their agreement with *'Many engineers work in industry'* increased sharply compared to pupils in the North-East, who had a higher baseline awareness of industry. This suggests that the CCI programme is particularly impactful in regions with less prior exposure to STEM opportunities.

Qualitative results: Understanding pupils' experiences

This section explores the qualitative data collected from pupils' open-ended responses about their experiences with the CCI programme. A total of 948 comments were analysed to understand what pupils enjoyed most and least, providing deeper insights into how the programme influenced their attitudes to and knowledge of science, industry and STEM careers.

Influence of the CCI programme on pupils' attitudes and knowledge

The CCI programme had a profound impact on pupils' attitudes towards science and industry. Many pupils described their enjoyment of science both before and after participating in the programme, though some acknowledged that it had not always been engaging or easy. Positive comments about enjoying science at school or home before the programme made up 72% of responses, while 9% noted that science could occasionally feel challenging or less engaging.

The qualitative responses highlight how the programme further improved pupils' enthusiasm for science. For instance, pupils expressed a newfound excitement about conducting experiments and learning through practical activities:

> *'I think science is interesting and fun as it makes me intrigued to know more'* (Girl, EE).
> *'We don't do much writing in science, but I honestly would like to do more science experiments and write about it'* (Boy, NE).

- **What pupils enjoyed most**

The hands-on nature of the CCI programme was a key factor in its success. Pupils frequently mentioned the activities (57%) and the visits to or interactions with industry partners (28%) as the most enjoyable aspects. Many pupils recalled specific activities or experiences that left a lasting impression:

> *'I enjoyed creating hydrogel because the progress was good, and I LOVED putting my hands in the bowl!'* (Boy, NE).
> *'I enjoyed going to the industry and seeing all of the machines, robots, and learning what [the company] do'* (Girl, EE).

Overall, 69% of pupils chose to mention learning something specific from these experiences, demonstrating the programme's ability to make science and industry tangible and relatable.

- **Learning about science and industry**

The programme introduced many pupils to the concept of industry, which was unfamiliar to them beforehand. Pupils gained a clearer understanding of STEM careers and the roles of scientists and engineers. For some, the programme confirmed their existing interests, while for others, it sparked new aspirations:

> *'I most enjoyed getting to learn what all the different scientists' roles were and how they all impact [...] our lives today'* (Girl, EE).
> *'I loved visiting [the industry] because it really caught my attention and I really, really want to be a scientist when I am older'* (Girl, NE).

The programme helped many pupils to see the relevance of science and industry to their lives, even if they did not intend to pursue STEM careers. However, for a few (6%, or 24 pupils), some activities were described as 'hard' or 'confusing', suggesting areas where additional support or clarity might enhance the experience.

The qualitative findings underscore the importance of hands-on, practical learning in engaging pupils with science and industry. Activities, industry visits, and direct interaction with CCI ambassadors made abstract concepts more concrete and exciting. For many pupils, the CCI programme expanded their understanding of science and introduced new possibilities for their futures, even if they did not see themselves pursuing a STEM career. The combination of active participation and exposure to CCI ambassadors allowed pupils to make stronger connections between classroom learning and real-world science and reinforced their confidence and ability to engage with scientific concepts.

These insights suggest that integrating practical activities and industry partnerships into the curriculum can improve both engagement and learning outcomes. By providing opportunities for pupils to apply knowledge in meaningful ways, such approaches help to make science more accessible and enjoyable for a wide range of learners. Teachers and programme organisers should continue to offer clear guidance and structured support during activities to ensure that all pupils, regardless of background or confidence level, can benefit fully from these experiences.

"The programme introduced many pupils to the concept of industry."

General discussion and implications

Engaging pupils in STEM education at an early age is a key strategy to enhance their confidence, skills and interest in science, technology, engineering and mathematics. Research shows that early exposure to STEM can lead to a greater likelihood of pursuing related careers, help reduce inequalities, and improve overall attitudes towards science within society (Archer *et al,* 2013; Maltese & Tai, 2011). However, enjoyment alone is not enough to sustain engagement or lead to deeper learning. While hands-on activities and industry visits can make science more exciting and relatable, research has shown that these experiences must also be structured to promote conceptual understanding and long-term retention (Abrahams & Sharpe, 2010). Simply making science 'fun' does not necessarily translate into lasting knowledge gains or career aspirations (Archer *et al,* 2010; Fernandez *et al,* 2023). Instead, practical experiences should be purposefully designed to reinforce key scientific concepts and critical thinking skills, ensuring that pupils not only enjoy STEM but also develop a strong foundation for future learning (Fernandez *et al,* 2023).

"The presence of female engineers and scientists during visits and classroom activities played a crucial role in showing pupils that STEM professions are viable options for everyone, regardless of gender."

In line with these findings, our study highlights the positive impact of the CCI programme on primary school-aged pupils, particularly in helping them to understand how science and technology are used in real-world settings. While existing STEM-industry collaborations often target secondary school pupils, this programme demonstrates the value of focusing on younger children. By involving teachers, schools and local companies, the programme fosters an appreciation for the practical applications of science, linking it to careers and industries within pupils' communities. The study's results align with Demirhan and Şahin (2021), who found that pupils benefit most from hands-on learning and real-world problem-solving in science education. This approach resonates with Wolcott's (1991) idea that learning should be viewed as acquiring culture, connecting children to the practices and knowledge of the scientific and industrial communities around them.

Gender differences in science interest and engagement are well-documented (Toma *et al,* 2019; Weinburgh, 2000). In this study, both boys and girls demonstrated improved understanding and attitudes towards STEM careers, particularly regarding the presence of women in science and engineering. While the changes were greater for boys, the programme helped to challenge traditional gender stereotypes by exposing all pupils to diverse role models in STEM. The presence of female engineers and scientists during visits and classroom activities played a crucial role in showing pupils that STEM professions are viable options for everyone, regardless of gender. This aligns with Jerrim and Schoon's (2014) assertion that encountering diverse role models can influence pupils' career aspirations.

Theoretical and practical implications

The findings of this study point out the importance of integrating real-world contexts into STEM education, both for those who may pursue STEM careers and for those who will benefit from understanding science's societal implications in other fields.

The CCI programme serves as a model for building pupils' science capital, a relatively recent concept that encompasses science-related knowledge, resources and attitudes (Archer *et al,* 2015). By providing classroom activities, teacher training and collaborations with local companies, the programme enables children, particularly girls, to see science in action and consider careers that they may not have previously imagined.

This approach aligns with previous research by Forbes and Skamp (2013), which emphasises the positive influence of scientists and engineers on children's attitudes towards science. The programme also addresses a gap in science-industry initiatives at the primary level, delivering resources and activities fully aligned with the curriculum. Teachers are supported through training, pedagogical resources and industrial partnerships, ensuring that science topics are effectively introduced and taught.

Practical recommendations for teachers

1. **Integrating real-world applications**: Teachers can endeavour to link science lessons with practical, real-world examples to make science concepts more relatable. Visits to industrial sites and interactions with STEM professionals can inspire pupils and provide them with tangible career pathways.

2. **Providing diverse role models**: Exposure to diverse professionals in STEM, particularly women and younger role models, helps to challenge stereotypes and encourage inclusivity in science and engineering careers. Teachers can use resources such as:
   a. Primary Science Teaching Trust's (PSTT) *A Scientist Just Like Me (ASJLM)* to introduce pupils to diverse real-world scientists in an engaging and relatable way (https://pstt.org.uk/unique-resources/a-scientist-just-like-me/).
   b. nuSTEM's scientists' resources, which showcase a variety of STEM careers with downloadable classroom activities (https://nustem.uk/resources/).
   c. Career cards, designed by CIEC to be used alongside a PowerPoint presentation with 9-11 year-olds to raise their awareness of the range of STEM careers open to them, career opportunities available in industry and the advantages of studying STEM subjects when they are older (https://www.york.ac.uk/ciec/resources/primary/career-cards/).

3. **Enhancing curriculum resources**: Programmes such as CCI should focus on developing high-quality, curriculum-aligned resources that are designed for classroom use. These resources should complement experiential learning activities, such as school trips and investigations. CIEC provides free, research-informed STEM teaching resources, which can be accessed online at https://www.york.ac.uk/ciec/resources/.

4. **Supporting teacher training**: Continuous professional development for teachers is essential to ensure that they feel confident in delivering STEM lessons that incorporate industry contexts. Training should include practical strategies for engaging pupils in hands-on activities and integrating STEM careers into the curriculum.

"This study contributes to the limited evidence on STEM programmes for primary-aged pupils."

Contribution to STEM education

This study contributes to the limited evidence on STEM programmes for primary-aged pupils. The findings demonstrate that programmes like CCI not only enhance classroom interactions but also provide valuable training and resources

for teachers. These initiatives are particularly effective in fostering positive attitudes towards STEM careers and equipping pupils with the skills and confidence to consider future opportunities in science, technology and engineering. By addressing both theoretical and practical challenges, the CCI programme offers a blueprint for engaging younger learners in STEM, ultimately helping to build a more inclusive and scientifically literate society.

Limitations and future directions

The limitations identified in this study fall into two main areas. Firstly, the participating schools represent a self-selected group from those offered the programme, which may mean that the full diversity of ethnic groups and socio-economic backgrounds in the region is not fully captured. This could have influenced the analysis by overlooking groups that might require additional support, or by not accounting for certain external factors. Secondly, the study did not include follow-up with science teachers after their participation in the CCI programme. As a result, it was not possible to gather evidence on how the full set of resources influenced their classroom practices in the long term, making it harder to assess sustained changes in teaching methods.

To address these limitations, we are currently working on several ongoing studies aimed at exploring these aspects further. For instance, efforts are being made to involve a more diverse range of schools to ensure better representation of different ethnic groups and socio-economic backgrounds. We are also conducting follow-up studies with teachers who participated in the CCI programme to examine how they integrate the resources into their teaching practices over time. These longitudinal studies aim to capture the long-term impact of the programme, including changes in teaching strategies and the effects on pupils' engagement and learning outcomes.

Conclusions

This article presents a summary of the findings from the study *Children Challenging Industry: Improving Young Pupils' Engagement with Science through Links with Industry,* published in the *International Journal of Science Education*. The data, collected during the 2019–2020 academic year (Bórquez-Sánchez *et al,* 2024), highlight the programme's impact on young pupils' engagement with science and industry.

This study concludes that the CCI programme has a positive impact on pupils' attitudes towards science and industry. Participants reported increased engagement and knowledge, particularly in areas where they previously had limited exposure. The hands-on activities and connections with CCI ambassadors helped to demystify STEM careers and foster a sense of curiosity and possibility among pupils.

The programme also provided primary teachers with new approaches to teaching science, supported by advisory teachers. These approaches encouraged innovative classroom interactions and linked industry-relevant activities with the curriculum.

Our findings suggest that the interconnected design of the CCI programme, integrating classroom-based learning, teacher training and industry partnerships, can serve as a model for developing future science-industry collaborations. By addressing the identified limitations, such programmes have the potential to generate even more consistently positive outcomes for pupils, ultimately enhancing their attitudes and aspirations towards STEM.

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