

# Not another questionnaire! Why is it important to measure the impact of educational programmes?

**Agata A. Lambrechts explains how and why CIEC research and evaluations enhance the evidence base about good practice in science teaching and learning, and effective links with industry**

	Agree a lot	Agree a little	Disagree a little	Disagree a lot	I don't know
I like science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'd like to be a scientist	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Science is my favourite subject	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Science is too difficult	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1 Snapshot of a CIEC questionnaire for children

The CIEC team has been running its flagship programme Children Challenging Industry (CCI) for 25 years. The programme provides young children (age 8-11) and their teachers with practical problem-solving classroom activities as well as access to science-based workplaces and professionals. Industrial partners benefit from the opportunity to raise awareness, in their local community, of their people and processes (what they do, how they do it, and who does it). Our team has carried out research and evaluation into the *impact* of our resources and programmes since the programme began in 1996, to ensure that CCI – and all our other programmes – are improved to meet the changing needs of both schools and companies. Furthermore, our research enhances the evidence base about good practice in building links between education and

industry, which can be used to establish new programmes all over the world.

## What are educational interventions?

An educational intervention is a programme or set of steps designed to help children during their educational journey, for example, to raise low levels of literacy, to improve attainment in maths or, as with our work, to raise interest in and engagement with science and increase knowledge about industry and STEM careers.

School interventions are usually specific in the length of time they take – from a single activity to several days, weeks or even months. The idea is that children receive the intervention as participants in an activity or sequence of activities, with the assumption being that the intervention will have a desired set of effects. To ascribe impact

of an intervention in school, however, can be tricky; without a systematic evaluation, it is not possible to claim that the intervention caused the desired outcomes.

## What are educational intervention evaluations and why are they important?

Educational intervention evaluations are systematic appraisals of the effectiveness of specific interventions. They answer the all-important questions of *what works, in what contexts* and *with which groups* in education. Frequent and rigorous evaluations that collect information from different sources are essential, so that any mistakes can be corrected, and alterations can be made to reflect changing needs of children, schools and other stakeholders.

Key words: ■ Research ■ Evaluation ■ Impact ■ Interventions

**Evaluations save teachers time in the long run by sharing with them which particular interventions have a real impact on their pupils.**

Teachers can then put their time and effort into the most effective activities. Evaluations also help the senior management of a school to see the value in their staff and in children participating in the programmes. Evaluations of programmes like ours help to raise the profile of primary science, share the achievements of children and teachers – with the results featuring positively in Ofsted reports. Finally, they help us to show the funders the value of their continued support, which is vital to schools being able to access the programme at an 85% subsidised cost.

## What makes a good evaluation?

Educational interventions can be tested and evaluated in different ways. This can include 'true experiments' carried out as part of randomised control trials, in which pupils, classrooms or schools are randomly assigned to receive an intervention or be part of a control group. Such experiments are often regarded as the ideal model of establishing whether an intervention 'works' (see Styles & Torgerson, 2018, for more information). Sometimes, however, it is not possible to randomise pupils, classrooms or schools. Alternatives include quasi-experimental evaluations (where an intervention is delivered without the random assignment of participants to conditions or orders of conditions), and simpler comparisons between pre- and post-intervention, calculating the correlation between participation in an intervention and outcomes. This quasi-experimental approach was chosen as the most suitable to evaluate the effectiveness of the CCI programme. Although such studies cannot fully rule out a variety of other explanations for change in outcomes, careful analyses of systematically collected data can go far in increasing our understanding of whether an

educational intervention works and in what contexts.

It is important for evaluation reports presenting statistical data to clearly indicate which differences are statistically significant at conventional levels – generally the .05 level. Those findings show that there is only a 5% chance that the difference reported could have occurred purely by chance if the intervention's true effect is zero (for more information, see Tenny & Abdelgawad, 2020). Ideally, evaluations should also report the effect size (Coe, 2002), that is, the magnitude of the difference between pre- and post-intervention (Bakker *et al*, 2019). To allow for such reporting, which provides greater confidence that outcomes are due to the intervention and not chance, evaluations need to have relatively large sample sizes. Importantly, effect size should be reported for all measured outcomes, because, with large sample sizes, positive and statistically significant effects can sometimes be found due to chance.

## The CCI programme – an educational intervention

The CCI programme is a multi-component intervention, involving delivery of two half-days of classroom-based science activities led by our specialist CIEC advisory teachers, sandwiched with a session taught by the children's usual teacher using CIEC science equipment and lesson plans. Every year, the vast majority of children (typically over 90%) go on a field trip to a local partner industry site, whilst some benefit from a visit by an industry ambassador. Teachers and the industrial volunteers involved in the visits are trained and supported throughout the programme by our advisory team. The fundamental principle of the CCI programme is that students

learn about science through practical problem-solving activities set in real-life contexts. Crucially, the industry visit is tailored to follow on closely from the classroom activities and varies greatly between sites.

## How does CIEC evaluate the CCI programme?

The evaluation of CCI aims to investigate the impact of the CCI programme on pupils and their teachers, in terms of their knowledge, views and enjoyment of science in school, and their understanding of the links with industry. The methodology used to evaluate the programme, like the programme itself, has evolved since 1996. Early on, interviews with teachers and focus groups with children were held to ask open-ended questions based on three areas:

- What are children's views of science and of industry?
- What are primary teachers' views of science and of industry?
- Does the use of industry-focused science lessons alter these teachers' or children's views?

The answers to these questions have helped us to develop questionnaires that consist of more closed questions based on level of agreement with statements. Two questionnaires are administered to pupils and teachers – one before the programme, and one after all the elements of the programme have been completed. In recent years, this has been done online. Our analysis is largely quantitative; however, we



**Figure 2** CIEC presents some headline data in user-friendly infographics

## Strengths of the CCI evaluation

- CCI evaluations report both statistical significance and, more recently, the effect size.
- Our sample sizes are relatively large, as every year hundreds of children participate in our programmes and complete both pre- and post-programme questionnaires.
- The quantitative findings are corroborated through analysis of qualitative comments made by children, as well as their teachers.
- We implement our CCI 'intervention' across a number of 'sites' (that is, different schools in various geographical regions), in typical school settings, with one of three CCI lessons delivered by children's regular teachers, and with schools being partnered with one of our industry partners.
- The evaluations are published on our website with open access, and use easily understandable, real-world terminology and language alongside the statistical data (for example, a 20% increase in number of children who agree with the statement 'There are many women scientists and engineers'), to ensure that our readers, who range from teachers to industry partners, can judge the importance of our findings.
- We consider the effect of our programme on subgroups of pupils – boys and girls, children in different parts of the country and in different year groups, alongside the effect on the overall population in our programmes, but treat any differences with caution.

continue to ask open-ended questions to get more in-depth, rich data from both children and their teachers.

## Why are our evaluations important?

As noted above, at CIEC we believe that it is important to regularly evaluate our programmes. The findings help us to improve our training materials and teaching resources and allow us to ensure that our programmes continue to have a positive effect on children, fulfil the needs of teachers and meet

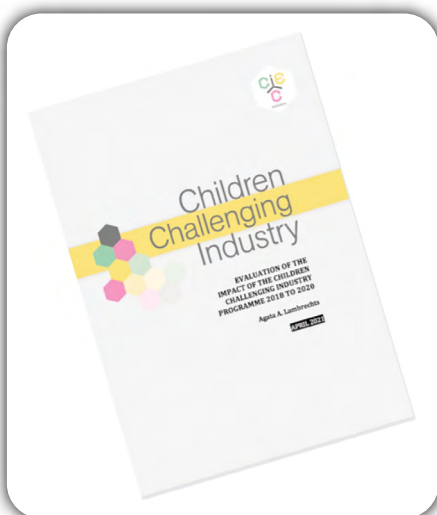
the expectations of our industrial partners. This is particularly imperative when we start working with new schools and new companies and, more recently, in a new part of the country – we need to ensure that our programme works just as well in new contexts.

However, the value of our evaluations and research goes beyond that – to date, the evidence base on the effect of interventions in primary-age children and their teachers has been lacking, with only a handful of studies that explore industry links with this age group in the UK or globally. This is despite the well-known issue of STEM (Science, Technology, Engineering and Mathematics) skills shortage in the general population, as well as in the workforce (see, for example, EU Skills Panorama, 2014) and despite prior research evidencing that leaving focused interventions related to science and STEM careers until students start secondary school may be 'too little, too late' (Archer *et al*, 2013, p.25). We believe that engaging students whilst in primary school opens their eyes to local opportunities and instils confidence in their own abilities to partake in the STEM pipeline, and thus may prove to be the most effective

and efficient route to achieving the desired level of STEM skills across the population. We acknowledge that we have only a limited knowledge of the possible longer-term impact of the CCI programme, such as sustained engagement in science learning and attainment, choice of STEM subjects at secondary school and beyond, and choice of STEM-related careers. What we know thus far is based on anecdotal data – we know of STEM professionals in industry who were inspired to follow this route thanks to CCI; and we know of 15-17 year-olds who went to companies that they had visited with us to ask for (and get) work experience opportunities. Nevertheless, our evaluations and research based on the same data enhance the evidence base about good practice in building links between education and industry, which can be used to establish new programmes in the UK and beyond.

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**Figure 3** In-depth research reports present the detailed methods and analysis used in CIEC evaluations

**Agata A. Lambrechts** was formerly a Research Associate in Science Education at the CIEC, University of York, responsible for carrying out CCI evaluations and other CIEC research. E-mail: [ciec@york.ac.uk](mailto:ciec@york.ac.uk)