Children Challenging Industry

Evaluation of the impact of the
Children Challenging Industry programme

2008-2010

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Executive summary

Provision from the CIEC *Promoting Science* (formerly the Chemical Industry Education Centre) provides children and their teachers with exposure to science-based workplaces, and industrial partners with an opportunity to enhance their reputation in the local community.

From September 2008 to July 2010, the programme reached 8,000 children and nearly 2,200 teachers in 297 primary schools. In addition, 55 science ambassadors were trained.

Industrial partners are a vital part of the programme. There were 213 site visits and 131 new personnel received training from CCI Advisory Teachers.

Children take part in three, half-days, of classroom-based science activities, all set within one of a range of industrial contexts. They then visit an industrial site, and the visit is tailored to follow on closely from the classroom activities. CIEC *Promoting Science* Advisory Teachers provide the classroom activities, CPD for all staff in each participating school and training for all industry personnel.

Children enjoy the activities

Data gathered before and after the CCI programme showed that over 90% of children said they learned something new and enjoyed the classroom challenges, whilst over 80% of children enjoyed the group work and science investigations. The programme succeeds in engaging children in science by showing curriculum science in a real life context.

Benefits of teacher professional development

There is clearly a need to engage primary school teachers in science related professional development. 56% of participants in the CCI programme had attended one day or less science CPD in the previous three years.

The programme delivers professional development sessions to teachers. Additionally, teachers observe and reflect on best practice when working with the CCI Advisory Teachers on the classroom activities.

Key strengths of the training are seen to be the practical and investigative nature of the activities and their industrial context. The programme has a significant input into the science and industry related professional development of the schools involved in the programme.

More positive attitudes in teachers and children

Data collected from participants in CCI show that children and teachers have more positive attitudes towards industry following participation in the programme. Children are more likely to consider a career in science and feel that industry is safe. Teachers are less likely to think of industry as having negative environmental impacts and have a greater awareness of the career opportunities that industry may offer their pupils.

Conclusions

CCI has a significant impact and successfully delivers science activities that enthuse and motivate primary children. Additionally, teachers involved in the programme receive valuable professional development in the teaching of science. A realistic view of industry is presented to participants. This leads to greater understanding and more positive attitudes in children and their teachers.

1 - Introduction

CIEC *Promoting Science* has developed and delivered the successful Children Challenging Industry (CCI) project since 1986. Its philosophy is the teaching of science through practical activities based in a real-world context.

Schools participating in the CCI programme are visited by a CIEC *Promoting Science* advisory teacher who delivers teacher professional development sessions followed by classroom activities. Advisory teachers also liaise with industrial partners, train site personnel and organise site visits for participating schools.

The CCI programme aims to:

- provide classroom-based training for teachers in aspects of the National Curriculum for science;
- increase children's enjoyment of science;
- improve primary school children's perception of the science-based manufacturing industries, and their relationship with science;
- improve teachers' knowledge and confidence of teaching science;
- improve teachers' perception of the science-based manufacturing industries, and their relationship with science.

1.1 National perspective of the CCI programme

Between September 2008 and July 2010, CCI has involved 8,000 children and provided training for 2,200 teachers. This is a major contribution to primary science education in the UK. In particular, the programme is unique in combining teacher professional development, classroom science activities and visits to local industrial partners.

The programme could not succeed without the continued support of the industrial partners who host site visits. Since July 2008, 131 new site personnel have received training from the CIEC *Promoting Science* team of Advisory Teachers and 213 site visits have been hosted.

A recent development has been the training of science ambassadors to further encourage schools-industry links. Ambassadors range from university research students to personnel within the science and manufacturing sector. CIEC *Promoting Science* Advisory Teachers provide training and support to equip Ambassadors to deliver a range of school-based interactive sessions.

Table 1-1: Reach of the CCI programme
(Sept 2008 to July 2010)

	Yorks & Humber	North East	North West	**All CCI regions**
Number of CCI/PSEP ambassadors trained	7	0+10	7+31	**55**
Number of schools in CCI/PSEP programme	109	95	93	**297**
Number of participating children	2,971	2,368	2,661	**8,000**
Number of teachers trained	644	660	893	**2,197**
Number of site visits	56	83	74	**213**
Number of new site personnel trained	16	77	38	**131**

1.2 The importance of Primary science in a real-world context

> *"My son was taken on a CCI visit to Ciba about 4 years ago, and he'd never been interested in science at all. The visit motivated him to want a career in science and he's now taken triple science at senior school and loves science."*
>
> *Comment passed on to* CIEC *Promoting Science by Joanne Love, Communications Manager, BASF.*

At a recent conference[1], delegates heard that an estimated 58% of new jobs created in the UK will be in science and technology-related areas of the economy. A key outcome was a call for more programmes which give teachers real world experience in science and technology contexts. Such experience is a central theme to the CCI approach.

Research for the Department for Business, Innovation and Skills showed that whilst science remains a popular subject at school, only 5% of the 14-16 year olds surveyed planned to go into a specifically science-related career (Opinion Panel, 2010). Such attitudes are developed early in a learner's school career. By the age of nine, 84% of children held views on the career they wanted to follow, with only 4% wanting to follow a career in science (Porter & Parvin, 2008).

The CCI programme has a lasting and positive effect on children who participate. Five years after participation in the CCI programme, nearly a third of the pupils remembered the classroom activities and two thirds remembered their industrial visit. The programme has

[1] Technical Education for the 21st Century, Gatsby Charitable Foundation and the Edge Foundation, 14th December 2010.

positive and lasting effects on children's attitudes to science and industry (Evans, Hogarth & Parvin, 2004).

It is clearly important to give children, at an early age, exposure to the science-based industries and the long-term career opportunities that they offer. Through site visits, teacher training and classroom activities, the CCI programme provides children and their teachers with first hand experience of how curriculum science is applied in the real world. Industrial partners understand the value of this approach and provide valuable support to the CCI programme by hosting site visits.

> *"CIEC have a fantastic primary programme and the earlier we can link children with industry the better; they gain a real understanding of how what they are learning in the classroom is linked to the 'world of work'. "*
>
> *Amanda Olvanhill*
> *Manager of Tees Valley STEMPOINT*

2 The Children Challenging Industry programme

The Children Challenging Industry programme consists of several elements, and place curriculum science in a real life context. It addresses not only classroom activities but also the professional development of teachers and industrial partners. The elements are:

- a range of written and web-based materials which enable pupils to investigate science in a real life context (Appendix 3);
- 9 hours of professional development, made up of 7.5 hours of classroom-based CPD, in which the children carry out practical enquiry-based science activities, and 1.5 hours whole staff CPD ;
- industrial partners receive a training session from a CCI Advisory Teacher (typically a half-day);
- CCI Advisory Teachers liaise with industrial partners on how to provide a successful site visit linked to the scientific concepts in the classroom investigation;
- a half-day site visit by each participating class.

2.1 Awards

Children Challenging Industry has been recognised by major regional and national awards:

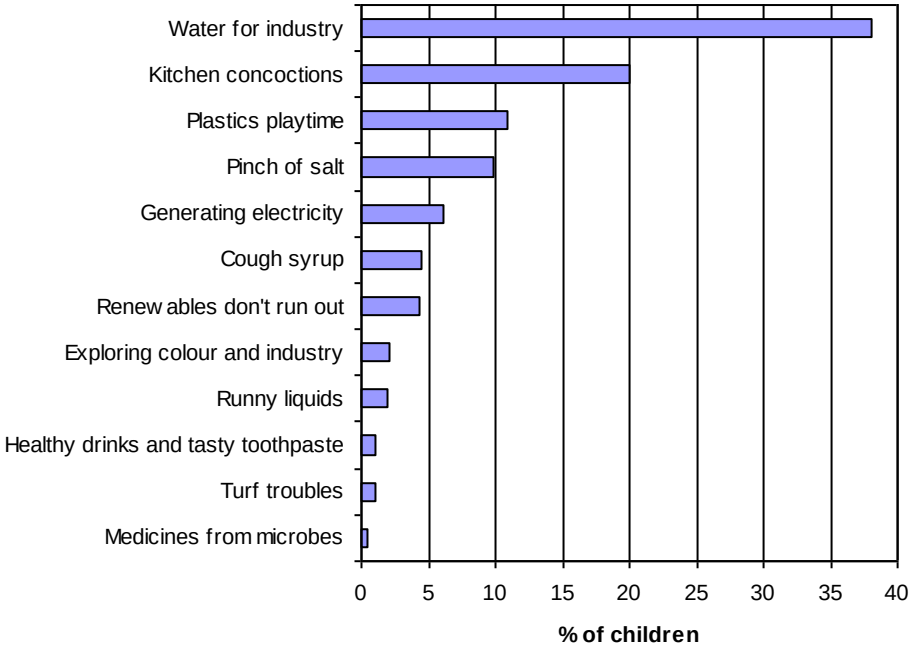
- Highly Commended at the IChemE 2009 and 2010 Annual Awards
- CCI's North East team highly commended in the COGENT Innovation and Excellence in Education and Training Award
- Classed as 'Highly Commended' in the CIA's Dow Reputation Award

3 Analysis of Children's data for the CCI programme

Since its inception, the Children Challenging Industry programme has collected data on its effectiveness. The following analysis refers to data collected on the CCI programme from September 2008 to July 2010.

The programme offers a range of classroom activities that link the science curriculum with real-life industrial contexts (Appendix 3). Figure 3 shows the spread of activities that were chosen by the schools in the data sample. Water for Industry remains the most popular activity and looks at how water can be filtered and used for heating and cooling in industry. The choice of topic is often related to the companies within the school's locality that are available for the industrial visit (Appendix 2).

Figure 3: Range of CCI classroom activities undertaken (Sept 2008 to July 2010)



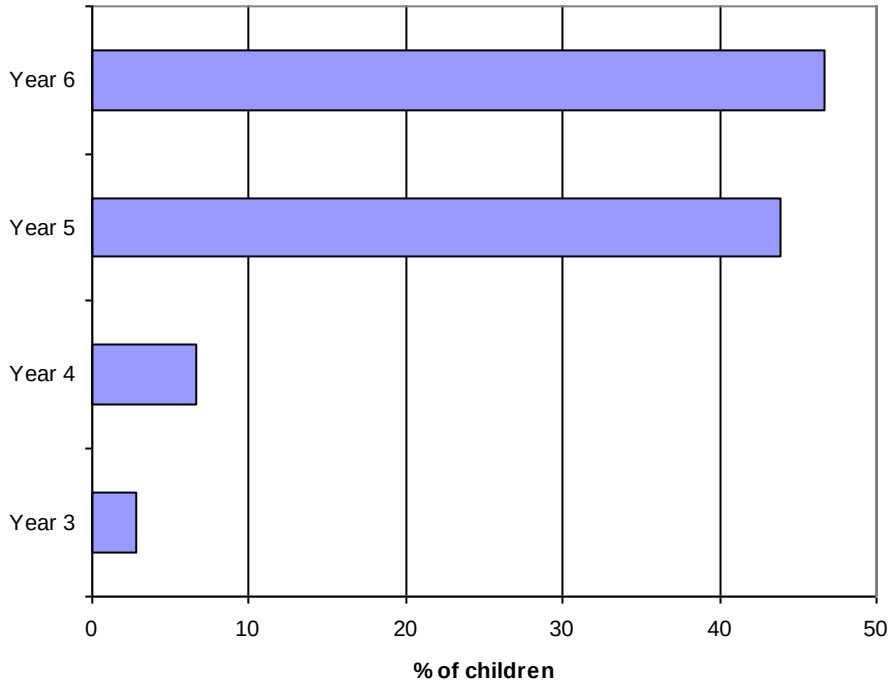
3.1 Children's data sample

Questionnaires were completed by children at the start of the activities and following their completion. Statistical analysis of the data is presented. Representative data were obtained from all regions, which are Yorkshire and the Humber, the North East and North West of England.

Data is based on 274 questionnaires completed before starting the programme and 945 questionnaires completed after undertaking the CCI activities and site visit. The number of pre-programme questionnaires analysed is lower than the post-participation sample as pre-programme responses are used to compare with baseline data gathered over previous years.

The sample contained a similar number of boys and girls and so there was no gender bias. The ages of the children ranged from 7 (year 3) to 11 (year 6), with the majority being in years 5 and 6 (see figure 3-1). The project focuses on 9-11 year olds, with a small number of 7-9 year olds being included in special circumstances (e.g. small schools with mixed age range classes).

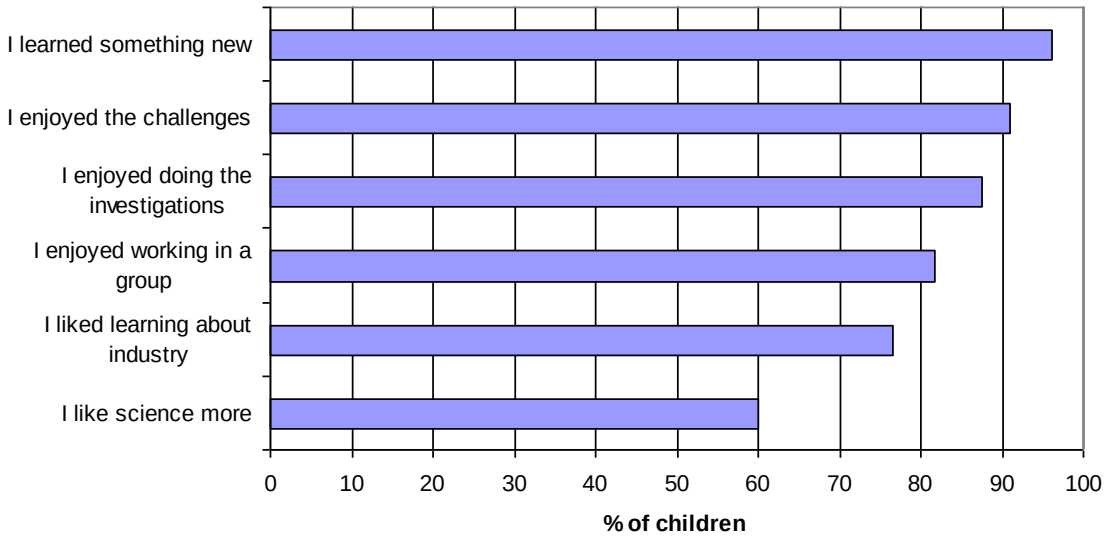
Figure 3-1: Age range of participating children (Sept 2008 to July 2010)



3.2Children'sviews of the CCI programme

Following completion of the CCI activities, children were presented with a range of statements relating to their views of the programme. They were able to respond with 'yes', 'no' or 'don't know.' Figure 3-2 summarises the positive responses to the statements.

Figure 3-2: Children responding 'Yes' to the statements relating to their CCI experience.



The data demonstrates that the CCI programme is received well by the children who take part. Over 90% of children said they learned something new and enjoyed the challenges, whilst over 80% enjoyed the group work and investigations. Areas to consider may be the relatively smaller numbers who liked learning about industry (77%) and who liked science more following the CCI activities (60%). However, the second response does not take into account the number of children who may have already liked science a lot before participating in the programme.

3.3 Increase in children's positive attitudes towards science and industry

> *Dear Miss Waller*
>
> *I am writing to say thank you for coming to teach our class about industry.*
>
> *Before you came in to teach us we thought industry was really bad and caused lots of pollution. I now know the real facts. I also thought I should mention how much I enjoyed my visit to Dow Chemicals. It was one of the best experiences of my life.*
>
> *Year 6 pupil*

It is not unsurprising that children of primary school age have begun developing attitudes towards science and industry. They are influenced by the portrayal of industry in the media, parents' and teachers' attitudes (Evans, 1999). Children often study the industrial revolution and in doing so are presented a dark, dirty and polluting image of industry. News items often focus on issues such as climate change, pollution and safety incidents. The Children Challenging Industry programme helps to give children, and their teachers, a balanced, realistic and first hand experience of modern science-based industry.

Within the children's questionnaire, a series of questions looked at attitudes towards science and industry (Appendix 4). Responses to these questions were given before and after participation in the programme. Statistical analysis allowed any significant changes in attitude to be identified.

Overall, both boys and girls showed significantly more positive attitudes towards science and industry following participation in CCI. Specific questions that showed significantly more positive responses are shown below:

- I'd like to be a scientist
- Scientists are important in industry
- Industry is useful
- Industry is safe
- Many scientists work in industry
- Industry causes pollution (less agreement with this statement)
- Many engineers work in industry
- Young people work in industry
- I learn about industry from my teachers

- Scientists have important jobs in industry
- Our lives would be worse without industry
- There are women scientists and engineers
- Industry makes things we need
- Engineers have important jobs in industry
- I could work in industry in the future

Following involvement in the CCI programme, significantly more children thought that industry was safe and would consider becoming a scientist or working in industry. Also, there was less agreement with the view that industry caused pollution and was dangerous. The programme succeeds in giving children a more realistic view of industry and its positive contributions. As well as gaining a greater understanding of the applications of science, the increase in positive attitudes towards industry is a valuable outcome of the CCI programme.

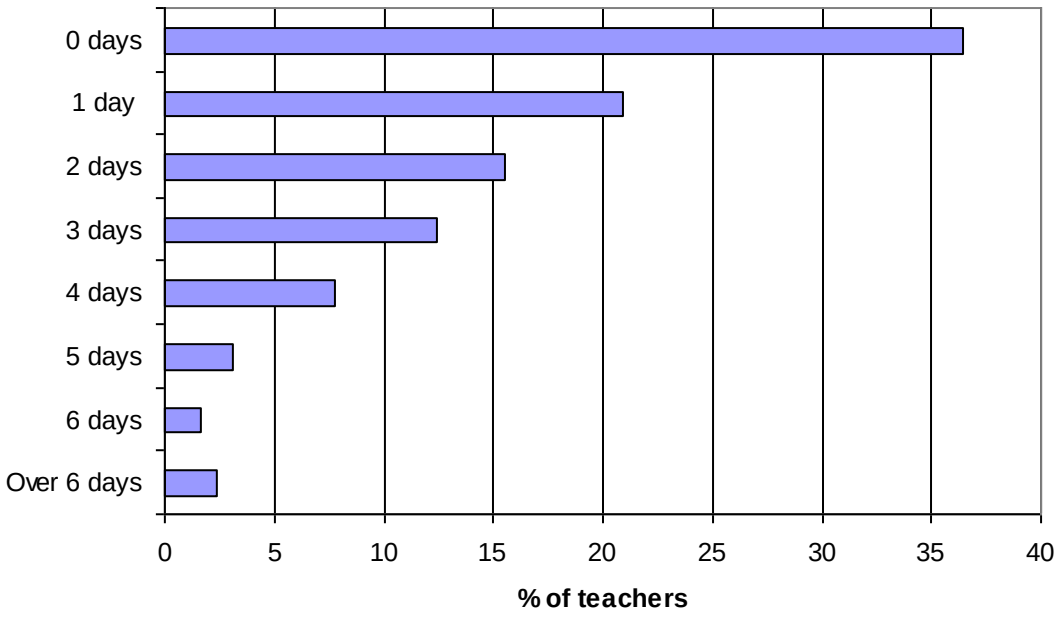
4 Teachers' data

Data were gathered from teachers involved in the Children Challenging Industry programme by completion of pre- and post-participation questionnaires (Appendix 5).

4.1 Teachers' science and industry professional development

It is disappointing that the teachers who participated in the CCI programme had previously received an average of less than two days of science in-service professional development in the preceding three years (figure 4-1). This situation is likely to get worse as local authorities lose advisory teachers due to budgetary constraints. CCI will play an increasingly important part in satisfying the need for science professional development.

Figure 4-1: In the preceding 3 years, time spent on science related in-service training by teachers, before participation in CCI.



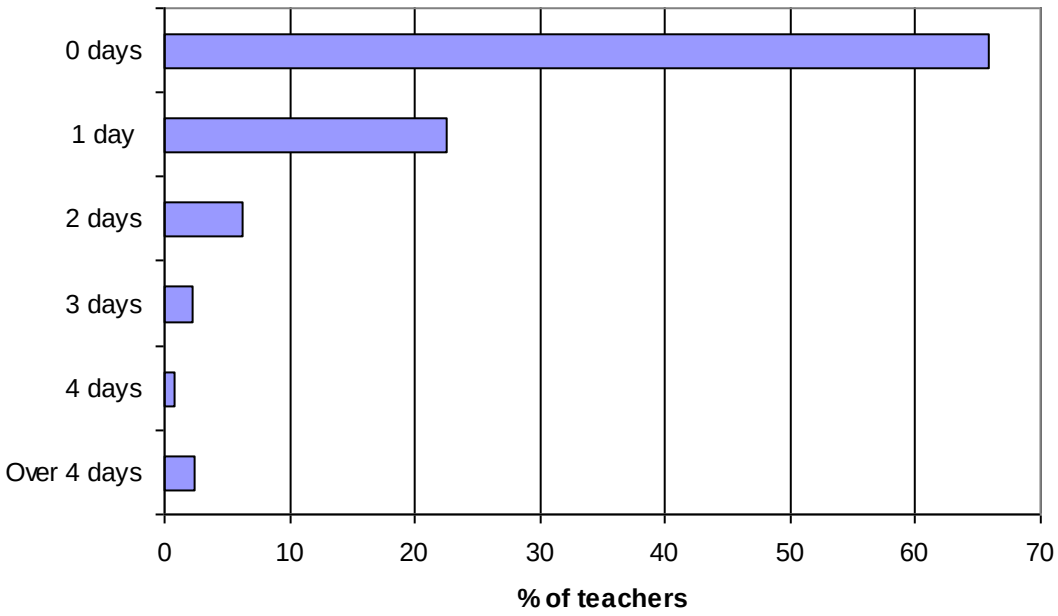
35% of teachers had undertaken professional development opportunities focusing on industry-links prior to involvement in CCI. 84% of schools did not have any policy relating to industry links and 59% of teachers had not organised a visit to industry (see figure 4-2).

Where links with industry had been established, schools had worked with:

- Local companies (46%)
- Education-Business Partnerships (19%)
- STEM[2] Network (18%)
- STEM Ambassadors (6.5%)

When links are made, schools tend to look for local partners. The CCI programme is valuable in encouraging and equipping teachers with the skills to develop links with local science-based industries.

Figure 4-2: In the 3 years before participating in CCI, time spent on 'school-industry links' professional development



4.2 Contribution of CCI to teachers' professional development

Against a background in which there is only rare participation in science and industry related training, the support and guidance received by schools participating in the CCI programme is a significant contribution to the professional development of teachers. In particular the manner in which CCI helps to broker relationships between schools and their local science-based industries.

[2] STEM: Science Technology Engineering and Mathematics

You have revitalised science at Hunts Cross. The teachers came to the staff meeting last Thursday tired (it was the second staff meeting in 2 days) and not knowing what to expect. SATs had taken all the fun out of science.

Within a very short space of time, the teachers were bubbling with enthusiasm about the variety of stimuli for investigations, the practical activities and the wealth of resources available.

Putting investigations into context is crucial. Linking them to industry has so many benefits, giving the children further insight into the world of work and raising their own personal expectations.

Primary School Headteacher

During the programme, all staff in each school participated in a 90 minute professional development session, delivered by a CCI Advisory Teacher. In addition, teachers observe two or three half-day classroom sessions with the Advisory Teacher. In this way, the programme helps to deliver teacher professional development in pedagogy as well as giving valuable experience of the science-based industries.

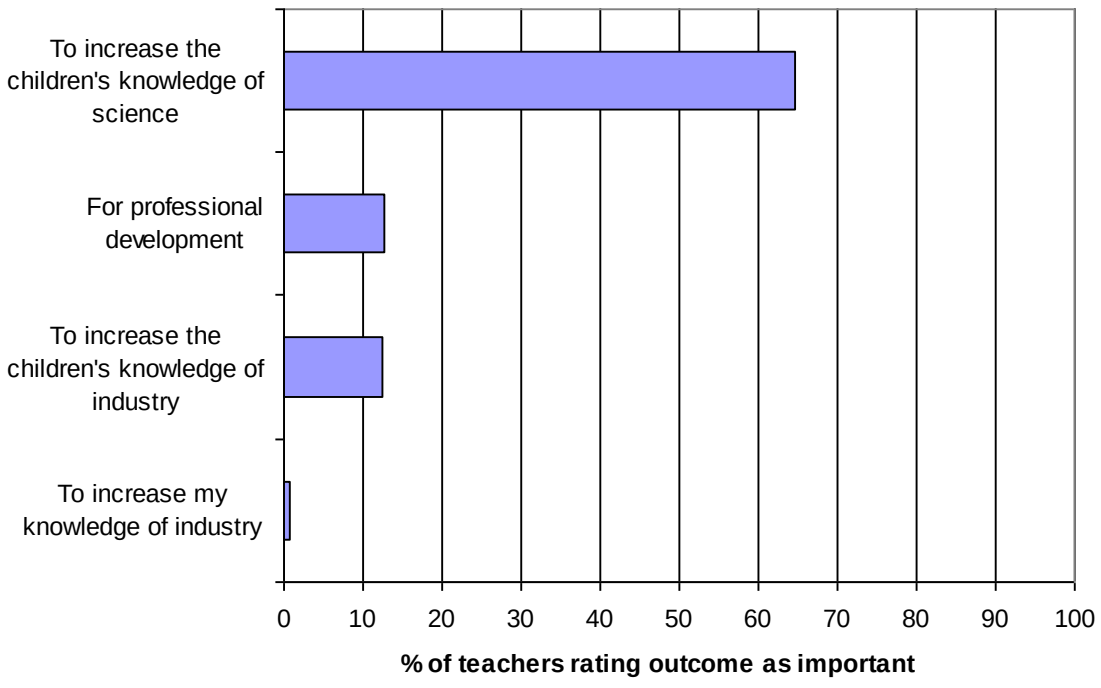
4.3 Teachers' expectations of the CCI professional development

To explore teachers' expectations of the programme, they were asked to consider four of the outcomes of the CCI training. These were:

- to contribute to teachers' own professional development;
- to increase children's knowledge of science;
- to increase children's knowledge of industry;
- to increase teachers' knowledge of industry.

Teachers expressed how important they rated each outcome. Figure 4-3 shows the percentage of 'most important' choices for each outcome.

Figure 4-3: The programme outcomes, rated as important by participating teachers



The responses show that teachers are looking for professional development that ultimately has a positive impact on their pupils' achievement in science. CCI satisfies this aim and has been shown to be effective in improving the test scores in schools were children may be under-performing (CIEC 2005). Whilst it may be argued that teacher professional development is integral to improving pupils' achievement, some teachers may see it as secondary to this aim.

It is encouraging that some teachers see it as important for their pupils to gain a better knowledge of industry. Further work needs to be undertaken to convince teachers of the value of becoming more knowledgeable about the work and opportunities offered in the science-based industries.

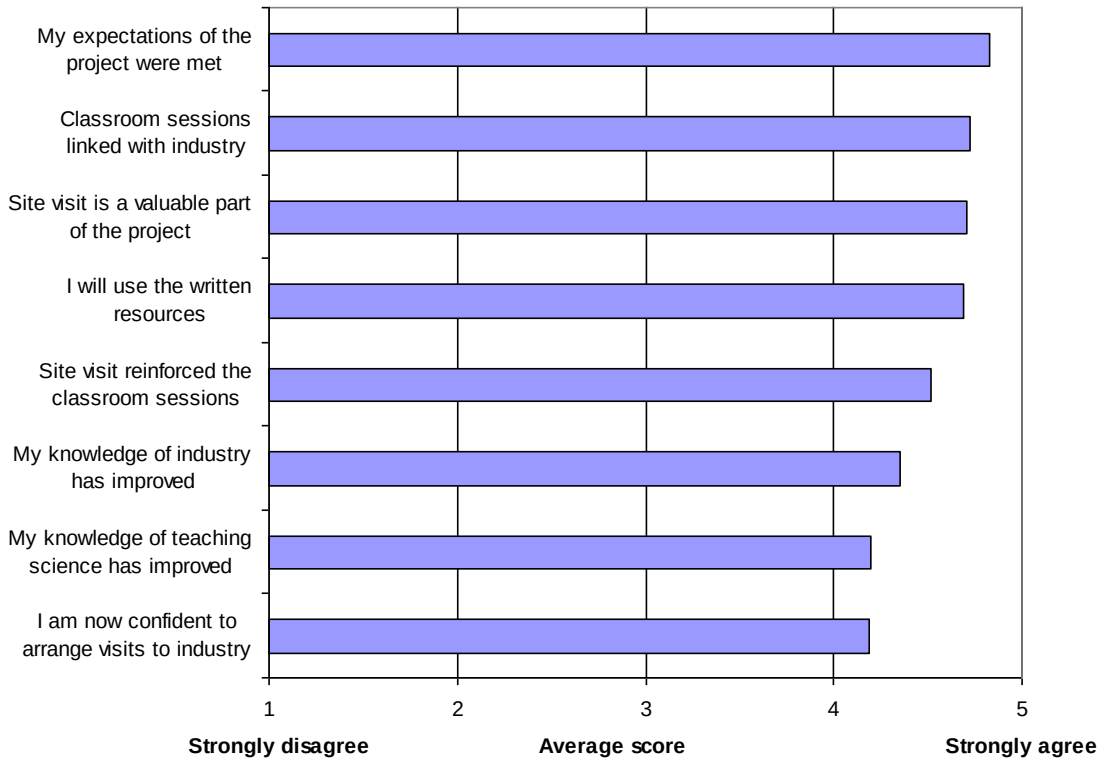
4.4 Outcomes of CCI teacher professional development

The CCI programme has three components to the teacher professional development provision:

- whole school staff session delivered by the CCI Advisory Teacher
- observing the Advisory Teacher during two, 2.5 hour classroom sessions
- participation in the site visit

The CPD is well-received, with 81% of the participants rating the CPD as excellent. In particular, teachers appreciated the emphasis on practical science. When asked about the key strengths of the CPD provision, 92% of teachers included the practical activities, 85% listed enhancing pupils investigative skills and 78% the industrial context. Figure 4-4 summarises the teachers' views of the programme.

Figure 4-4: Average of teachers' responses following participation in the CCI programme.



It is encouraging to see that for all factors questioned, teachers were very positive about the CPD. Expectations were met and teachers saw the value of the site visit. Previous research has shown that the written materials will be used after the involvement of the Advisory Teacher has ended and this will help to extend the impact of the programme beyond the initial presentation. Whilst not as strong as other responses, teachers were generally confident to arrange their own visits to industry. This is further vindication that an approach which includes an element of professional development helps to equip teachers with the skills that encourages them to maintain links with industry in future years and with future classes.

4.5 Teachers attitudes to industry

In addition to looking at the effect of the programme in the classroom, information was gathered on teachers' attitudes to industry both before and after taking part in Children Challenging Industry. The data was analysed for statistically significant changes in attitudes. Following involvement in the CCI programme, teachers' attitudes were seen to be more positive towards industry in several respects.

Significantly more positive attitudes to industry were expressed in responses to the following questions after participation when compared to responses before the programme:

- Industry causes pollution (less negative responses)
- Industry provides many career opportunities
- Industry improves our quality of life
- Industry has a negative effect on the environment (less negative responses)
- Industry offers interesting and rewarding jobs

The CCI programme cannot claim to change attitudes long-term, as this data is not gathered. It does, however, give many teachers their first experience of the conditions and working practices in a modern industrial workplace. This can only have positive effects on their understanding of science-based industries and also equip them to give a realistic view of the career opportunities available to their pupils.

5 Conclusions

From September 2008 to July 2010, Children Challenging Industry (CCI) reached over 8,000 children, nearly 2,200 teachers and 297 primary schools. In addition, 55 science ambassadors were trained.

Industrial partners are a vital part of the programme. There were 213 site visits and 131 new personnel received training from Advisory Teachers. CCI provides children and their teachers with exposure to industry and a greater appreciation of the opportunities available. Industrial partners are able to gain an insight into the demands of education as well as enhancing their reputation in the local community.

Data gathered on the CCI programme showed that over 90% of children said they learned something new and enjoyed the challenges, whilst over 80% of children questioned enjoyed the group work and investigations. The programme succeeds in engaging children in science by presenting it in a real life context. Additionally, children's attitudes to science and industry are significantly more positive following participation in the programme.

Research has shown that views of future career choices are formed very early (Porter and Parvin, 2008). CCI plays a significant role in showing children, and their teachers, a realistic view of science-based industries. In doing so, CCI encourages them to consider the career opportunities available.

In addition to providing children with high quality science teaching, the CCI programme also delivers teacher professional development. The uptake of science and industry-related professional development by primary teachers appears to be very low. 36% of participants in the CCI programme had not attended any science-related CPD in the previous three years and 20% had attended just one day's training within the preceding three years.

The CCI programme delivers a 90 minute professional development session to all teachers in participating schools. Teachers also observe and reflect on best practice when working with the CCI Advisory Teachers on the classroom activities and gain a greater understanding of industry on the site visit.

In context, the CCI programme has a significant input into the science and industry related professional development of the schools involved in the programme. This is reflected in the views expressed by teachers following participation.

Teachers' attitudes to industry were measured before and after participation. Following the programme, teachers had more positive attitudes towards industry in areas that included environmental impact and career opportunities. Such changes will help teachers to give a realistic picture of science-based industries to their pupils.

The Children Challenging Industry programme is delivered in Yorkshire and the Humber, North East and North West of England. It has a significant impact and successfully delivers classroom activities that enthuse and motivate primary children. Additionally, teachers involved in the programme receive valuable professional development in the teaching of science. Finally, exposure to industry improves understanding and attitudes in children and their teachers.

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Appendices

Appendix 1: CCI and PSEP team

Joy Parvin

Gayle Pook

Michele Smale, Tanya Shields, Sue Andrews, Nicky Waller

Appendix 2: Current CCI and PSEP activities

A Pinch of Salt	Investigations into solutions, evaporation and filtration.
Cough Syrup	The activities are based on the development of a new cough syrup. Children work to identify the best conditions for growing micro-organisms to produce the active ingredient in the medicine, the best way to collect it, and the ideal consistency for the syrup.
Exploring Colour and Industry	Classroom activities with pigments and natural dyes that model real processes in the colour industry.
Generating Electricity	Wind generators, circuit construction, problem-solving and electrical safety.
Healthy Drinks and Tasty Toothpaste	Children investigate how to develop an appealing toothpaste and how acid causes tooth decay. They look at the ingredients for toothpaste and the effectiveness of a variety of formulations.
Kitchen Concoctions	Activities include making a soap bar, developing a bubble mixture, investigating the effectiveness of washing products and scourers, and making a simple fire extinguisher.
Medicines from Microbes	In this context, a biotechnology company is producing a new medicine and needs to investigate the best conditions for the growth of the mould that makes it.
Plastics Playtime	Children test and classify plastics before investigating their thermal insulation and shock resistance properties.
Renewables Don't Run Out	A resource that explores alternatives to fossil fuels for producing energy and oils. It includes practical activates such as extracting plant oil and comparing plant-based fuels.
Runny liquids	A company making a solution based on a wood resin needs to meet specific criteria for optimum manufacturing conditions.
Turf Troubles	A sports company wish to provide a turf surface at a sports ground suitable for a range of activities. Children investigate the conditions needed to grow the best turf.
Water for Industry	Children look at the use of water as it moves through an industrial site where it is treated, used as cooling water, and treated again before being returned to a river.

Appendix 3: Children's questionnaires

Children's questionnaire pre-programme

Children Challenging Industry **Code:** ☐

Children's questionnaire 1

Name: Please tick the right boxes:

girl ❑ boy ❑ year 4 ❑ year 5 ❑ year 6 ❑

All of the questions below are about how you feel about science and industry. Try and answer as many as you can with **your ideas**.

1. Please tick the topic you are doing

A Pinch of Salt	❑	Exploring Colour & Industry	❑
Plastics Playtime	❑	Kitchen Concoctions	❑
Water for Industry	❑		

Tick a box for each question, which says how you feel about science:

		Yes	No	I don't know
2.	I like science			
3.	I'd like to be a scientist			
4.	Science is my favourite subject			
5.	Science is too difficult			
6.	Scientists are important in industry			
7.	We do too much writing in science			
8.	I like watching science programmes on TV			
9.	I like doing science experiments at home			
10.	We do too much science in school			
11.	School science clubs are a good idea			
12.	We have to do too much work in science			
13.	I like reading science stories			
14.	We have to do a lot of planning in science			

Tick a box for each question, which says how you feel about industry:

	Yes	No	I don't know
15. Industry is useful			
16. Industry is safe			
17. Many scientists work in industry			
18. Industry is dangerous			
19. Industry causes pollution			
20. Many engineers work in industry			
21. I learn about industry from TV			
22. Young people work in industry			
23. I learn about industry from my teachers			
24. Scientists have important jobs in industry			
25. Our lives would be worse without industry			
26. There are women scientists and engineers			
27. Industry makes things we need			
28. Engineers have important jobs in industry			
29. I could work in industry in the future			

Children's questionnaire post-programme

Children Challenging Industry

Children's questionnaire 2 Code [ ]

Please tick the right boxes:

girl ❑ boy ❑ year 4 ❑ year 5 ❑ year 6 ❑

All of the questions below are about how you feel about science and industry. Try and answer as many as you can with **your ideas**.

2. Please tick the topic you are doing

A Pinch of Salt	❑	Exploring Colour & Industry	❑	Electricity	❑
Plastics Playtime	❑	Kitchen Concoctions	❑	Water for Industry	❑

Tick a box for each question, which says how you feel about science, now you have completed the project:

	Yes	No	I don't know
2. I like science			
3. I'd like to be a scientist			
4. Science is my favourite subject			
5. Science is too difficult			
6. Scientists are important in industry			
7. We do too much writing in science			
8. I like watching science programmes on TV			
9. I like doing science experiments at home			
10. We do too much science in school			
11. School science clubs are a good idea			
12. We have to do too much work in science			
13. I like reading science stories			
14. We have to do a lot of planning in science			

Tick a box for each question, which says how you feel about industry, now you have completed the project.

	Yes	No	I don't know
15. Industry is useful			
16. Industry is safe			
17. Many scientists work in industry			
18. Industry is dangerous			
19. Industry causes pollution			
20. Many engineers work in industry			
21. I learn about industry from TV			
22. Young people work in industry			
23. I learn about industry from my teachers			
24. Scientists have important jobs in industry			
25. Our lives would be worse without industry			
26. There are women scientists and engineers			
27. Industry makes things we need			
28. Engineers have important jobs in industry			
29. I could work in industry in the future			

30. Have you enjoyed working on this project? Write down…

The thing that you enjoyed doing the most	The thing that you enjoyed doing the least

31. Answer 'yes', 'no or 'don't know' to the following questions.

I learned something new _____ I liked learning about industry _____

I enjoyed the challenges _____ I enjoyed doing the investigations _____

I like science more _____ I enjoyed working in a group _____

Please tell us more about your answers (such as why you have enjoyed or not enjoyed certain things.)

Appendix 4: Teachers' questionnaires

Teachers' questionnaires

Date: _____ Code: _____

Pre-project questionnaire for teachers

The aims of this questionnaire are to gather teachers' views of the manufacturing industry and its links with science, and to evaluate the effectiveness of the *Children Challenging Industry* project. Any information provided here will be used anonymously.

Selected CIEC Resource Pack:_____

Days (approx) spent doing science in-service training in the last 3 years_____

Days spent doing industry links in-service training in the last 3 years_____

School industry links

Does the school have a policy on industry links yes/no

Have you ever organised a visit to industry yes/no

Please tick the industrial companies or link organisations with which the school already has links:

Education-business partnership	❑
Setnet/Setpoint	❑
Science & Engineering Ambassadors (SEAs)	❑
Local company	❑

Which science resources sponsored by the chemical and allied industry (e.g. BP, CIBA, Esso, etc.) have you used?

a. _____

b. _____

What are your main objectives of the sessions? Please label the following four (or 5) items in order of priority (i.e. give the most important objective a '1' and the least important a '4')

For professional development (ideas for teaching science)	❑
To increase the children's knowledge of science	❑
To increase the children's knowledge of industry	❑
To increase my knowledge of industry	❑
Other	❑

Please describe 'other' here _____

Professional Development

Name any CPD that is currently available to you and your colleagues _____

_____

Describe any additional CPD opportunities that you would value if they were available.

_____

Please complete the table below:

	Strongly agree	Partly Agree	Don't Know	Partly disagree	Strongly disagree
Industry produces a wide variety of useful products					
Industry causes pollution					
Industry provides many career opportunities					
I feel negative about industry					
Industry improves our quality of life					
A job in industry would be tedious					
Industry creates wealth and boosts our economy					
Industry has a negative impact on the environment					
Industry offers interesting and rewarding jobs					

Thank you for your time and cooperation in completing this questionnaire

Date: _____ Code: _____

Post-project questionnaire for teachers

The aims of this questionnaire are to gather teachers' views of the manufacturing industry and its links with science, and to evaluate the effectiveness of the *Children Challenging Industry* project. Any information provided here will be used anonymously.

I rate the training as: Excellent ❑ Good ❑ Satisfactory ❑

Please indicate the strengths of the sessions:

Strengths

Industrial context ❑
Expert knowledge of science ❑
Expert knowledge of industry ❑
Practical science activities ❑
National curriculum coverage (inc. Sc1) ❑
Extra/new person in class ❑
Teaching ideas ❑
Children's investigative skills ❑
Group work ❑
Equipment provision ❑
Other (please specify) ❑

Please complete the table below:

	Strongly agree	Partly Agree	Don't Know	Partly disagree	Strongly disagree
My knowledge of industry has improved					
My knowledge of teaching science has improved					
My expectations of the project were met.					
I will use the written resources again.					
The classroom sessions offered an effective link with industry.					
The site visit reinforced the classroom sessions.					
The site visit is a valuable part of the project.					
I am now confident to arrange visits to the manufacturing industry.					

Please use the space below to suggest any improvements to the training:

Please complete the table below:

	Strongly agree	Partly Agree	Don't Know	Partly disagree	Strongly disagree
Industry produces a wide variety of useful products					
Industry causes pollution					
Industry provides many career opportunities					
I feel negative about industry					
Industry improves our quality of life					
A job in industry would be tedious					
Industry creates wealth and boosts our economy					
Industry has a negative impact on the environment					
Industry offers interesting and rewarding jobs					

Thank you for completing this questionnaire.

Appendix 5

Statistical analysis

Data cleaning

Following entry, data were checked for completeness. Missing data were checked against questionnaires. Unfeasible answers to questions were checked for error on questionnaires. Impossible values recorded on questionnaires were recorded as missing.

Children's views of science and industry

Questions 2 – 29 on the questionnaire concern the child's positive or negative attitudes towards science and industry. Each individual question was summarised in a table displaying the number of children who responded yes, no and don't know to each question.

For positive questions, such as "I like science", the responses were scored as:

- Yes = 2
- Don't know = 1
- No = 0

For questions that contains negative meanings, such as "Science is too difficult", the responses were scored as:

- Yes = 0
- Don't know = 1
- No = 2

The questions were checked using Cronbach's Alpha to ensure they could be reliably used as a scale. If Cronbach's Alpha is more or equal to 0.7, the questions can be combined into a scale. Cronbach's Alpha measures the extent to which item responses obtained at the same time correlate with each other. It determines how consistently the variables measure a construct, in this case, the positive attitude of children towards science.

The analysis was based on non-parametric methods since the data from the questionnaire was mainly ordinal (e.g. yes, no, don't know). A Mann-Whitney U test was performed to compare the responses from the two different unmatched groups of students before and after the project. Significance level was determined by the P-value for the two-tail test.

Teachers views of industry

Nine questions were identical in the pre- and post-participation questionnaires. Questions that contain positive meanings (such as Industry produces a wide variety of useful products) were scored: strongly agree with 5, partly agree with 4, don't know with 2, partly disagree with 2 and strongly disagree with 1. For questions that contain negative meanings (such as Industry causes pollution), the scoring system was reversed.
Scores obtained before the CCI programme were compared with scores from after the programme using an unpaired t-test.