# Stats and Figures

Statistical Consultancy

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| **Report Title:** | **Children Challenging Industry**<br><br>**Analysis of children's & teachers' data from the TEES VALLEY region, 2000-2003.** |
| Customer: | Joy Parvin |
| Author: | Charlotte Evans & Katy Hewis |
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Stats and Figures,
Charlotte Evans,
41 Gledhow Lane,
Leeds,
LS8 1RT
Tel: 0113 266 4857
Email: charlotteevans@onetel.net.uk

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# 1 Executive Summary

Classroom-based training, consisting of three 2½-hour sessions, was delivered to primary school teachers and their year 5 and 6 pupils. The children completed one of four topics on offer, chosen by the teacher. These were, *Water for Industry*, *A Pinch of Salt*, *Plastics Playtime* and *Exploring Colour and Industry*.

The advisory teacher demonstrated how industry could be used as a resource, by providing a real and motivating context in which to teach science. The classroom activities were set within an industrial context, and 87% of children visited one of twenty possible industrial sites. The advisory teacher conducted a 1½-hour training session on science–industry links for the whole staff in each school.

The Children Challenging Industry (CCI) project aims were as follows:

- Provide classroom-based training for teachers in aspects of the National Curriculum for science
- Improve primary school children's perception of the chemical industry and its relationship with science
- Increase children's enjoyment of science
- Improve teachers' knowledge and confidence of teaching science
- Improve teachers' perception of the chemical industry and its relationship with science.

## 1.1 Children's data

363 children completed questionnaires from the year 2000 to 2003, before and after the CCI project.

The children were asked about the environment of industrial sites. Before the project, the predominant view of industry was that it was noisy, smelly, dirty and hot with many people working on production lines.

After the CCI project the children, whether they had been on a site visit or not, portrayed a significantly more accurate view of industry. They were more likely to say that an industrial site was safe and employed fewer people than expected.

The children drew pictures of their perceptions of industry, both before and after the project. They were scored, with a positive score indicating a more informed image as a result of the project. The children's drawings of the internal and external views of an industrial site were significantly more detailed and accurate after the project. The children who had been on a site visit were particularly more likely to attain a higher positive score than the children who had classroom lessons only.

The children were asked to draw someone in industry and give this person a job title. After the project, the two jobs that were significantly more likely to be mentioned, were scientist and engineer. The children were eight times more likely to draw a scientist, while the number of children drawing a 'materials handler' dramatically decreased. When asked to list other jobs carried out on industrial sites, children were also much more likely to list scientist as a job carried out in industry.

After the project, when asked which job they would choose to do in industry, the children were nearly ten times more likely to choose scientist as a job they would

like to do. The reasons the children chose to be a scientist were that it would be enjoyable or fun. They were far less likely to choose to be a 'materials handler' (i.e. jobs involving handling materials directly, such as pouring, stirring, etc.). By the end of the project the children were significantly less likely to say that they did not want any job in industry or that they did not know which job they wanted to do.

Many of the children learnt new things about science, as shown by the number of children who said that the ingredients or the processes of making materials were not as they expected. Virtually all the children learnt about the importance of science in industry shown by the fact that nearly all the children said scientific testing was important.

The children enjoyed the project, as shown by the number who indicated activities that interested them. The most popular activities were those that were practically-based and contained new information.

These results demonstrate how much the children learnt about industry and the types of jobs in industry during the CCI project. By the end of the project, the image of scientists was immensely positive. Nearly half of all the children mentioned that scientists and engineers worked in industry. They felt that these professional jobs were far more attractive than before the project. If these views were sustained it would be expected that the number of children who wanted to work in industry would rise.

## 1.2 Teachers' data

78 teachers returned questionnaires from the year 2000 to 2003, before and after the CCI project. Half of the teachers had not had recent training in delivering the science curriculum and many had no science qualifications. Training related to industry was even less common.

Few teachers had links with industry and only half of the teachers had used any resources developed by industry. Teachers were more likely to teach industry in the context of geography and pollution, than science.

The feedback from the training was overwhelmingly positive. The sessions were of an extremely high standard and were highly rated by all the teachers. The weaknesses most likely to be mentioned were that there was too much to cover and there were difficult concepts covered in the project. These were both more strongly associated with younger age groups

Prior to involvement in CCI, when prompted, nearly all teachers thought there were positive and negative things about the chemical industry. Many teachers had not seen or received any information about the chemical industry either through resources developed by industry or through links with the chemical industry. By the end of the project, 86% of teachers said they had learnt something about science or industry.

Those that had used resources, prior to involvement in CCI, were most likely to say they did so because they were free and of good educational standard.

The change in attitudes towards industrial resources that occurred during the project was impressive. Virtually all the teachers thought that industrial visits would be useful in future and 89% of teachers wanted to use resources developed by the industry after the training. This was a vast improvement when compared with the two thirds of teachers who wanted links with industry, and the half who had used industrial resources, before the training.

# 2 Introduction

## 2.1 Background

Research carried out in recent years has highlighted teachers' lack of scientific knowledge and confidence to teach science. Close links have been found between primary teachers' ability to question children effectively and their understanding of scientific concepts. Productive questions promote science as a way of working, in which a variety of solutions can be sought from first hand experiences. For this reason, the Qualifications and Curriculum Authority feel that primary teachers should obtain a minimum of a GCSE in science in order to be able to teach the subject (Blackburne, 1997).

Successful teaching of science is dependent not only on adequate knowledge of science but also on the ability of placing science in context. By setting science activities within an industrial context, the problem of science being an isolated subject with no relevance to everyday life is overcome. The National Curriculum recognises this and states: 'Pupils should be given the opportunities to consider the part science has played in the development of many of the things that they use'. Research has shown that developing children's industrial understanding and providing a purpose and relevant context for their classroom science activities, leads to increased motivation and ownership of their work.

It is clear that using an industrial context becomes highly valued by primary teachers when teaching science. However, research has shown that the views of industry held by the public (which includes teachers) are often negative or narrow. These views are based on limited knowledge, usually obtained from the media, which is indifferent at best, even hostile, to the chemical industry. News reports often cover industry in the role of polluter, rather than as providing benefits to society or playing an important role in scientific research.

In-service training has therefore been designed and delivered to show teachers how industry can be used as a resource, by providing a real and motivating context in which to teach science. The classroom activities were set within an industrial context, and many children also visited industry.

## 2.2 Project aims

The five main aims are stated below:

- Provide classroom-based training for teachers in aspects of the National Curriculum for science
- Improve teachers' knowledge and confidence of teaching science
- Improve teachers' perception of the chemical industry and its relationship with science
- Increase children's enjoyment of science
- Improve primary school children's perception of the chemical industry and its relationship with science

## 2.3 Method

The schools were approached using a mail-shot within the Local Education Authorities that make up the Tees Valley region.

The teachers of year 5 or year 6 children, wishing to participate, were then approached to select from a range of teaching topics. These included *Plastics*

*Playtime, A Pinch of Salt* or *Water for Industry*. A web-based colour topic was introduced in September 2002, *Exploring Colour and Industry* (www.colour-ed.org).

After initial planning meetings and data collection, the advisory teacher carried out three activity sessions, of 2½ hours duration, with the class of children. Although a variety of teaching methods was used, the majority of the activities were practical in nature, with classes being divided into groups of four children for these activities. After the classroom training was completed, a site visit was arranged to a local company site.

The training was provided to 95 classes between 2000 and summer 2003 in the Tees Valley region. The teachers were asked to complete three different forms during their training.

The first form, a background information questionnaire, was completed before the training and asked questions about the school and teaching methods used. The second form was the pre-questionnaire and was also completed before the training. It covered questions about the teachers' training and qualifications, their knowledge of the chemical industry, their use of industrial resources, and in which classes they taught about industry.

The post-questionnaire was completed after the training and asked teachers about their reaction to the training as well as their attitudes towards the chemical industry.

Questionnaires were returned for analysis from 64 teachers and 323 children from 54 schools. Three of the schools were involved in the project two years running and seven of the schools had two teachers involved in the project. 41 teachers sent back both pre- and post-questionnaire forms. 23 teachers sent back either the pre- or post-questionnaire.

The teacher's data was collated and input into STATA, a statistical software package. The data was analysed to measure the impact of the project. The main areas of interest were:

- Background information on children, schools and teachers
- Children's views of industrial settings
- Children's views of industrial jobs
- Children's views of science and industry
- Evidence of a need for science training
- The reaction of teachers to the training
- Knowledge and skills of the teachers with regard to the teaching of science and industry
- Perceptions of the teachers regarding science and industry.

The findings are reported and discussed in the following sections. All the results are displayed as percentages unless otherwise specified.

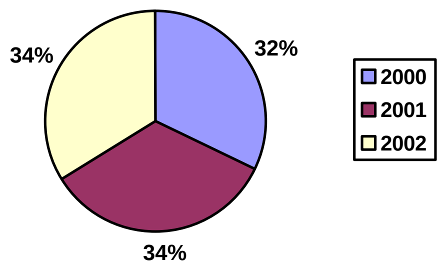
# 3 Background information

Many of the variables analysed in this section are compared with the results obtained in the previous study by Joy Parvin (Parvin, 1999). In 1996 to 1998, training was provided, and teachers and children were interviewed to assess what they had gained from the sessions. These original findings lay the groundwork for the current report.

## 3.1 Academic year

The year and term the questionnaires were completed by the children was provided by the teacher. The results are shown in Figure 3-1.

**Figure 3-1: Academic year data collected**

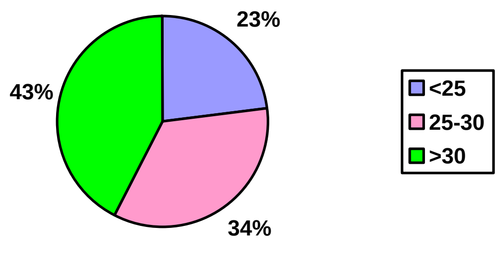



The total number of children's questionnaires collected in this region since 2000 was 363. Similar numbers of questionnaires were collected for each of the three academic years. Virtually all of the schools included four pupil's questionnaires from each class.

## 3.2 Number of children in the class

Teachers were asked how many children were in their class. The results are shown in Figure 3-2.

**Figure 3-2: Number of children in the class**



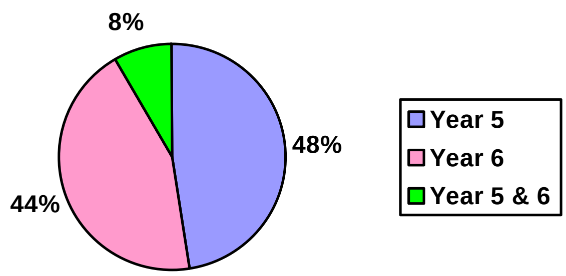

These figures are broadly similar to those seen in the previous study. However there were more classes with more than 30 children and fewer classes with 25-30 children. This could be because there were more schools from a city taking part in this study, which tend to have larger classes.

In this study, the mean number of children in the class was 29. The minimum was 17 and the maximum was 40. The smaller classes tended to be in areas that are more rural. The bigger classes may be also be because two classes were being taught together.

## 3.3 Year groups and gender

Teachers were asked which year groups they were teaching. The results are shown in Figure 3-3.

**Figure 3-3: Year groups taught**




In this study, the majority of the classes were either year 5 or year 6 pupils. Slightly more than half the pupils were from year 5 with the remainder mainly made up of year 6 pupils. Year 5 has become the most popular age group to be involved in the project, as the focus on the SATs (Standard Assessment Tasks) in year 6 often moves the attention away from investigative work. However, a high proportion of teachers still value investigative work, and year 6 pupils are often involved in the summer term, after the tests in May. Year 4 pupils are involved when they are in a mixed year class with year 5.

Due to smaller schools taking part in the previous study, there were more classes with mixed year 5 and 6 pupils (37%) than in this study (8%). Smaller schools are more likely to combine year groups whereas larger schools tend to keep the years separate.

The ratio of boys to girls was, 185 (51.0%) male and 178 (49.0%) female

## 3.4 Ethnic profile

The teachers were asked about the ethnic profile of their school. Some teachers (23%) did not answer this question, maybe because they did not feel able to. It is possible that the results are not accurate. For those that did answer, the results are in Table 3-1.

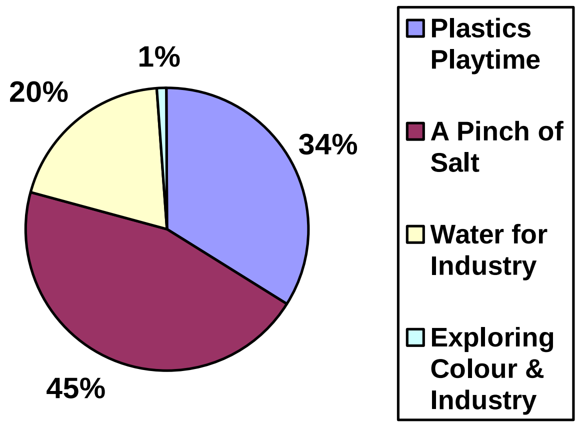
**Table 3-1: Ethnic profile**

| Ethnic profile | Percent |
|---|---|
| Mainly white | 82 |
| 5-15% ethnic | 11 |
| Multiracial | 7 |

## 3.5 Topic

The class teacher from each school chose one of the topics provided. The proportion of children experiencing each topic is shown in Figure 3-4.

**Figure 3-4: Topic**




The most popular topic was *A Pinch of Salt* with nearly half the teachers choosing this topic. It covers many concepts required by the national curriculum and is tested in year 6 SATs. Approximately a quarter chose *Water for Industry* and a third chose *Plastics Playtime*. A small percentage chose *Exploring Colour and Industry,* and this was because it was a new topic introduced much later than the other topics, in October 2002.

The topics chosen varied between the school years. The profile for year 6 was evenly spread between *Water for Industry*, *Plastics Playtime* and *A Pinch of Salt*. The profile for year 5 was more in favour of *A Pinch of Salt,* with half choosing this topic. The remaining half was evenly spread between *Water for Industry* and *Plastics Playtime*.

The teachers of younger children were steered towards *Plastics Playtime* which was written with younger children in mind, while the teachers of older children were steered towards *Water for Industry* which was more geared towards this age group.

## 3.6 Industrial sites visited

The sites visited by schools in the Tees Valley region are shown in Table 3-2.

**Table 3-2: Site visits in the Tees Valley region**

| Site Visited | Number of pupils |
|---|---|
| Teesmouth Field Centre | 76 |
| Corus | 28 |
| Omya uk | 20 |
| Huntsman | 16 |
| Seal Sands Chemicals | 16 |
| Halterman/Dow | 12 |
| Frutarom | 12 |
| BP Cats Terminal | 8 |
| Dupont | 8 |
| Lundbeck Pharmaceuticals | 8 |

| | |
|---|---|
| Oxford Chemicals | 8 |
| Johnson Matthey | 8 |
| Philips Petroleum | 5 |
| BPI Visqueen | 4 |
| Conoco Phillips | 4 |
| Basell Wilton | 4 |
| Green Gates | 4 |
| Koppers UK | 4 |
| Simon Storage | 4 |
| British Polythene Industries | 4 |
| **Total** | **253** |

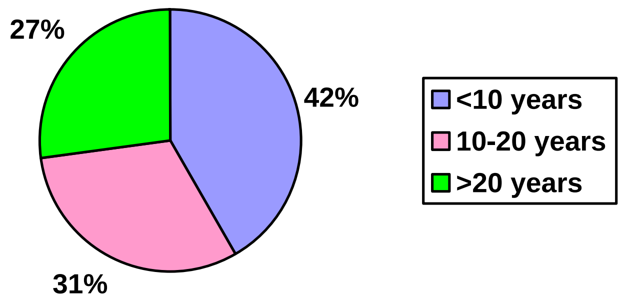
The three most common sites visited by the children were Teesmouth Field Centre, Corus and Omya. There were eight-teen other sites visited by classes in this region, indicating there were many companies interested in being involved in the CCI project.

A small proportion of children (13%) did not visit an industrial site. There were 18 classes from the year 2000 where information on the site visit was not available.

## 3.7 Years in teaching

Teachers were asked how many years they had been teaching. They were split into three groups, fewer than 10 years, 10-20 years and more than 20 years to enable the results to be compared with the previous study.

**Figure 3-5: Years spent teaching**




The mean number of years that teachers had been teaching was 14 years in this study. The maximum was 33 years and the minimum was 0 years (a newly qualified teacher!).

The teachers in both this study and the previous study were split into the three categories approximately equally. In this study, there were more teachers who had been teaching for fewer than 10 years.

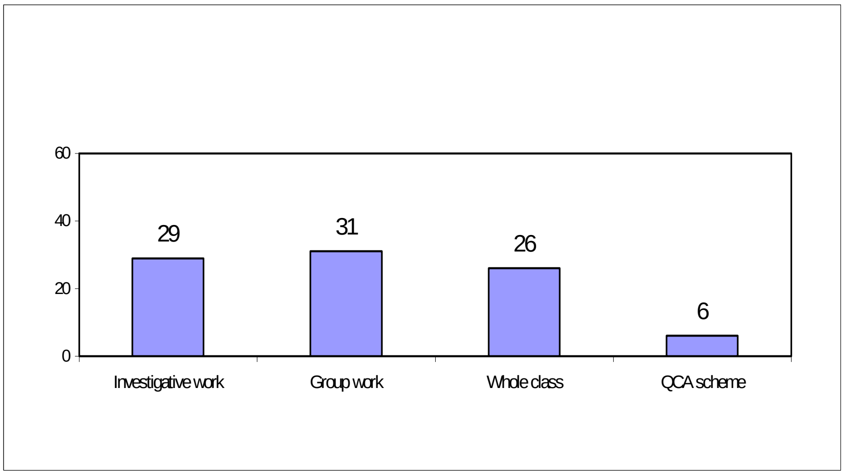
## 3.8 Teaching science

85% of the teachers stated that they were the only teachers that taught science to their class. The remaining 15% (9) teachers had input from other members of staff.

A small number (14%) of teachers also taught science to other classes. One teacher said that they taught specific projects and seven teachers said they supported other classes during SAT revision.

Teachers were asked about their teaching methods but many teachers (31%) did not answer this question. This may have been because it was not clear that an answer was required or because they were not sure what answer to give.

**Figure 3-6: Details of teaching methods**




Those that did answer the question were most likely to say ‘investigative work’ or ‘whole class and group work’. The number of teachers teaching investigative work was higher for this region than in other regions. There may be particular reasons why teachers in this region do more investigative work. There are science advisors in Tees Valley, whereas other regions have very limited science advisory input.

## 3.9 Chapter summary

The CCI project sought the views of science and industry from 363 children in primary years 4 to 6. 92% of the year groups being taught were either solely year 5 or year 6. The average number of children in a class was 29 in this study, higher than in the previous study.

The advisory teacher was able to offer a variety of topics to the teachers and children, to suit their needs and interests, together with company visits. *A Pinch of Salt* was the most popular choice. There was a wide choice of industrial sites for the children to visit with many companies taking on impressive roles in the CCI project.

The mean number of years teachers had been teaching was 14. 85% of the teachers said they were the only teacher to teach science to their class and 86% said they did not teach science to any other classes

# 4 Children's views of industrial settings

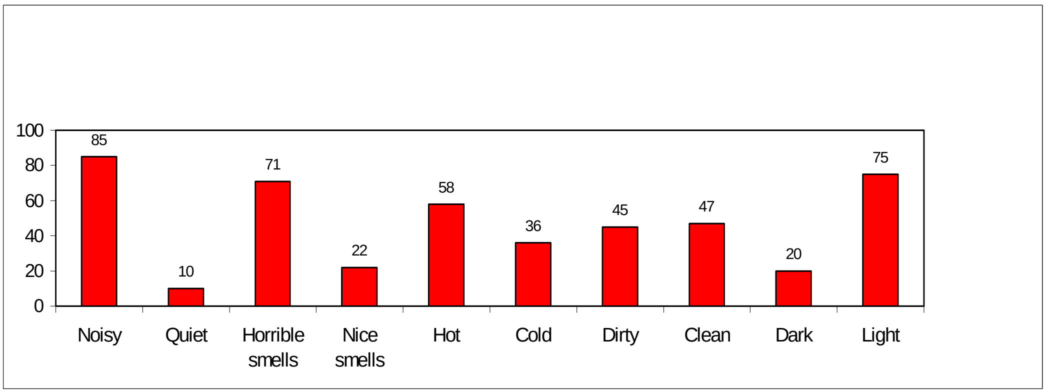
This section discusses the children's views of industry in two parts. The first part involves questions on words that describe industrial sites and the second part involves analysis of the children's drawings of the inside and outside of an industrial site.

## 4.1 Industrial environment

The children were asked a series of closed questions about industrial sites before and after the project. The questions included a choice of two answers, for example, industrial sites are cold or hot, have horrible smells or nice smells, are noisy or quiet, etc. Some children ticked both answers or left the answer blank. These answers were considered neutral and were not included in the following analysis.

The first group of questions included questions on the industrial environment; light, noise, cleanliness, smells and temperature. The results of these questions are shown in Figure 4-1.

**Figure 4-1: Children's descriptions of industry before intervention**

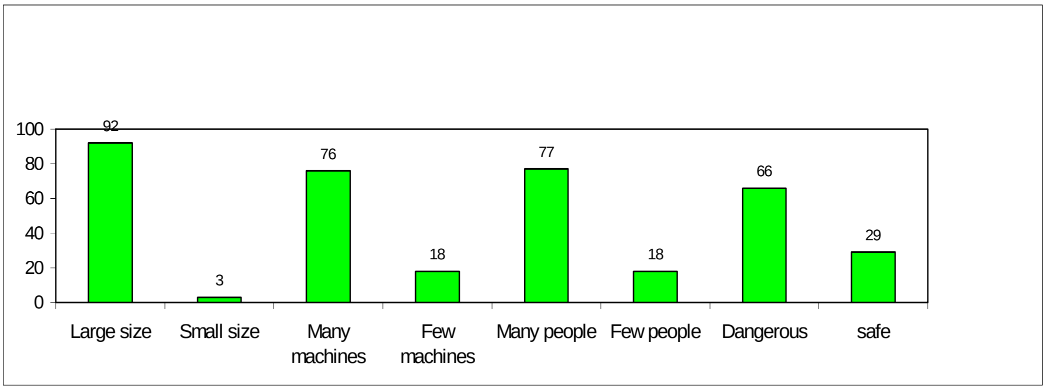



Before the project, the predominant view of industry was that it was noisy, smelly and hot. The results are similar to those obtained by Parvin (1999). She found that 80% of children thought an industrial site would be noisy and 75% thought it would have horrible smells. She also found that 55% of children thought that it would be hot. All the figures are very close to the results obtained in this study. The only result that varied significantly from Parvin's study was the percentage of children who said it would be dark. In this study, far fewer children thought an industrial site would be dark compared with Parvin's study. This may have been because the percentage of children carrying out *A Pinch of Salt* topic was lower in Parvin's study (20% compared with 40%). Children are particularly unlikely to say that salt is produced in a dark environment, as they often refer to the seaside.

Many of these perceptions of industry are not accurate for the majority of industrial sites. Although there are sites that are noisy and smelly, they are by no means all like this. The children therefore did not have an accurate picture of industry before involvement in the project.

The second group of questions focused on the number of people and machines that would normally be found on site, the size of a typical site and the degree of safety usually found. The results of these questions are shown in Figure 4-2.

**Figure 4-2: Children's descriptions of industry before intervention**



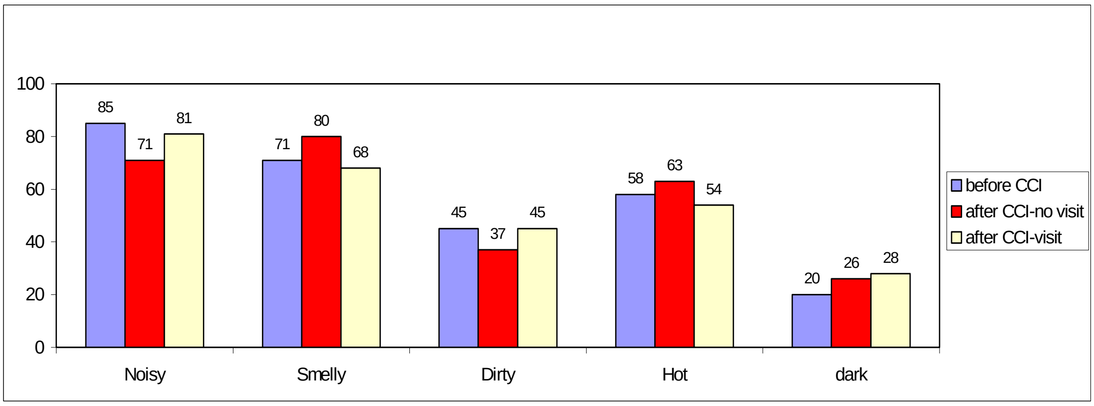

Again, the overall picture is one of a large site with lots of people and noisy machines. Many children also saw it as a very dangerous atmosphere. Parvin's study produced very similar results with the number of children stating a site would be large, with many machines and/or people between 75 and 85%. The percentage of children who thought a site would be dangerous was also very similar in Parvin's study (70%).

As before, the views of many of the children are largely inaccurate before the project. Many felt that industrial sites were huge places with lots of people on production lines using noisy, dangerous machines.

It was hoped that after the CCI project the children would have more accurate views of industrial sites. It was expected that the children who had been on a site visit would have increased their knowledge of industrial sites to a larger extent than the children who had not been on a visit. Therefore, the children were split into two groups for further analysis, those who had been on a visit and those who had not had a visit. However, the number of children who did not have a visit was very small in this region (13%) which makes the results less conclusive than if a similar number of children did not visit a site as did.

The changes in the views of children were analysed to see if there were any differences in the answers given after the project (with visit to industry compared with no visit to industry) compared to before the intervention. The results are shown in Figure 4-3.

**Figure 4-3: Industrial views of children**

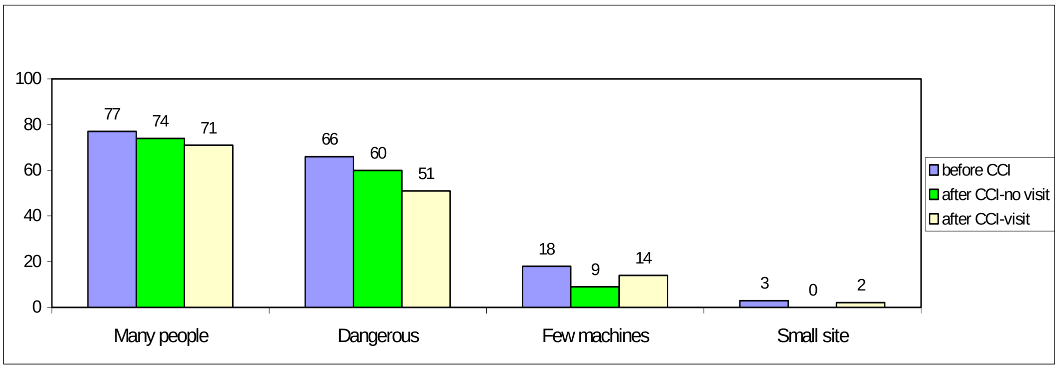



The children who had been on a site visit were slightly less likely to say that a site was noisy, smelly and hot. Whereas the children who had not been on a visit were slightly less likely to say an industrial site was noisy or dirty. The number of children who did not go on a visit was small so care must be used in interpreting this data. However, it appears that both classroom-based lessons and site visits help children become more knowledgeable about the environment of industrial sites. Both groups of children gave a slightly more balanced view of what an industrial site is actually like compared to their views before the project.

Further investigation showed that the type of topic had an influence over the children's views of the environment in industry. Before the project, children participating in *A Pinch of Salt* were more likely to say that a site was light and clean. Conversely, those participating in Plastics Playtime were more likely to say that a site was hot and smelly.

The results of the second group of questions are shown in Figure 4-4.

**Figure 4-4: Industrial views of children**




The children who visited an industrial site were less likely to say that industry is dangerous and more likely to say that there are only a few people on a site. This accurately reflects the situation in many sites where fewer people work than children would expect and safety of the site is extremely important. The children who had not had a visit showed a similar trend but to a lesser degree. In addition, both groups of children were more likely to say there were many machines in industry and that industrial sites are large. Both classroom lessons and site visits play a role in teaching children about the environment of industrial sites.

In Parvin's original study the question was framed differently and the post-intervention question was more open. The percentage of children who said industrial sites were safer was smaller at 4% because many children chose to leave the question blank.

The results are slightly disappointing, as the changes in the children's perceptions of industry are smaller than expected. However, the drawings present quite a different interpretation of the extent to which their perceptions changed.

## 4.2 Drawings analysis

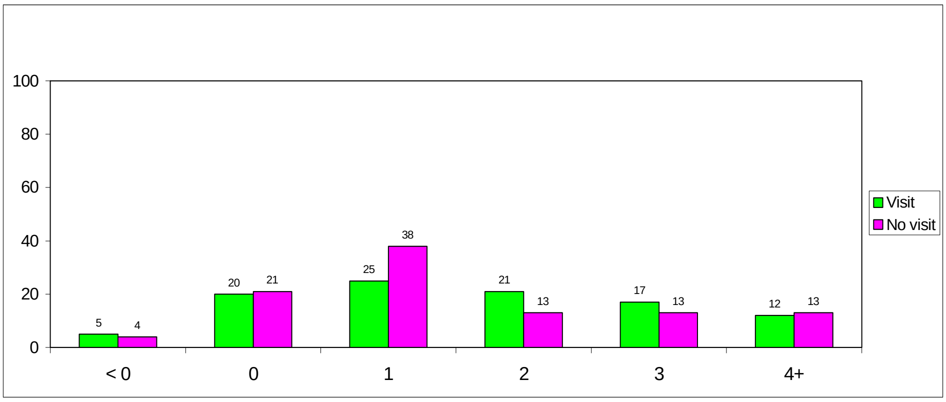
The children were asked to draw pictures of their impressions of an industrial site (inside and outside), before and after the CCI project. The pictures were compared and given a score based on the difference between the pre- and post-intervention pictures.

A high positive score demonstrated good knowledge of the site and a high negative score demonstrated poor knowledge. A score of zero indicated no change in the child's knowledge as measured by their drawings. The criteria used for scoring the external and internal drawings are listed in the Appendix.

Children who had an industrial visit may have learnt more about the appearance of sites, and therefore the scores of children who went on an industrial visit were compared with the scores of children who did not. These results were analysed using a t-test.

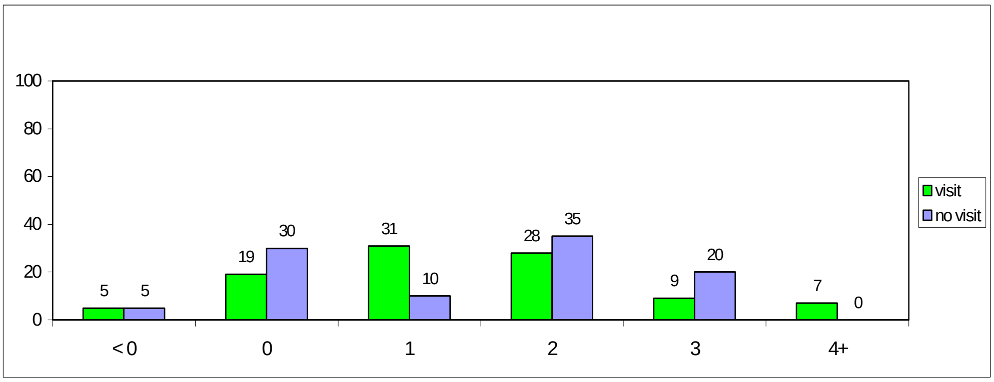
The results of the scores of external and internal pictures are shown in Figure 4-5 and Figure 4-6.

**Figure 4-5: Scores of drawings of external view of industrial sites**




The scores were significantly greater than zero for both groups. In other words, children, regardless of whether they had a visit or not drew pictures that were more detailed at the end of the project, compared with the beginning. The external drawings depicted a slight difference in the results of children who had been on a site visit, compared to those who had not. The mean scores were 1.7 and 1.5 for the children who had, and had not had, a site visit respectively. Children who had a visit were more likely to have a score of two or more, whereas those without a visit were more likely to have a score of one or less.

**Figure 4-6: Scores of drawings of internal view of industrial sites**




The scores were significantly greater than zero for both groups. In other words, children, regardless of whether they had a visit or not, drew more detailed pictures at the end of the project, compared with the beginning. For the internal drawings, the average score was 1.4 regardless of the site visit.

In the next section, examples of drawings have been provided to illustrate the differences between high and low scores. Drawings of the outside are displayed first, followed by drawings of the inside of industrial sites.

### *4.2.1 DRAWINGS OF THE EXTERNAL IMAGE OF INDUSTRY*

The children were first asked to draw what they thought the outside of an industrial site would look like. Some of the children drew pictures depicting an 'old fashioned' view of industry before the project, and some drew pictures with very little detail.

The pictures drawn after the project tended to be more modern images of industry, and included more detail.

The following before and after pictures are an example of a high positive score obtained by a child who carried out the topic *A Pinch of Salt*. In addition, this child had an industrial visit.

**Figure 4-7: Child 1, external image of industry pre-CCI**

**Figure 4-8: Child 1, external image of industry post-CCI**


Before the project, the child portrayed an oppressive image of industry that was typical of many of the children's pictures. The building drawn was dark and sombre with many smoky chimneys. Afterwards the child's drawing was much more detailed and less stereotypical. The chimneys disappeared, and a modern building took its place. The slag heaps and open pipes were replaced with storage containers and closed pipe-work, connecting different areas of the site and fenced off areas.

Many of the children who carried out the topic on salt drew pictures of the sea or buildings beside the sea as they thought that salt came from salt water. Very few children knew about 'solution mining' before the project started, however during the project, it was covered in detail and these children drew very different pictures after the CCI project.

The following before and after pictures are an example of a high positive score obtained by a child who did the topic *Water for Industry*. This child also had an industrial visit.

**Figure 4-9: Child 2, external image of industry pre-CCI**

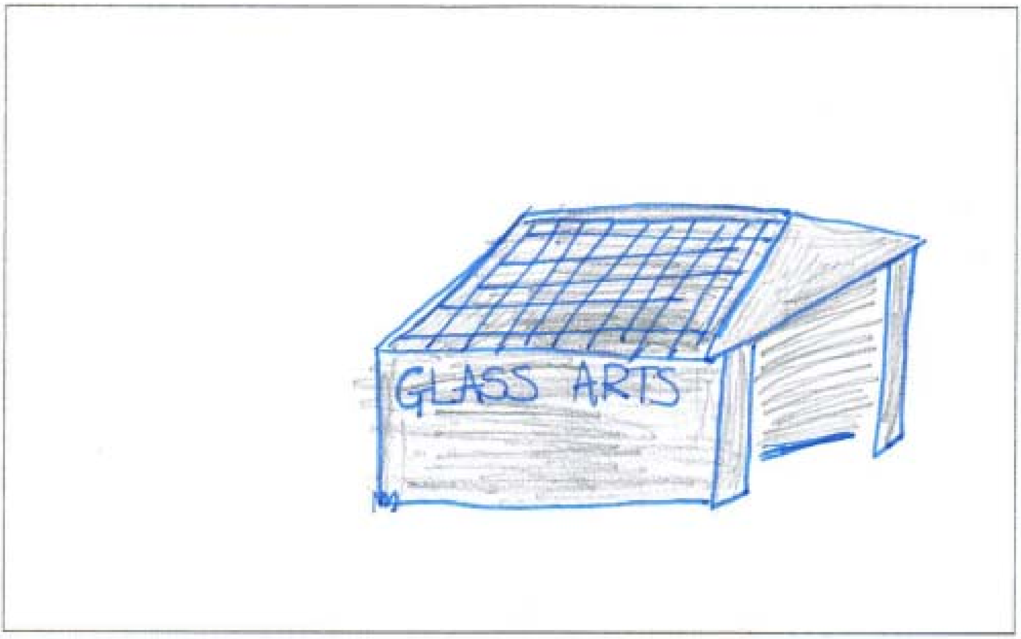
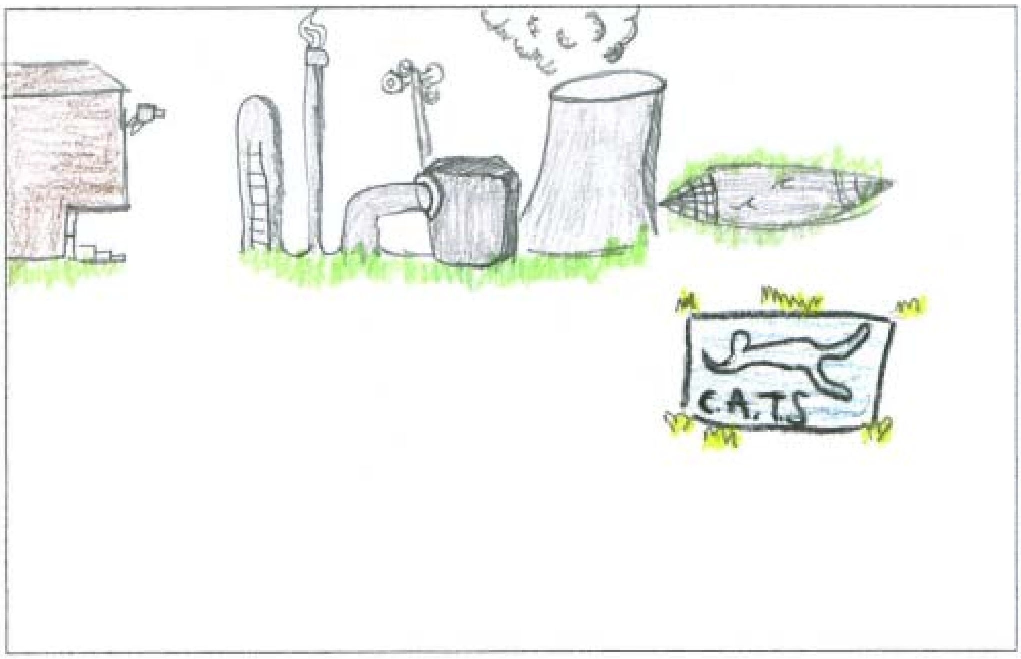



**Figure 4-10: Child 2, external image of industry post-CCI**



After visiting BP, Child 2 has used knowledge of industry to depict the exterior view of the site as consisting of different buildings, pipes, storage areas, cooling tower and a company logo.  This is in contrast to the drawing made before the training which was very simple, containing no detail except writing on the outside of the building (which appeared to be related to a craft industry).

The following before and after pictures are an example of a lower positive score obtained by a child who did the topic *Water for Industry*.  This child also went on an industrial visit.

**Figure 4-11 :  Child 3, external image of industry pre-CCI**

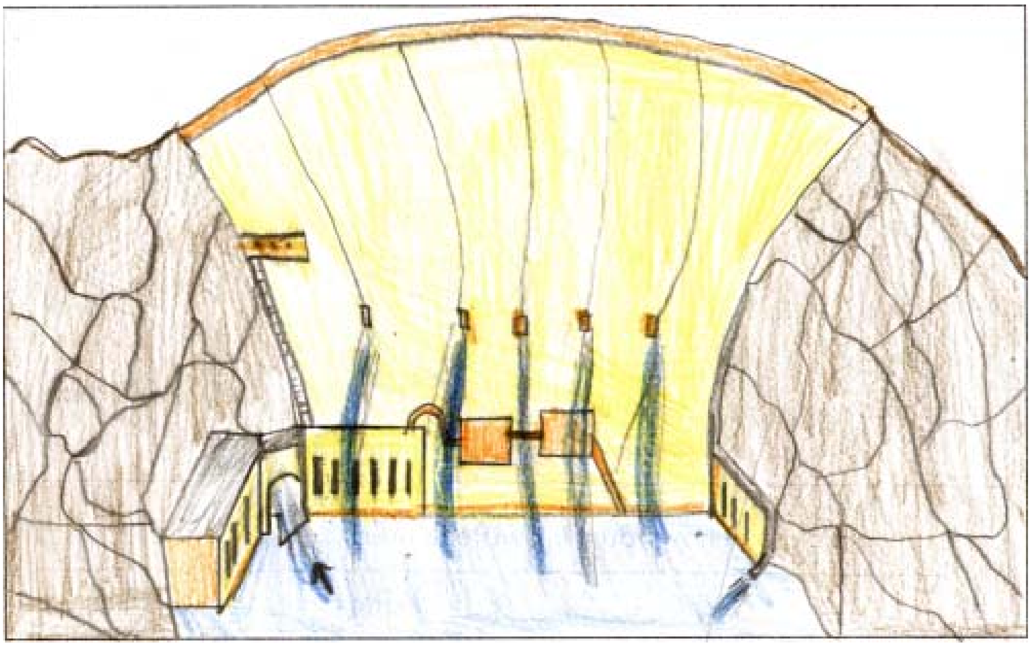


**Figure 4-12 :  Child 3, external image of industry post-CCI**

This is an unusual example of a child who drew a detailed, sophisticated drawing before the project.  Although the picture drawn after the site visit was accurate in depicting the site that he visited, the picture drawn before was also a good representation of how water is used in industry, albeit very rarely, in Britain. This child had a good knowledge of industry before the project and therefore did not obtain as high a score as a child who knew very little before the project. This was not common and the vast majority of children who received a low score, did so because their pre-intervention drawing was simplistic.

The next two pictures are from another child who obtained a low positive score (2) after completing the topic *Plastic Playtime*, and had an industrial visit.

**Figure 4-13 : Child 4, external image of industry pre-CCI**

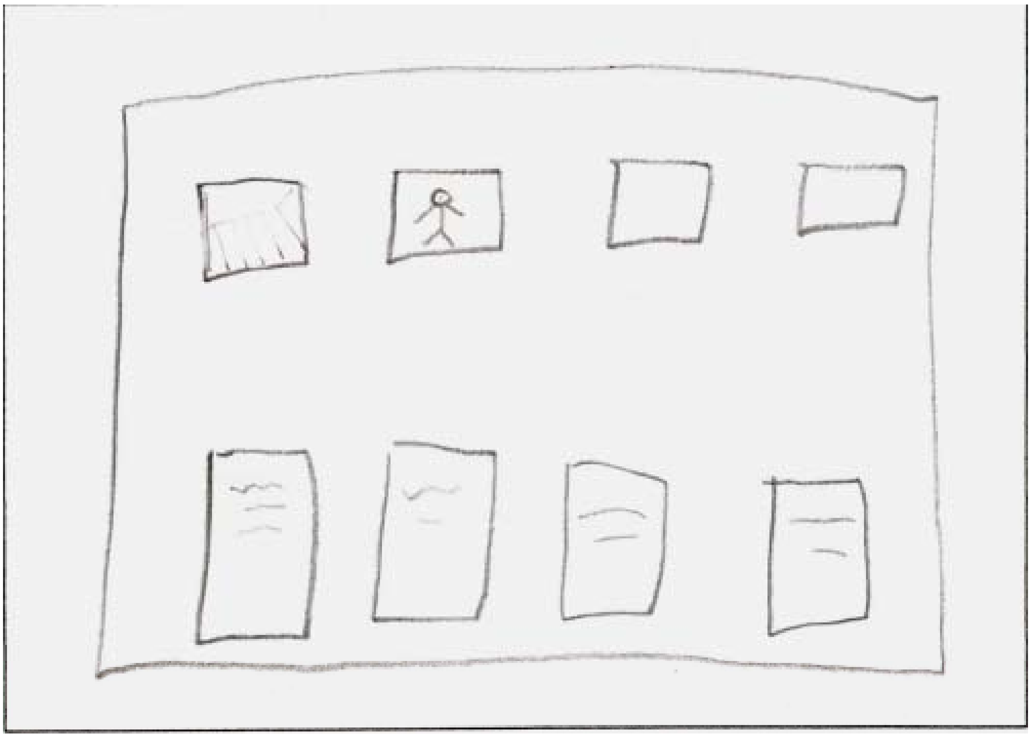


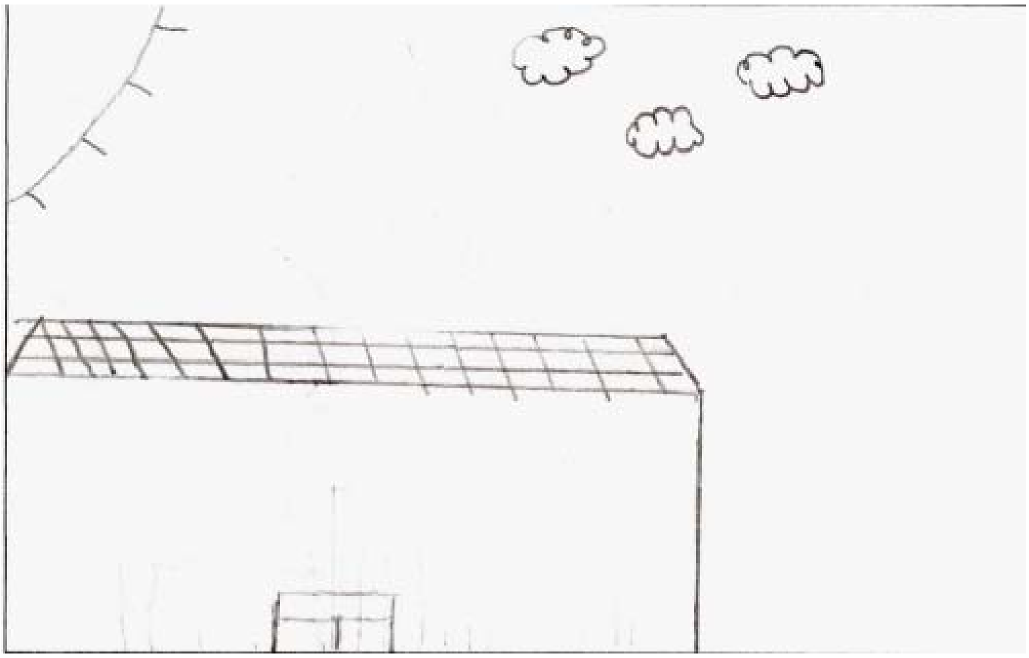
**Figure 4-14 : Child 4, external image of industry post-CCI**

The post-intervention drawing is slightly more detailed and includes enclosed pipes together with what appears to be a cooling tower. However, the picture is not as detailed as previous post-intervention drawings in this report. The child has, none the less, improved their knowledge of the external image of industry as a result of the CCI project.

The following before and after pictures are an example of a zero score obtained by a child who did the topic *A Pinch of Salt*. This child also went on an industrial visit.

**Figure 4-15 : Child 5, external image of industry pre-CCI**

**Figure 4-16 : Child 5, external image of industry post-CCI**



This child's views are fundamentally the same, both before and after the project. The child has drawn a simple building with one or more doors in both drawings.

Despite a site visit, this child was unable to draw a different scene to portray the outside of an industrial workplace. There may be various reasons why the post-intervention drawing is poor. Perhaps time was short and this was all the child could complete or the child did not have strong skills or confidence to draw. This child's post-intervention drawing of the inside of the same place was similarly sparse.

### 4.2.2 DRAWINGS OF THE INTERNAL IMAGE OF INDUSTRY

The children were then asked to draw what they thought the inside of an industrial site would look like. Before the project, many of the children drew pictures depicting an 'old fashioned' view of industrial processes, with dangerous substances being poured into huge vats, and conveyer belts containing lines of people. The pictures drawn after the project tended to be images that are more modern which contained more pipes and closed vessels, as well as fewer people.

The following before and after pictures are an example of a high positive score obtained by child 1 who had an industrial visit.

**Figure 4-17 : Child 1, internal image of industry pre-CCI**

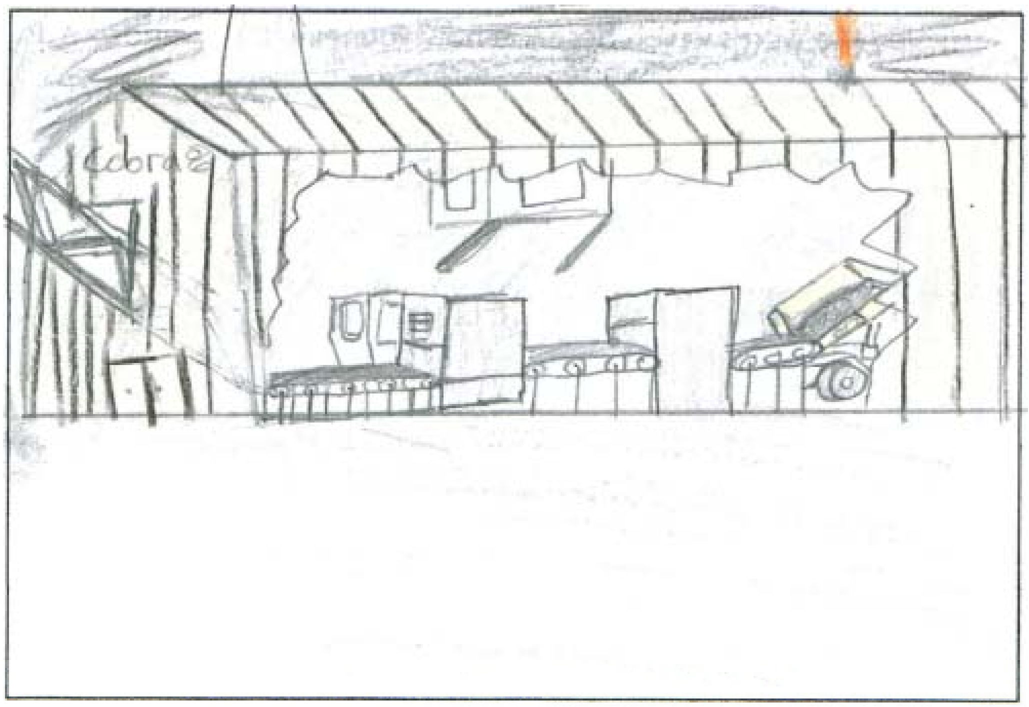
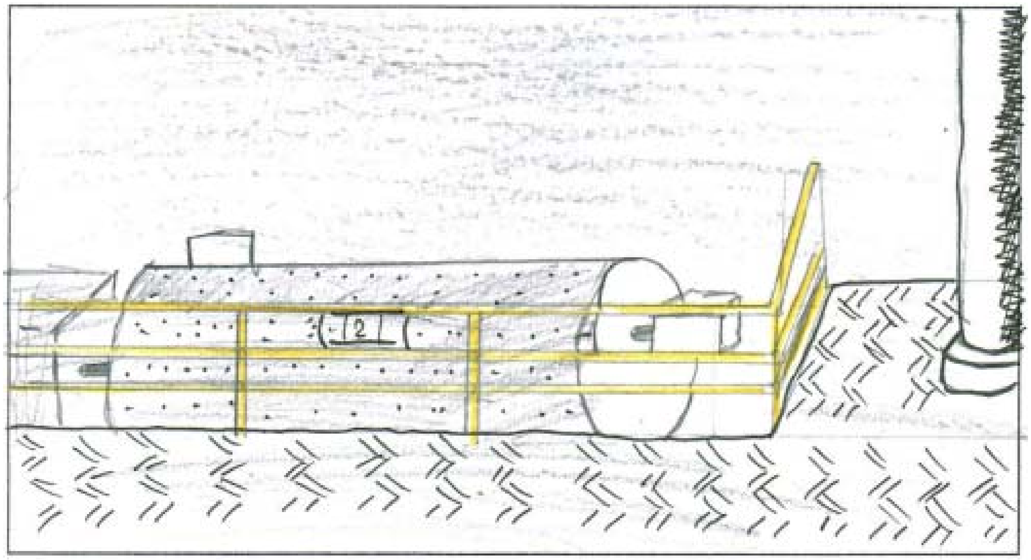


**Figure 4-18 : Child 1, internal image of industry post-CCI**



The inside of the building was also portrayed as dark and sombre before the project. The building appears to contain conveyer belts and machines. After the training, the picture portrays a more modern image with metal flooring, pipes and safe closed vessels, which are marked.

There has been a move from open-topped vessels to closed vessels being filled from pipes. This demonstrates how much the child has learnt about the processes involved as well as a heightened awareness of safety. This is also represented in the non-slip floor and railings.

The following before and after pictures are an example of a high positive score obtained by child 2 who had an industrial visit.

**Figure 4-19 : Child 2, internal image of industry pre-CCI**

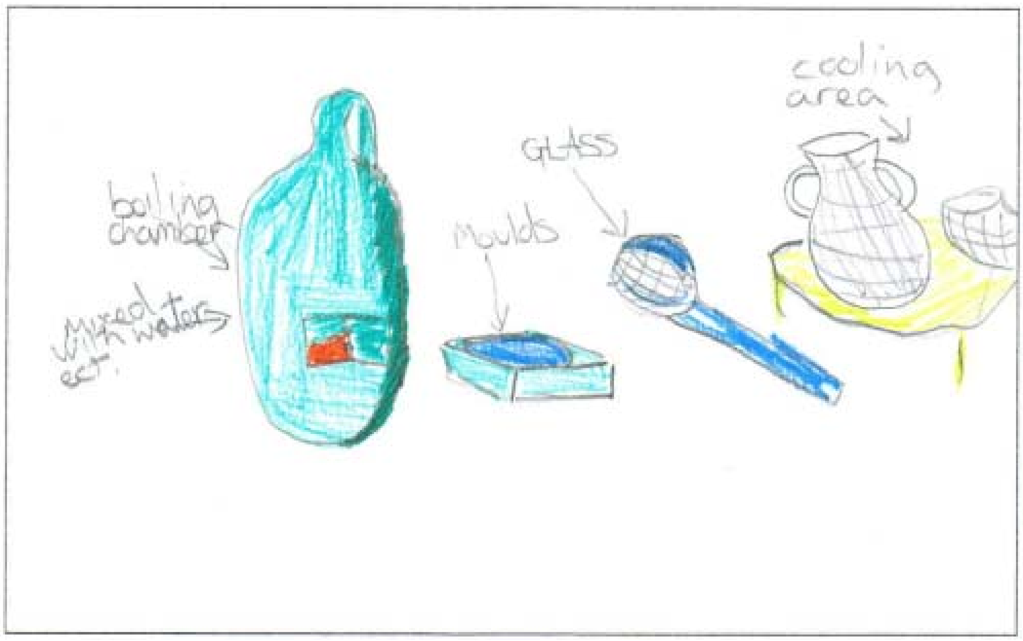
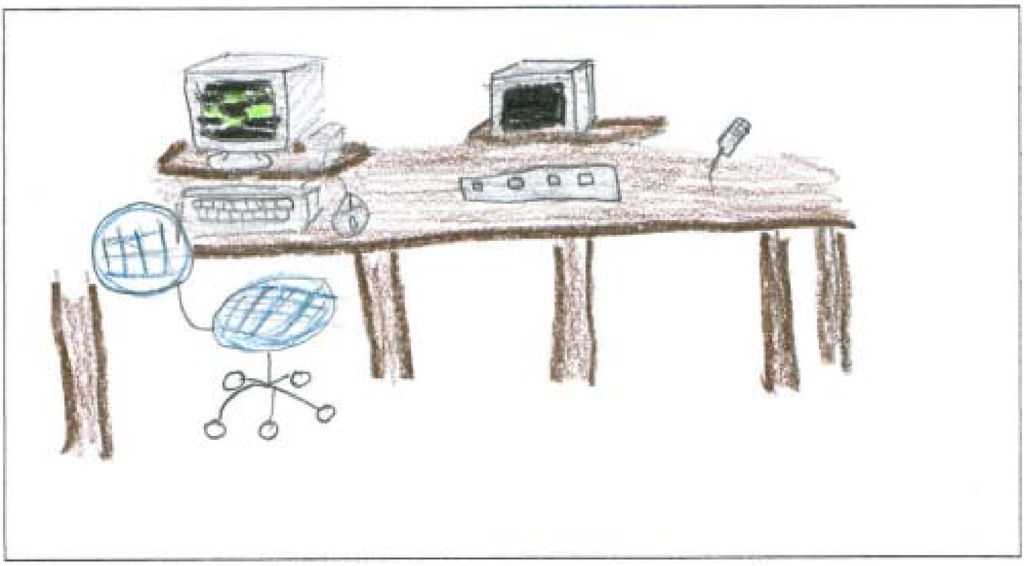


**Figure 4-20 : Child 2, internal image of industry post-CCI**



When asked to draw the inside of an industrial site, this child included open vessels and moulds, which depicted a non-automated vision of industry. Other children showed workers apparently pouring liquids into vessels. In the second drawing, the child has depicted a very different scene with computers and a modern environment. Many children included computers in their second drawing and others included enclosed pipes and were less likely to include conveyer belts.

The following before and after pictures are an example of a lower positive score obtained by child 3 who had an industrial visit.

**Figure 4-21 : Child 3, internal image of industry pre-CCI**

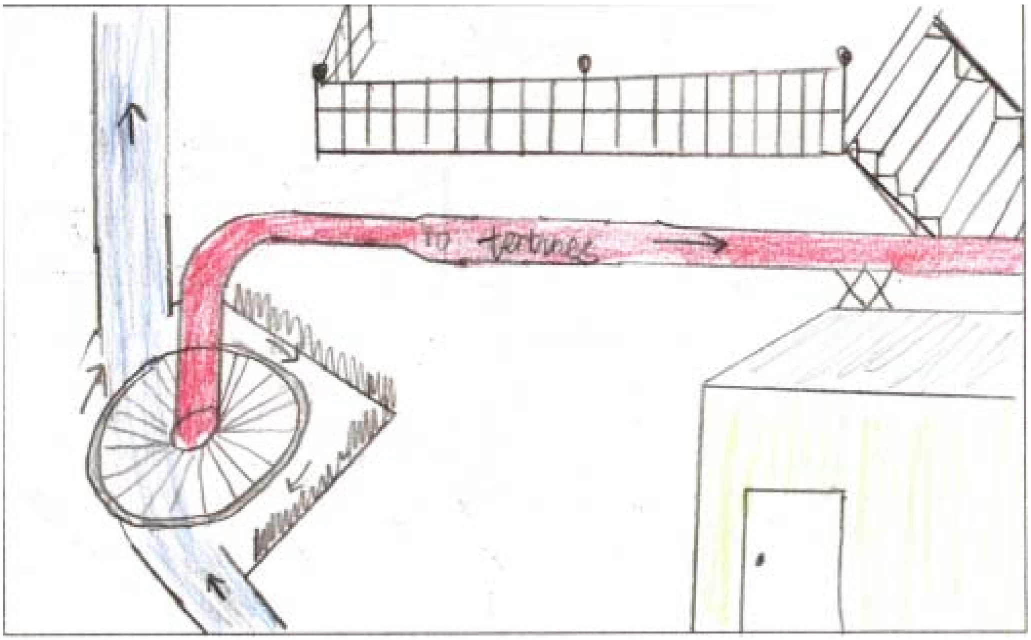
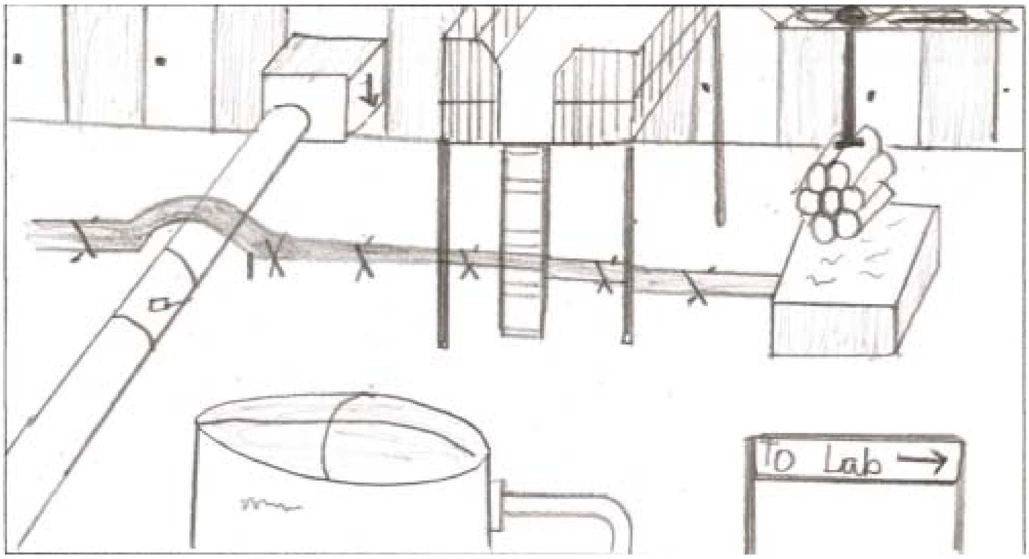


**Figure 4-22 : Child 3, internal image of industry post-CCI**




This child obtained a low score for his drawing of the outside of industry because his pre-intervention drawing was so detailed and it is the same situation with his inside drawings. In both drawings of the internal image of industry, there are enclosed pipes and specific equipment, with no conveyer belts or huge numbers of workers. This again demonstrates this child's good knowledge of industry before the project started.

The next set of drawings is also from a child who visited industry and obtained a medium score of 3.

**Figure 4-23 : Child 4, internal image of industry pre-CCI**

**Figure 4-24 : Child 4, internal image of industry post-CCI**


Comparison of these two drawings gives a positive score. There has been a move away from open vessels handled by machine operators. After the project, this child has drawn a picture of a scientist working in a laboratory. They have included scientific equipment such as flasks and enclosed pipes in the background of the picture. The inclusion of the pipes is evidence that the picture is of a scientist in industry and not the advisory teacher in the classroom.

The following before and after pictures are from child 5 who obtained a zero score, despite having an industrial visit.

**Figure 4-25 : Child 5, internal image of industry pre-CCI**

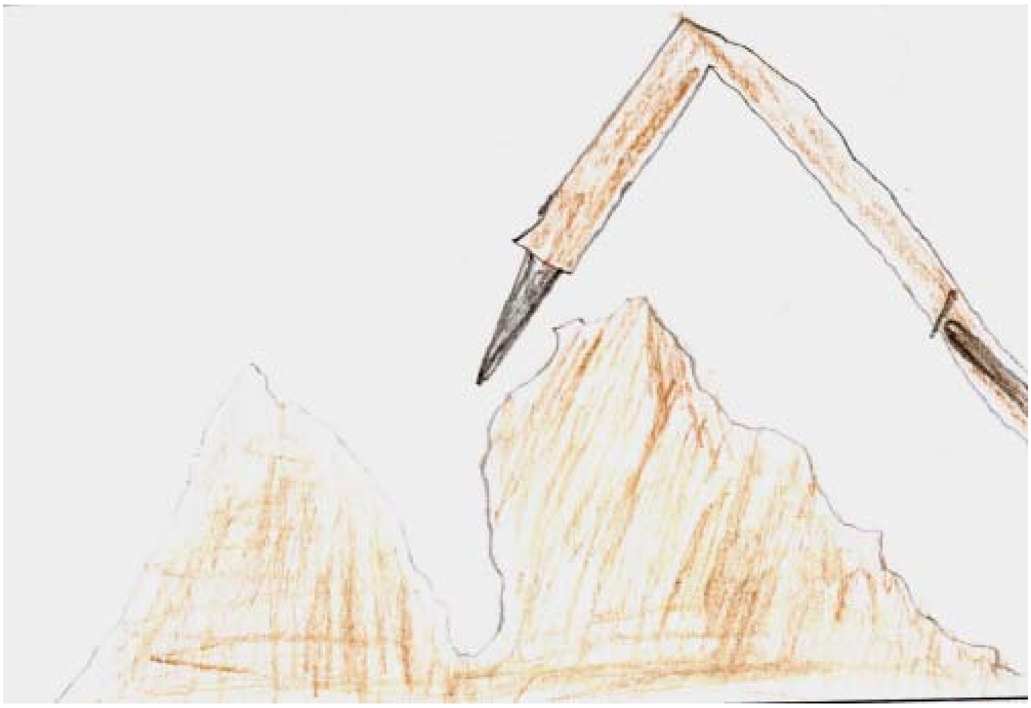
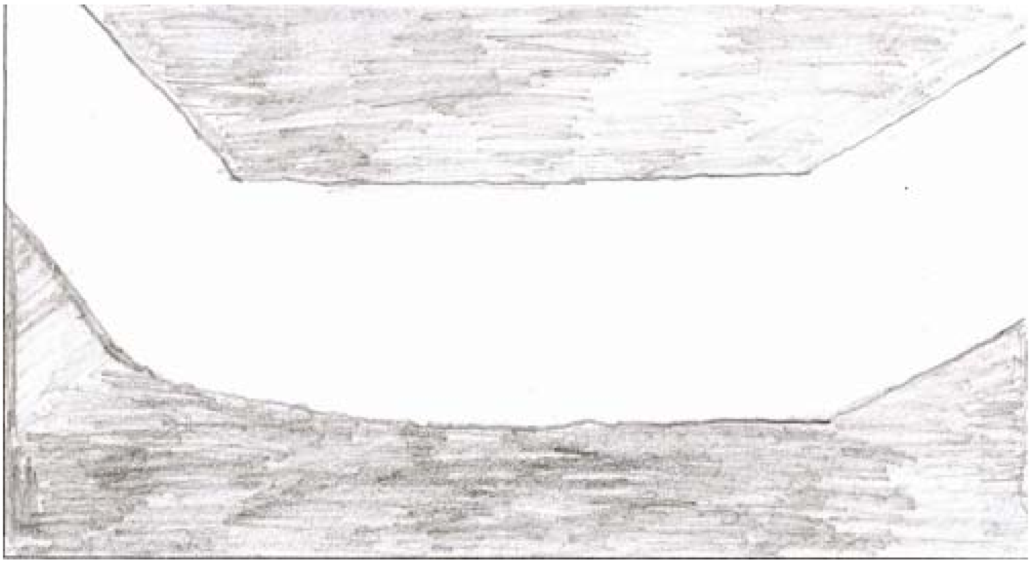


**Figure 4-26 : Child 5, internal image of industry post-CCI**



This child's views of industry are fundamentally the same here. Although the drawings are simplistic both before and after the project, the pre-intervention drawing did accurately reflect the fact that salt is mined. However, the post-intervention drawing added nothing compared to the previous drawing. This could have been because of time constraints or because they did not feel able to draw anything more intricate.

## 4.3 Chapter summary

Children who had been on a site visit were slightly less likely to say that industrial sites are noisy, smelly and hot. Children who had not been on a site visit were slightly less likely to say an industrial site was noisy or dirty. Both groups of children were more likely to think that industrial sites were safe, and had fewer people than expected. Both groups of children gave a slightly more balanced view of what an industrial site is actually like compared to their views before the project.

These results provide some evidence of the usefulness of the site visit and classroom lessons in educating primary school children on the environment of industrial sites. The results are slightly disappointing, as the changes in the children's perceptions of industry are smaller than expected. However, the drawings present quite a different picture.

After the project, the children were more likely to draw detailed images of external and internal images of industry. This indicated that they were more aware of the processes involved in industry after the project. However, the children visiting an industrial site were better able to depict a more accurate picture of industry than those who did not have a visit. Although children who had not had a visit were shown images of industry using video and photographs, for some children this was not in itself enough to learn about industrial environments. Parvin (1999) came to the same conclusions. She concluded that the best way to improve children's knowledge of industry is to follow up their classroom activities with a well-planned visit to an appropriate company.

# 5 Children's views of industrial jobs

This section deals with children's perceptions of jobs occurring in the industrial workplace. It is divided into three sections:

- Jobs depicted in drawings
- Other jobs cited by children that occur in industry
- Jobs the children thought they would choose to do in industry.

## 5.1 Drawing of a person who works in industry

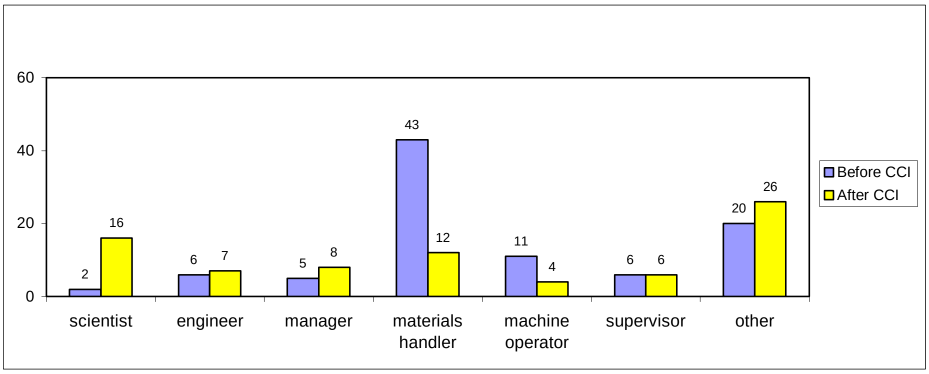
The children were asked to draw a picture of a person who works on an industrial site. They were then asked to write down the job of the person they had drawn. The types of jobs listed were analysed to see if there were any significant differences after the children had experienced the CCI project compared with their answers before the project.

Many different jobs were listed, and those listed less than 5% of the time were amalgamated to form the category 'other'. This group included, packer, driver, office worker, computer operator, miner, cleaner, worker, cook, mechanic, tour guide and first aider.

Some children did not draw a picture or state the person's job and these were categorised as 'No response' but were not included on the graph.

The results are shown in Figure 5-1.

**Figure 5-1: Industrial jobs depicted in children's drawings**




Before the project many of the jobs of people drawn were categorised as 'materials handler', where children quoted jobs relating to processes such as mixing, heating and moulding. They were less able to suggest specific jobs and usually described their drawing by describing what the person was doing rather than giving a job title. The number of children drawing a materials handler or machine operator decreased dramatically from 43% to 12%. These results were statistically significant.

Before the project took place, the children were very unlikely to say that they had drawn a scientist or an engineer. In her original study, Parvin found that children do not associate scientists with industry. They are more likely to associate them with a research environment. They are unsure of scientists and engineers roles in industry and therefore feel more comfortable with jobs involving products, machines or offices.

The situation after the project was very different. The number of children drawing a scientist increased dramatically from 2% to 16% after intervention. In addition, the number of children listing engineer or manager also increased slightly. The number of children drawing an engineer showed a more marked increase in other regions.

The children were more significantly more likely to omit drawing a picture after intervention 21% compared to 7%, pre-intervention) and this may be because they felt they were repeating what they had done just a few weeks previously. The number of children drawing people who were categorised as ‘other’ increased slightly.

The group of children who had been on an industrial site visit were no more likely than the children who did not have a visit, to state scientist as the person’s job. Unlike the results in this study, Parvin (1999) found that the site visit had an impact on the children’s awareness of the variety of jobs required to run an industrial site. However since her original study, more role-play has been introduced into the classroom sessions. This role-play highlights the different roles of people working in industry and may explain why the site visit did not have a significant impact in this study.

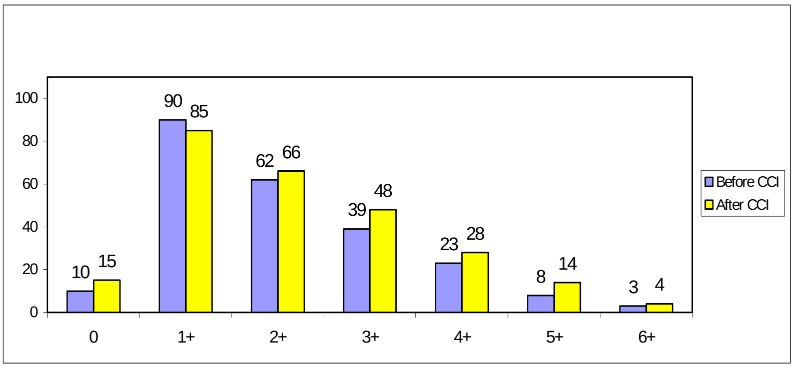
The fact that these results did not demonstrate a significant difference between those children who had and had not been on an industrial visit is welcome news. It means that children who do not go on a site visit are learning about the roles of scientists in industry during the classroom lessons.

These positive results provide strong evidence that the children learn about the importance of scientists and their roles on industrial sites. After the project, the children were significantly more likely to draw a scientist and significantly less likely to draw a materials handler.

## 5.2 Other jobs done in industry

The children were asked to list other jobs that they believed were done on industrial sites. The children listed up to nine different jobs before and after the project. The results are shown in Figure 5-2.

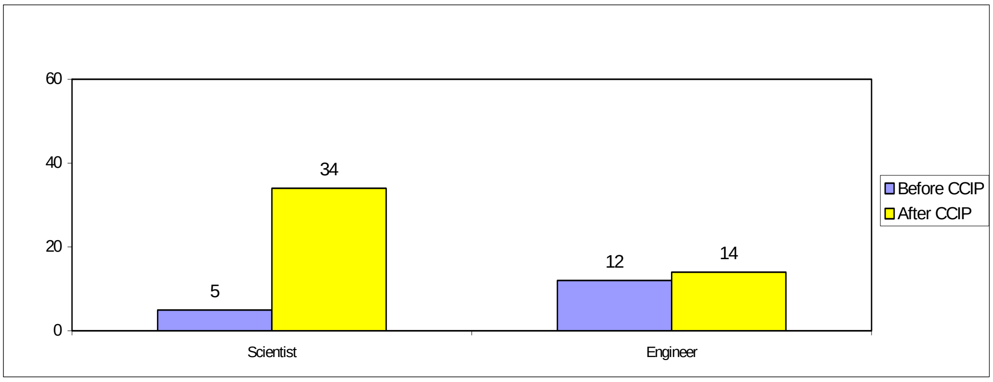
**Figure 5-2: Number of jobs listed by children before and after CCI**




The number of children listing three or more jobs was significantly higher after the CCI project compared to before the project. The project raised the children’s awareness of the variety of jobs held in industry.

The number of children who listed scientist or engineer was investigated. The children who quoted scientist or engineer as the job of the person they had drawn were added to those who listed scientist or engineer in the list of other jobs. This then gave the total number of children who mentioned scientist or engineer in the questionnaire. The results are shown in Figure 5-3.

**Figure 5-3: Proportion of children citing industrial scientists or engineers**




The proportion of children who listed scientist as a job on industrial sites increased nearly seven times from 5% to 34%. However, the proportion of children who listed engineer as a job on an industrial site did not increase as dramatically. The percentage of children who mentioned a scientist or engineer was 43%.

There was a huge increase in the children's awareness of scientists. This demonstrated that before the project, many children were not aware of the roles of scientists in industry. After the project, nearly half of all the children mentioned that scientists or engineers worked in industry.

Other jobs were listed more frequently after the project, such as manager. In addition, the children were more specific about job titles, for example manager was expanded to give personnel manager, control manager and warehouse manager, which did not happen before the project. This is due to the role-play included recently in classroom sessions as well as the site visit. Conversely, jobs such as materials handler were listed less frequently.

## 5.3 Chosen Job

The children were asked which job they would like to do on an industrial site, and give reasons. The complete list of jobs chosen is shown in Table 5-1. This demonstrates the variety of jobs that children had in mind.

**Table 5-1: Industrial jobs chosen by children**

| Which job would you choose | Percent before | Percent after |
|---|---|---|
| Scientist | 2 | 19 |
| Engineer | 3 | 3 |
| Materials handler | 32 | 7 |
| Manager | 13 | 20 |
| no response | 9 | 14 |
| None | 7 | 5 |
| Machine operator | 6 | 4 |
| Driver | 5 | 8 |
| Packing | 4 | 2 |
| Supervisor | 4 | 2 |
| don't know | 3 | 0 |
| Cleaner | 3 | 1 |
| Office | 2 | 5 |
| Computer | 2 | 2 |

| Which job would you choose | Percent before | Percent after |
|---|---|---|
| Security | 1 | 1 |
| Miner | 1 | 2 |
| Other - technician, worker, cook, tour guide. | 3 | 3 |

Before the project, the most popular job chosen was 'materials handler'. Thirty-two percent of the children wrote down words describing this type of job such as 'moulding the plastic into shape' and 'mix the salt'. Other jobs mentioned by more than 5% of the children were, manager, machine operator and driver. The job that children were less likely to choose after the CCI project (i.e. a decrease of 4% or more) was 'materials handler', which decreased dramatically from 32% to 7%.

There were just two jobs that the children were significantly more likely to choose after the CCI project, and these were 'scientist' and 'manager'. An increase of 4% or more was statistically significant. The proportion of children saying they would like to be a scientist was 2% before the project and increased nearly 10 fold to 19% after the project. The proportion of children saying they would like to be a manager increased from 13% to 20%.

When asked about job preferences before the CCI project, in this study 9% left the question blank and 10% put 'none' or 'don't know'. After the project more children left the question blank (14%) but significantly fewer put 'none' or don't know' (5%).

These results are similar to those seen by Parvin (1999). She also found that materials handler was by far the most common job chosen before intervention followed by manager, machine operator, packer and driver. She too found a dramatic decrease in the number who chose 'materials handler' after intervention.

Parvin also saw a rise in the number of children who chose 'scientist' after the project, however the increase in her original study was not quite as dramatic. The fact that the children came from a different region may explain this difference or it may be because role-play has been introduced in the classroom sessions.

The results are extremely positive. The classroom sessions and the site visits increased the children's knowledge of the role of scientists in industry. The classroom sessions were designed specifically to link the science done in the classroom with that done by professional scientists on a site. These results provide clear evidence that the advisory teacher successfully conveyed the message, resulting in many children adding to their knowledge of scientists. After the project there was only a tiny minority of children that could not choose a job that they would like to do in industry.

The children were asked why they had chosen that job and the answers were extremely varied. The responses before the project were generally more simplistic. After the project the children had a better appreciation of the occupations in industry, and gave specific reasons for choosing them.

The use of the phrase 'get to' was used frequently, e.g. 'you get to drive forklifts'. It was taken to mean that the child would like to do that particular activity and therefore was classified under 'enjoy'. This quote illustrates the point. 'Scientist, you get to discover things and do a lot of things'.

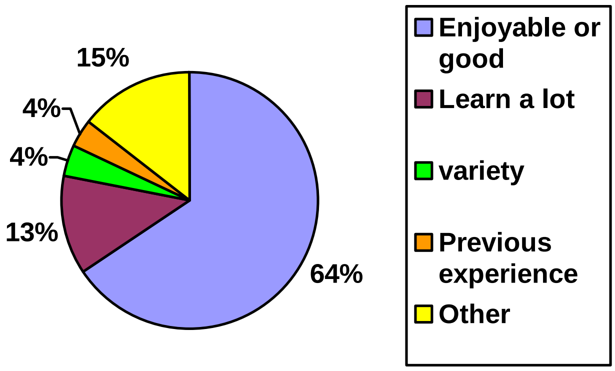
The number of children who chose a job because it was enjoyable increased by 50% after the project. This is evidence that more children may have seen working in industry as a possible future career. The number choosing jobs because they were easy decreased by 50% and this indicates that their knowledge of jobs had improved.

The reasons why scientist and engineer were their chosen jobs, were investigated in more detail.

Before the project 8 children chose scientist as a job they would like to do. When asked why, the most common response was that it would be enjoyable (5 children). Other words used were fun, exciting and interesting. The remaining three children each gave a reason such as they would have authority or they would learn things.

After the project, 55 children chose scientist as a job they would like to do. The reasons why are shown in Figure 5-4.

**Figure 5-4: Reasons why scientist was a job preference**




The reasons for choosing scientist were wonderfully positive ones with the most common one being that a scientist's job was enjoyable, fun interesting or good. Some quotes are provided below;

> *"Scientist, because it looks fun to do."*

> *"Scientist, because it looks more exciting than the other jobs."*

> *"Scientist, because I like doing investigations and experiments."*

> *"Researcher, because it is interesting finding scientific information."*

Some of the children stated that as a scientist they would learn a lot. An example is;

> *"Scientist, because you get to learn new things while you are working."*

The 'other' category included wanting to be a scientist because it was safe or easy.

Before the project, 9 children chose engineer as a job they would like to do. When asked why, the most common response was that they thought it would be enjoyable or fun (7 children), or they had previous experience (2 children).

After the project, 10 children chose engineer as a job they would like to do. The reason for all the children except one was that it would be enjoyable.

The image of scientists and engineers was an immensely positive one after the children had experience of the CCI project. After the CCI project, there was a huge increase in the number of children who wanted to be scientists. The main reason was that it would be enjoyable, fun, interesting or exciting.

## 5.4 Chapter summary

The children learnt about the importance of scientists and engineers and their roles on industrial sites. After the CCI project the children were 8 times more likely to draw a scientist (16% compared with 2%). In addition, they were far less likely to draw a materials handler when asked to depict a person who works on an industrial site (12% compared with 43%).

The proportion of children listing scientist as an industrial job increased nearly seven times from 5% to 34%. Nearly half of the children (43%) stated that scientists or engineers worked in industry.

The proportion of children saying they would like to be a scientist increased nearly ten-fold from 2% to 19% after the project. The proportion of children saying they would like to be an engineer did not significantly increase after the project. The children were much less likely to choose to be a 'materials handler' after the project. This reduced from 32% to 7%.

The project raised the children's awareness of the variety of jobs held in industry.

Jobs such as materials handler were listed much less frequently than before. After the project, the children were more knowledgeable about the variety of jobs carried out in industry.

# 6 Children's views of science and industry

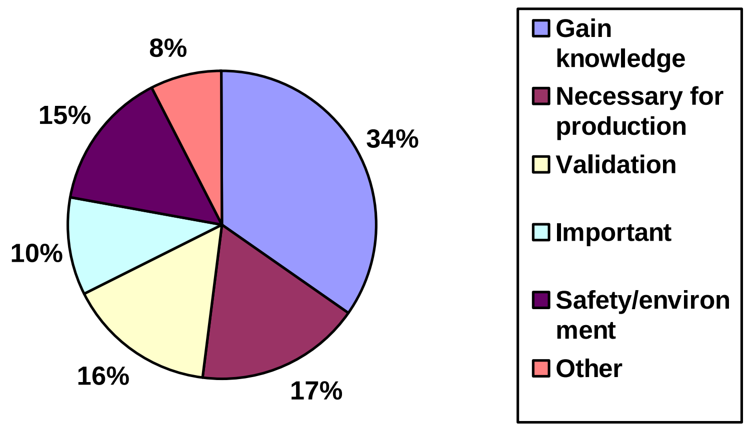
This section discusses the children's views of the importance of science and its relevance to industry.

## 6.1 Science tests

After they had completed the CCI project, the children were asked whether they thought that their school science tests had any relevance to the industries that manufacture the products they have been studying. 99% of the children said that they thought the tests were important. Only four children did not think the tests were important.

The children were asked why they felt the tests were important. The children gave many different reasons for their views. These are shown in Figure 6-1.

**Figure 6-1: Reasons why children think science tests important to industry**




A third of the children felt the tests were important for gaining new knowledge to make improvements to products or processes. For example, one response referred to new uses for plastic and another to identifying different types of plastic:

> "You will need to know which plastic is for what."

A further 17% of children said the tests were necessary to enable products to be made:

> "The factories need to know about salt dissolving and about evaporation."

Another child taking part in the *Water for Industry* topic said:

> "The factory can't afford to get things wrong and need the most efficient and safest way of cooling water."

Another group of children mentioned testing of a product or process, which was categorised as 'validation'. For example,

> *"*It is important that you test things out and make sure that the method you've chosen is the best*."*

A significant proportion of children mentioned safety or the environment. For example,

> "People in industry might need to do tests on something to make sure it's safe."

Ten percent of children said it was important but gave no further details.

Parvin obtained similar results. She found that knowledge of the product was the most important reason for carrying out science tests, in terms of how the product is made and its properties, uses and quality.

Nearly all of the children were able to formulate an opinion as to why scientific tests were important. It appears that the classroom lessons, which involved carrying out scientific tests, taught them the importance of science and it's links with industry. However, the fact that the question was not asked before the project means that no firm links to the project can be made. One recommendation, that has already been implemented, is to determine the children's views before the project, to provide stronger evidence of the project's effect on the children's views.

## 6.2 Chemicals (ingredients) and products

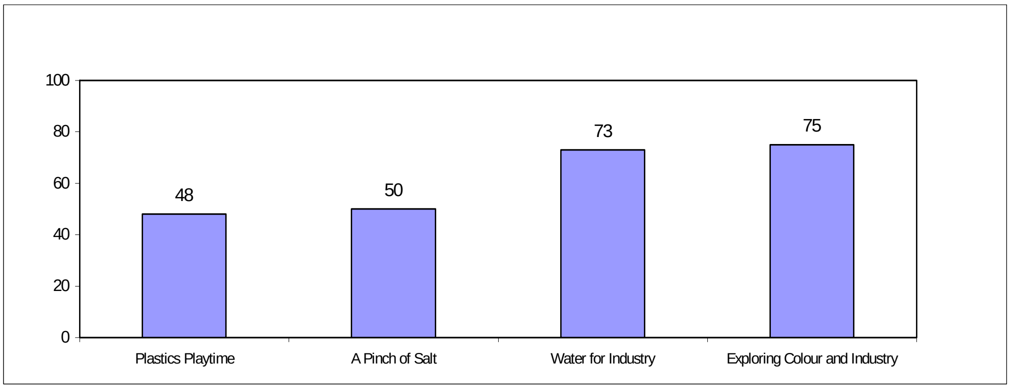
The children were asked whether they had learned anything about the way ingredients were used to make products. Due to the diversity of subject matter covered by each topic, the question was worded differently according to which topic had been completed. See Table 6-1.

**Table 6-1: Questions asked for each topic**

| Topic | Question |
|---|---|
| Plastics Playtime | Are plastics made with the ingredients you expected? |
| Exploring Colour and Industry | Is dye made with the ingredients you expected? |
| Water for Industry | Is water used in industry in the way you expected? |
| A Pinch of Salt | Is salt made in the way you expected? |

The answers varied by topic, which was statistically significant (Chi squared <0.001). When all the topics were analysed together, the proportion of children who said that it was not as they expected was 46%. The answers were evenly split between those that said, it was not as they had expected and they had learnt a lot about the process, and those that said it was as they expected, and therefore they knew a fair amount already. The results were analysed by topic as shown in Figure 6-2.

**Figure 6-2: Product made in the way expected, by topic**



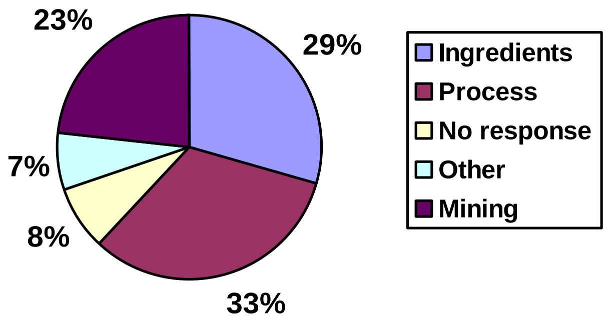

The children who had completed *Plastics Playtime* and *A Pinch of Salt*, were least likely to say that the product was made and used in the way expected. In these groups, approximately half of the children said it was not as they expected. This result is not surprising. The fact that plastic derives from oil is not well known by children (or teachers!).

In addition, many of the children thought salt came from seawater. In fact, this figure of 50% should have been smaller as many children stated that salt came from the sea in the pre-project questionnaire. When asked if it was as they expected after the project many said it was as they expected even when they had put the wrong answer originally. This may be because they felt they should have known and they did not want to admit that they did not know where salt came from. Many adults would probably feel the same! Alternatively, they might have forgotten what they originally thought.

Three quarters of the children who had completed *Water for Industry* and *Exploring Colour and Industry* (note that only 4 children completed *Exploring Colour and Industry*) said it was as they expected. These results reflect the fact that the process of how water is used is more familiar to children than how plastic is made and where salt is extracted.

When asked to elaborate on their answers, the children again, gave significantly different responses according to the topic covered. The responses for all the children regardless of topic are shown in Figure 6-3.

**Figure 6-3: What the children had learnt about industry**




The most common responses from the children were that the ingredients or the processes used to make the product were not what they had expected at the beginning of the project. A large number of children also mentioned mining, referring to salt, which was not as they imagined.

One child commented on *Plastics Playtime:*

> *"I found out that plastic was made out of oil."*

Another who had completed the *Exploring Colour and Industry* topic commented:

> *"There were ingredients that I had never heard of before but I have now."*

A child who had been involved in *A Pinch of Salt* said:

> *"I thought it (salt) came from the sea."*

With mining and processing combined, more than half of the children said they had learnt about different processes used. This was related to their topic, so if they had been learning about salt they mentioned the process involved in making salt. One child said:

*"I found out that you had to crunch the rock salt and they had lots of big machines."*

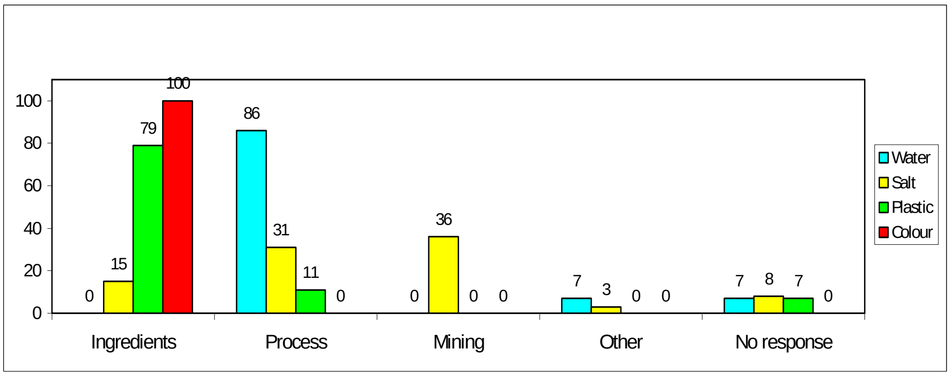
Another child who was involved in Water for Industry said:

*"I found out that it (water) was used to cool hot steel."*

Mining is discussed in more detail in the next section.

The results of the answers were separated by topic and are shown in Figure 6-4.

**Figure 6-4: What the children said they learnt by topic.**




As the graph shows, there are significant differences between the topics. The children involved in *Plastics Playtime* and Exploring *Colour and Industry* were most likely to say that it was the ingredients that were different from what they had expected. Only a minority mentioned that it was the process that was different.

The children involved in *A Pinch of Salt* and *Water for industry* were more likely to say that it was the process involved, including mining, that was different from what they had expected. The children found the ingredients familiar but admitted that they were not familiar with how salt was made, or water used in the processing of materials. More than half of the children involved in *A Pinch of Salt* who mentioned that the process was different from expected, specifically mentioned the mining of salt. Many of the children thought that salt was extracted from seawater and learnt that salt is actually extracted from rocks.

Half the children admitted that they had learnt a substantial amount about how chemicals were changed into products as they stated that it was not what they had expected before the project started.

## 6.3 Chapter summary

Nearly all of the children felt that scientific testing was important and relevant. There were many reasons why they held this opinion, the most common one being, new knowledge was gained for quality control or product development.

Approximately half of the children felt that products were made from the ingredients they expected. Children who had completed the *Plastics Playtime* topic and *A Pinch of Salt* were less likely to agree with this statement than children who had completed other topics. The children who claimed that it was not as they expected, expanded to say that it was either because the ingredients or the processes used to make the product were different from expected.

# 7 Children's reaction to the CCI project

In the post project questionnaire, the children were asked to tick activities that interested them a lot, and cross activities that did not interest them. They were told they did not need to tick or cross every box. They were also asked whether they found the site visit interesting. The questions varied according to the topic so this section is separated into topic headings.

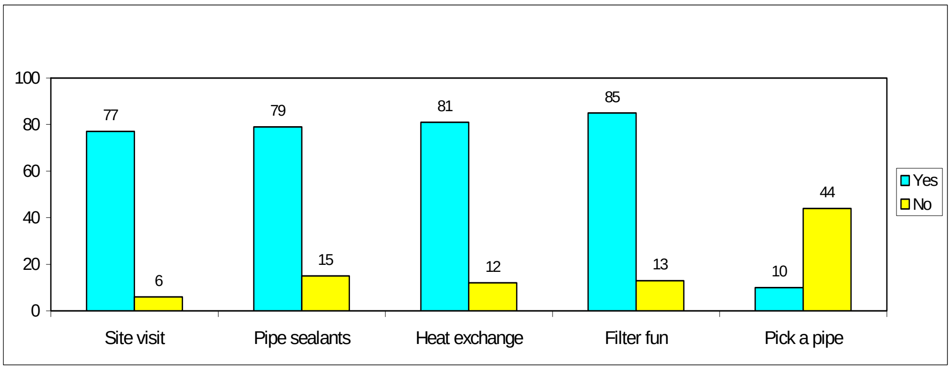
## 7.1 Water for Industry

The children were asked if they found the following activities interesting:

- Site visit
- Pipe sealants
- Pick a piece of pipe
- Filter fun
- Cool it (heat exchange).

The results are shown in Figure 7-1.

**Figure 7-1: Children's interest in each *Water for Industry* activity**




The majority of the children enjoyed the site visit.

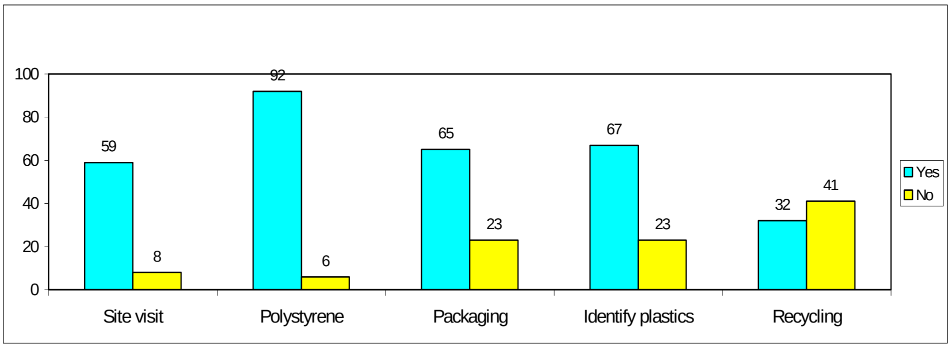
The children's favourite activity in the classroom was the activity on filtering. The children's least favourite activity for this topic was 'pick a piece of pipe'. This may be because the activity involves observing metals and plastic reacting with water over several days rather than more hands-on practical.

## 7.2 Plastics Playtime

The children were asked if they found the following activities interesting:

- Site visit
- Identify four plastics
- Expanding polystyrene
- Materials for packaging investigation
- Insulating properties of plastics
- Recycling information.

**Figure 7-2: Children's interest in each *Plastics Playtime* activity**




The majority of the children enjoyed the site visit.

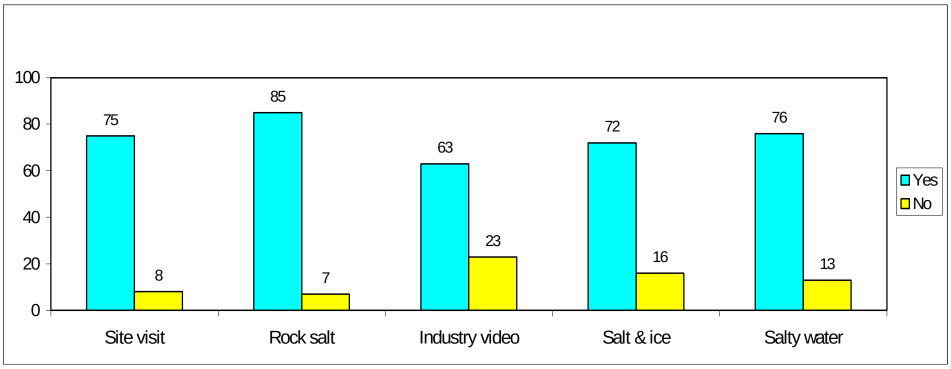
The children's favourite activity was the activity on expanding polystyrene. Although predominantly a teacher-led demonstration rather than hands-on practical (often most-favoured), it is extremely visual and with outcomes which surprise the children. The children's least favourite activity for this topic was receiving information on recycling plastics, which many of them knew about already.

## 7.3 A Pinch of Salt

The children were asked if they found the following activities interesting:

- Site visit
- Salt and ice investigation
- Salt from salty water
- Rock salt to table salt
- Salt industry video.

**Figure 7-3: Children's interest in each *A Pinch of Salt* activity**




The majority of the children enjoyed the site visit.

The children's favourite activity was the extraction of salt from rock salt; a highly practical activity involving a series of processes using their prior knowledge and scientific skills. The children's least favourite activity was watching the video on industry.

## 7.4 Exploring Colour and Industry

The children were asked if they found the following activities interesting:

- Site visit
- Fading in sunlight test
- Mixing and separating coloured inks
- Fading with washing test
- Colour making process
- Mixing powder paints.

There was feedback from only four children, which was not enough for further analysis. The most popular part of the topic was the colour making process, which all the children said they enjoyed.

## 7.5 Chapter summary

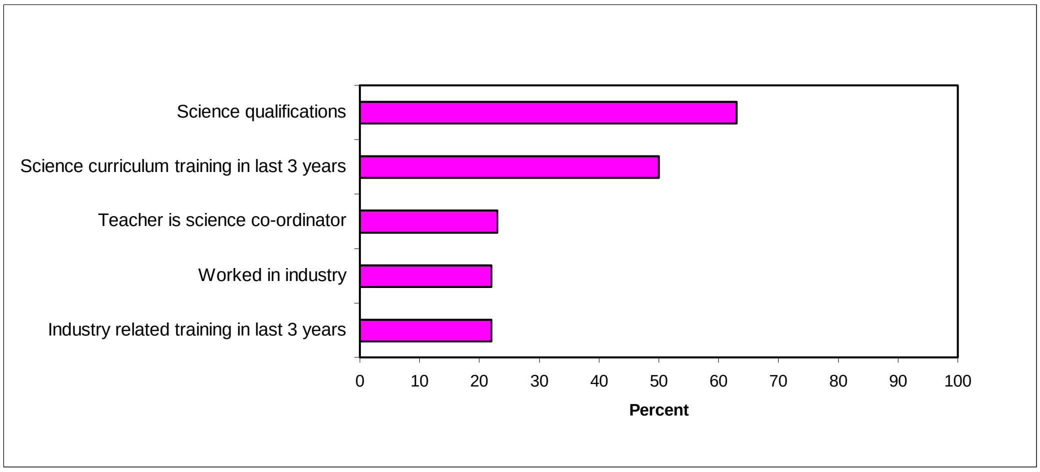
All the topics contained activities that were interesting to the vast majority of children. The most popular activities tended to be those that were practically-based and also contained information that was new to the children.

# 8 Evidence to support the provision of training

## 8.1 Summary of training and qualifications

The teachers were asked about their science qualifications and what training they had undergone in the past three years. The graph below summarises the results.

**Figure 8-1: Training and qualifications**

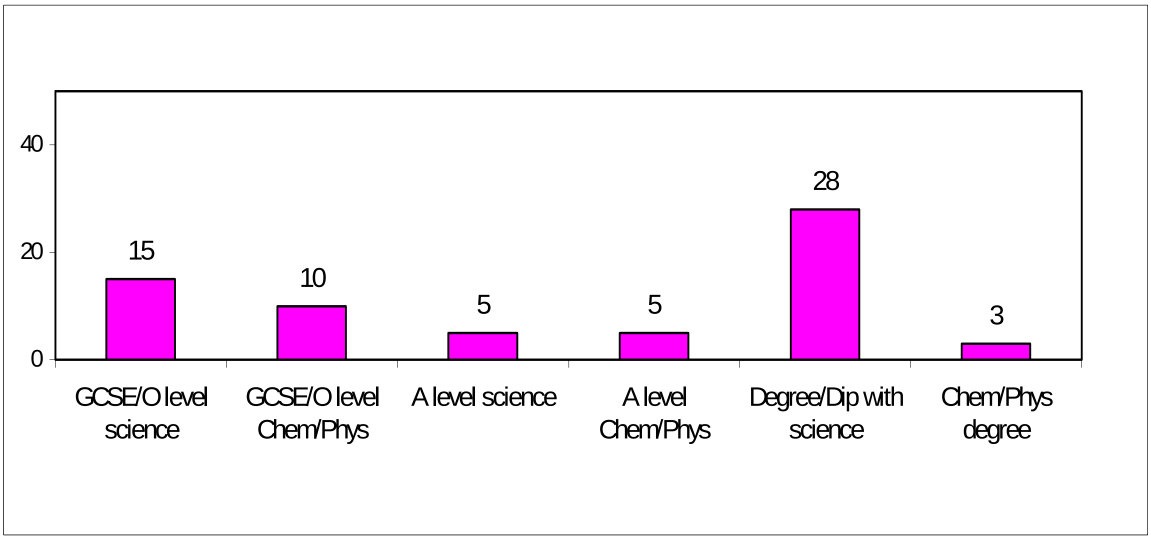



## 8.2 Qualifications

Approximately a third of teachers (37%) did not have a GCSE/O level in Science, the minimum qualification considered to be needed to teach primary school science.

Those that said they did have a science qualification gave the answers shown in Figure 8-2. If a teacher stated that they had experience of chemistry or physics this was coded as 'Chem/Phys', if a teacher mentioned biology or general science this was coded as 'science'. Some teachers gave more than one answer so they might have said that they had A level science and a science degree.

**Figure 8-2: Science qualifications**



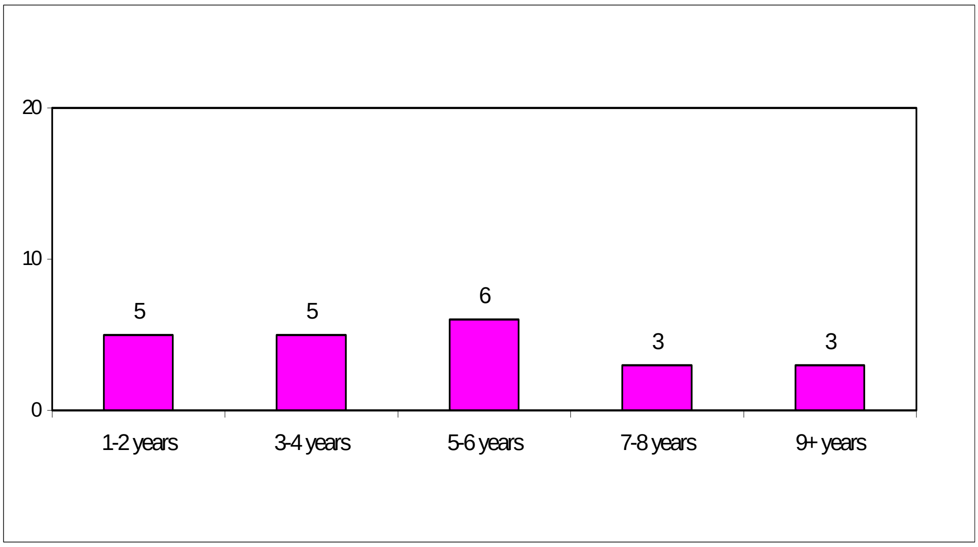
In the previous study, 57% of the teachers did not have any science qualifications. This is considerably higher than in this study and may be because there were proportionally more teachers who had been teaching for more than ten years in the previous study. Therefore, more teachers in this study may have trained with a science specialism, as part of their degree in education. However, there is concern that the question may be too open-ended on the questionnaire, so this is being re-phrased for future data collection.

This study has not shown that having a degree leads to an increase in knowledge or improved attitudes towards industry. Teachers who have been teaching a long time are less likely to have a degree and more likely to have a teacher's certificate. However, there is no evidence that these older (and more experienced) teachers are less knowledgeable or more negative about the chemical industry.

## 8.3 Work experience

Teachers were asked how many years they had worked in industry. These results are shown in Figure 8-3.

**Figure 8-3: Number of years in industry**




In this study, 22% of the teachers had experience of working in industry, ranging from one to eleven years.

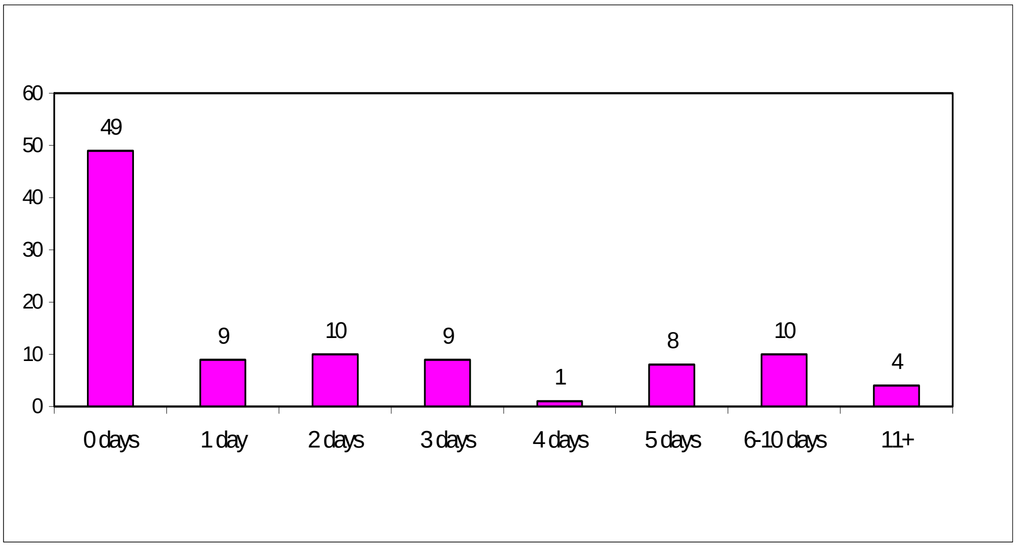
This figure is higher than the results of the previous study where 14% of teachers had worked in industry. There was a period in the mid '90's when those with an industry background were offered a 'fast-track' into teaching which may explain the higher proportion of teachers with experience of industry in this study.

Teachers with industrial experience would be expected to have more knowledge and more positive attitudes towards industry and this is explored in later sections of the report.

## 8.4 Training

Teachers were asked how many days of science training they had undergone in the last 3 years. The results are shown Figure 8-4.

**Figure 8-4: Number of days of science training**




Half the teachers had undergone some science training in the last three years. The following table compares this study with the previous study, (Parvin, 1999).

**Table 8-1: Number of days training**

| Number of days | Percent this study | Percent Previous study |
|---|---|---|
| 0 | 49 | 45 |
| Total 1-3 | 28 | 20 |
| Total 4-6 | 12 | 18 |
| Total 7-30 days | 12 | 18 |

The most common response was two, three or five days training over the last three years. Most teachers had odd days of training except for eight lucky teachers who had two or more weeks of training! All teachers have five training days per year where they must cover all aspects of the primary curriculum. It is surprising that half of the schools are not using any of these days to cover science.

In the previous study there was quite a large group of teachers, who had completed a DfEE course lasting more than 8 days, which explains the high figure of 18%. In the 1990's there were government funded science-training courses which were 20, 10 or 5 days which explains why a smaller number of teachers had two or more weeks of training in this study.

There were slightly more teachers in this study who had not had any science training. This could be due to the focus on literacy, numeracy and ICT in schools in recent years.

Only 16 (21%) of the teachers had undergone industry-related training. This result was higher than the one obtained in the previous study of 7%. Industry training is much less common than science training. Seven teachers had a day, or part of a days training, and three teachers had each had two, three and five days training respectively. There are probably far fewer courses available in industry training to teachers. Many teachers may not know of anything available. Providing this information to teachers may increase the proportion of teachers taking this type of training or make them more aware of organisations such as Education Business Partnerships (EBPs) that offer work placements to teachers.

Science co-ordinators are much more likely to have science training experience but only 13 (22%) of teachers stated they were a science co-ordinator. The number of years that each teacher had been a science co-ordinator is shown in the table below.

**Table 8-2: Years as science coordinator**

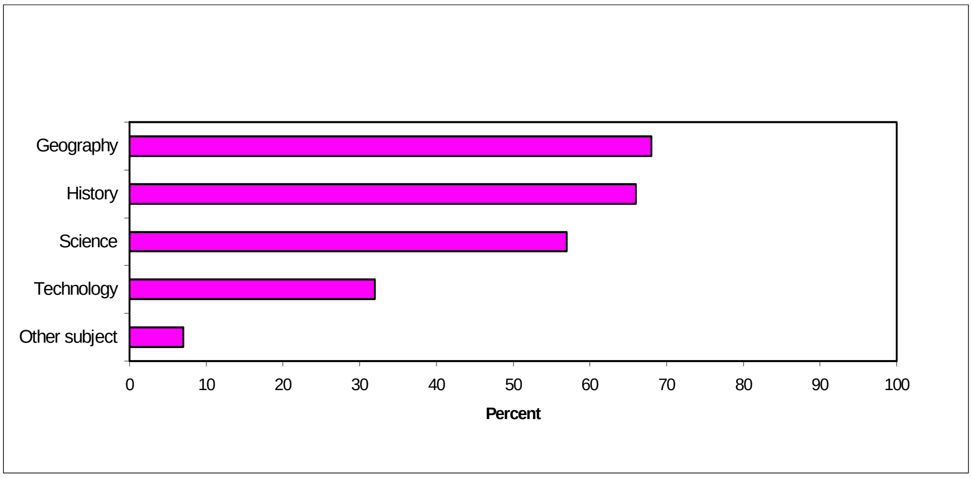
| Number of years | frequency | Percentage |
|---|---|---|
| 0 | 40 | 82 |
| 1-2 | 4 | 8 |
| 3-5 | 3 | 6 |
| 6+ | 2 | 4 |

Some teachers keep the role of science co-ordinator for many years rather than rotating it round the department so that training may always fall to the same few teachers every year.

## 8.5 Teaching of industry within the curriculum

Teachers were asked where they taught about industry in the primary curriculum.

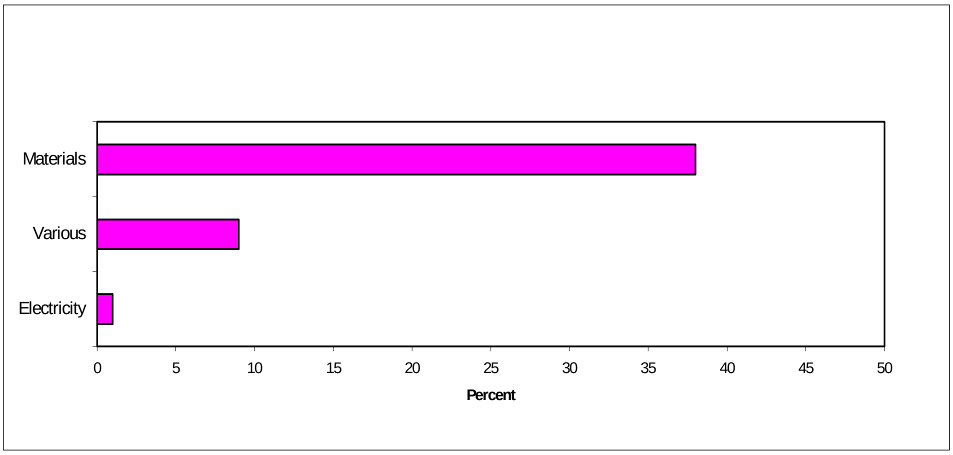
**Figure 8-5: Subjects covering industry in the curriculum**




It is gratifying to see that more than half of the teachers covered industry in the science curriculum compared with 12% in Parvin's original study. However, this still left 37% of teachers sampled who did not cover aspects of industry in their science curriculum.

The most common places to cover industry were in geography and history. A closer look at the subjects covered within geography, history and science are discussed below.

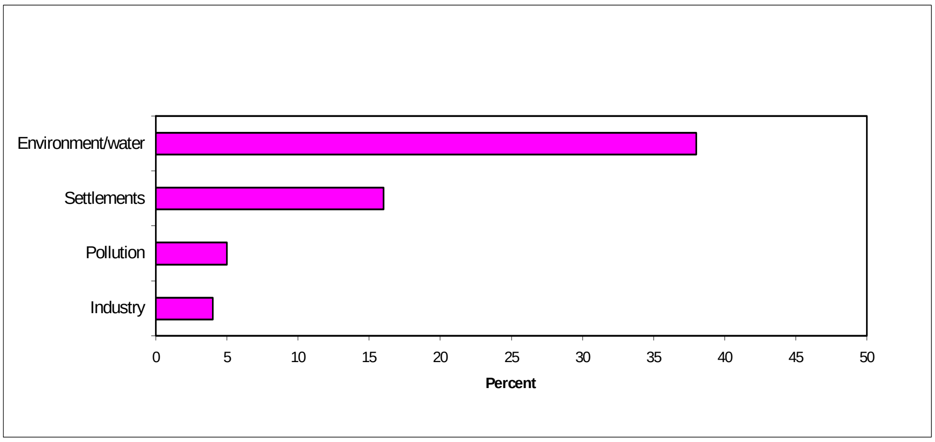
**Figure 8-6: Science**




Industry was most often mentioned when covering the 'materials' topic in science. The range of science topics was very limited. However, this was an improvement in the number of teachers from the previous study covering industry in the science curriculum. Teachers who mentioned pollution were categorised under the topic in geography to obtain a total of the number of teachers discussing industry and pollution.

Geography is a wide-ranging subject with many topics. Some of the topics were grouped together. Pollution was kept separate, but environment and water were amalgamated as the difference between them was quite blurred.

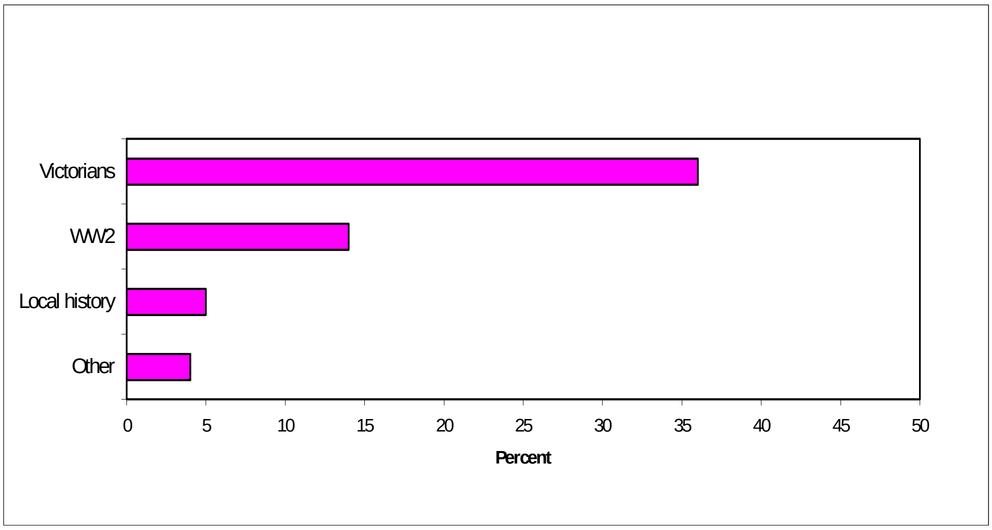
**Figure 8-7: Geography**




The number of teachers who listed pollution as a topic was quite small, however teachers who listed environment or water may have also discussed pollution. And the environment was mentioned in the geography curriculum by nearly half of all teachers.

Industry was included in a variety of history topics.

**Figure 8-8: History**




The Victorian era was the most commonly cited topic where industry was covered. This gives an old fashioned view of industry of a hundred years ago, if not balanced with more modern views, taught in science and technology. Teachers may feel more knowledgeable and confident teaching about industry as it was in the Victorian era rather than as it is now.

In the previous study the most common link with industry was through local history rather than the Victorian era, but the question was asked in a slightly different way so it difficult to compare the two groups of teachers. A small number of teachers listed additional subjects under history, including mining, electricity, transport and explorers. These were coded ‘other’ in Figure 8-8.

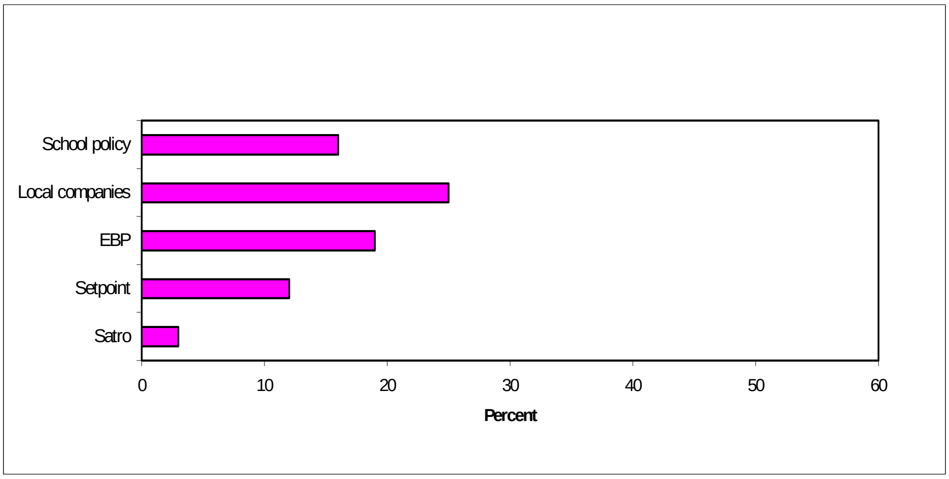
Topics in technology included a variety of topics such as marketing, packaging, communication and moving parts but no obvious large group. 68% of teachers said they did not teach about industry in technology. Five teachers listed other subjects in which they covered industry. These were Personal Health and Social Education, literacy and maths.

One of the aims of this training was to encourage teachers to teach about industry in the science curriculum. This would enable children to learn about industry as it is today and to learn about how it is relevant to the science curriculum taught in schools now.

## 8.6 Industrial links

Teachers were asked about their links with industry and the results are shown below. It should be noted that SATROs no longer exist and Setpoints are relatively new, having started in late 2001.

**Figure 8-9: Schools with industrial links**




One in six schools had a policy on industry links. Schools could be involved with a number of organisations such as EBP, SATRO and Setnet that promote links with industry. Of the links available, local companies were the most common, with a quarter of schools stating they had links of this type. In another region, the EBP was the most common link and this may have been because the advisory teacher had an office in the region's EBP.

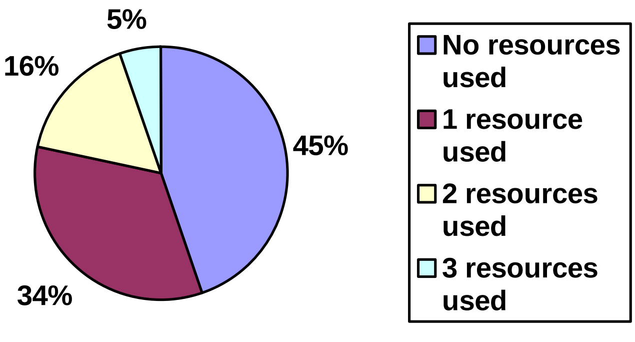
Eight teachers said their school had links with other companies and these included Teesside University and BNFL. The majority of schools did not have existing links with industrial companies.

One of the aims of the training was to encourage teachers to forge links with companies and perhaps learn about the benefits to the school of having these links.

## 8.7 Use of resources by teachers

The teachers were asked whether they had used any resources from industrial sources. The results are shown in Figure 8-10.

**Figure 8-10: Use of resources**




Nearly half of the teachers did not use any resources sponsored by or developed by the chemical and allied industry. The most common reason given for not using resources was that teachers did not know about them. Nearly two thirds of the teachers said they had not seen any resources. Only 5 out of 30 teachers said that they did not use the resources because of company propaganda. Attitudes towards resources are discussed further in chapter 11.

Teachers seemed to be more likely to know about resources if they had school policy, which was confirmed by the data. Teachers were more likely to use resources if there was a school policy (75% versus 56%). This was not statistically significant when analysing this region alone, but when the data were pooled with other regions the result was statistically significant.

The industrial resources that the teachers had used were wide ranging. There were very few resources that more than a few teachers had used. The most common resources were Energy matters by Shell, educational materials from BP, ICI, British Steel and Science is Great (a local workshop-based annual event).

It is interesting to note that the proportion of teachers using resources in Tees Valley was much higher than the proportion of teachers from other regions. This could be due to the local campaign – Science is Great and the work of Teesside Chemical Initiative, Learn2work, as well as previous work of ICI's education unit (now closed).

## 8.8 Chapter summary

Half of all the teachers had not had recent training in science, 37% had no science qualifications, and yet they were expected to teach science in the primary curriculum.

Training in industry was even less common (22%). It's no surprise that teachers did not feel confident to link with industry.

Teachers were more likely to teach about industry in the context of geography or history than science or technology. Teachers were not aware of the relevance of teaching the science curriculum with an industrial context to make the subject more interesting and relevant.

A few teachers had links with industry and 16% had a school policy on industrial links. Nearly half of all the teachers had not used any resources developed by industry. Teachers who had links with industry were more likely to use industrial resources to teach primary science. Many teachers may be unaware of the relevance of teaching science through industrial context.

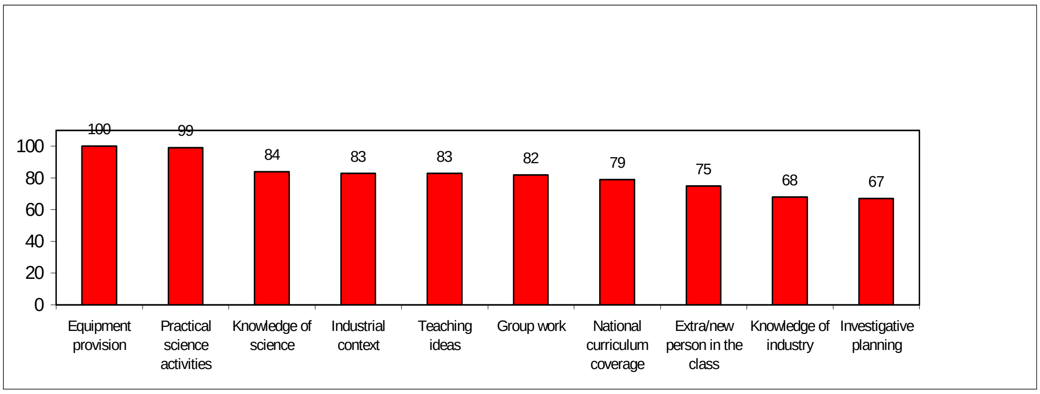
In summary, this training was very much needed by primary teachers to increase their confidence, knowledge and motivation of teaching science using industrial contexts.

# 9 Teacher's reaction to the CCI project

## 9.1 Strengths

Teachers were asked to indicate which of the following categories were strengths of the session

**Figure 9-1: Strengths of the CCI project**




Virtually all the teachers indicated that equipment provision and the practical science activities were strengths of the sessions. Knowledge of science, industrial context, teaching ideas and group work were also rated very highly (by over 80% of teachers)

The categories least likely to be indicated as strengths of the project, were knowledge of industry and investigative planning. This is surprising, as encouraging investigative work is one of the main aims of the project.

It was interesting that teachers were more likely to mention the provision of equipment and practical science activities as strengths. Teachers obviously feel they need more equipment and support in this area. It is possible that other aspects of science are easier to learn from books about the science curriculum but the practical investigations that compliment this are more difficult to master.

Another interesting factor was that knowledge of industry was rated as a strength much less often than knowledge of science. Many teachers may have seen the visit as the industry side of the training and the classroom activities as the science side of the training.

79% of teachers found the training relevant to the national curriculum but some did not. Is it possible that the relationship of the training to the curriculum is not being stressed enough. Recent changes to the science curriculum have put more emphasis on investigative methods and therefore the training is extremely relevant to this part of the curriculum. If the training is not seen as being closely linked to the curriculum the teachers may be less likely to use the information gained in future classes

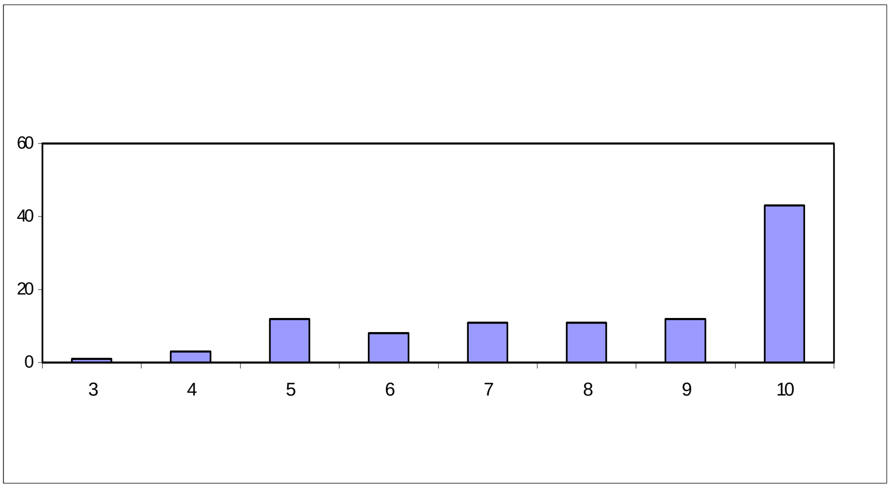
Eighteen teachers also included other strengths. These included high quality (4), likeable teacher (4), good assessment ideas (4), real science (3), well planned (2) and child friendly (1). Some teachers listed more than one strength.

In the previous study, the wording was different for the question on strengths of the project. Teachers were asked to list the strengths of the session rather than tick the relevant boxes. The list of strengths on the new questionnaire is based on the responses to this open-ended question in the previous study.

The two main strengths in this previous study were industrial context and expert knowledge. Given a list, the teachers would tend to tick more categories than if they had to write them down spontaneously so it is difficult to compare the results of the two studies. Practical science was third on the list in the previous study so was rated even higher in the current study.

The mean number of strengths selected was 8 out of 10. Nearly half of all the teachers ticked all 10 strengths. Three-quarters of the teachers ticked seven or more categories as strengths. See Figure 9-2 for a breakdown of the results.

**Figure 9-2: Number of strengths out of ten**




This is a strong indication of how highly the training was regarded. Teachers were extremely enthusiastic about the project and felt it had been a valuable use of their time.

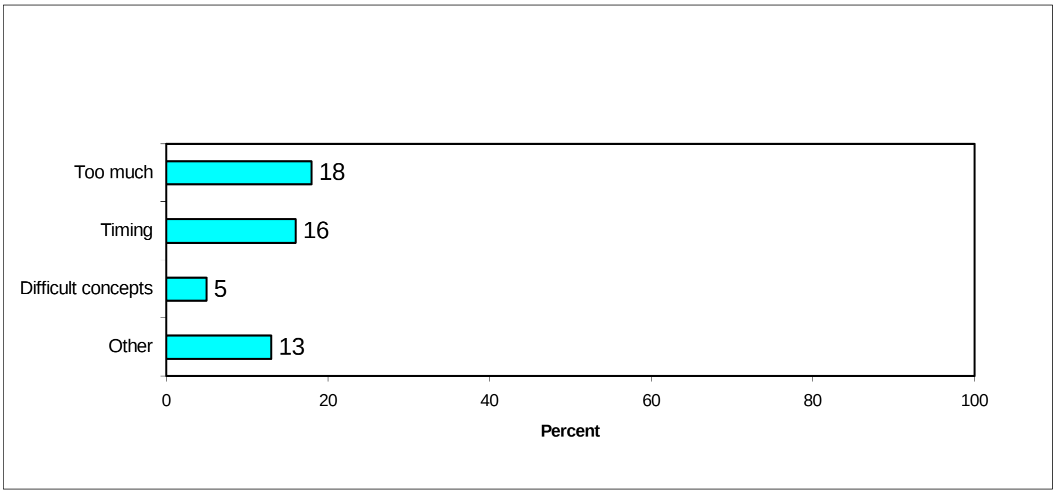
A few quotes are included below as examples of how the teachers received the sessions:

> *"The children thoroughly enjoyed the experience, responded very positively and moved their own understanding forward."*
>
> *"Everything was brilliant – fitted in with curriculum."*
>
> *"Excellent teaching skills – communication with a vast range of abilities."*
>
> *"Purposeful study stimulated by appropriate resources."*

## 9.2 Weaknesses

The teachers were asked whether they thought there were any weaknesses to the sessions. The results are shown in Figure 9-3.

**Figure 9-3: Weaknesses of training**




The number of teachers who indicated there were weaknesses was small. The most common weakness was that too much was included in the project. In the previous study, 33% had said there was too much to cover so this figure has been halved. The sessions had been changed to reflect this but a significant number of teachers still thought there was too much in the sessions. This is already being considered by the team of advisory teachers and strategies to deal with it put in place.

Only a very small number of 5% cited that some of the concepts covered were difficult to grasp. This is less than in the previous study where 13% of teachers had said there were aspects that were difficult in the sessions.

The number of teachers in the previous study who said they had problems with timing was very similar to this study, although actions have been taken to offer all schools freedom of choice of when they do the project. It is therefore unlikely that the proportion can be reduced much further as it is due to the unavoidable problem for teachers of shortage of time.

Other weaknesses were as follows. The number of teachers stating each weakness is included in brackets: not enough time (3), not enough visual examples (2), too many children (2) and too much sitting (1) . One teacher even said the pace was too slow.

The teachers, who were teaching year 6 only, were less likely to cite 'too much to cover' or 'difficult concepts'. Only 3% of year 6 teachers said that there were difficult concepts, compared with 15% of teachers of younger age groups (statistically significant). In addition, only about half as many teachers (17%) of year 6 classes thought there was too much to cover compared with other teachers (27%).

Some teachers may have felt that the pressure of the national curriculum prohibits them from spending too much time on this subject. One teacher said;

> *"Too much to cover – could have spent longer on it but pressure of n.c. prevents this."*

In the previous study, it was found that many teachers thought there were difficult concepts in the science curriculum as a whole, however only two teachers in this region expressed these views. In other regions, the percentage was higher.

## 9.3 Chapter summary

The feedback from the training was overwhelmingly positive. The sessions were of an extremely high standard that was highly rated by all the teachers. It was obvious that the teachers and the children found the whole experience extremely enjoyable and a valuable use of their time

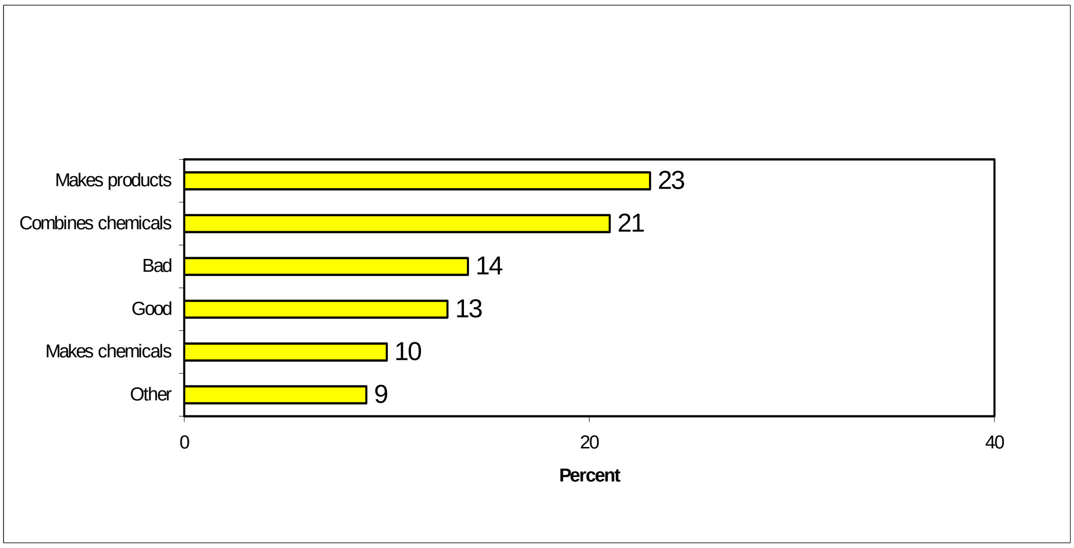
The weaknesses most likely to be mentioned were, 'too much to cover', 'difficult concepts' and 'timing'. 'Too much to cover' and 'difficult concepts' were associated with teachers of younger year groups

# 10 Knowledge and skills of teachers

## 10.1 Knowledge of the chemical industry

An attempt was made to measure the teachers existing knowledge of the chemical industry. The teachers were asked to describe the chemical industry. The results are shown below

**Figure 10-1: How teachers described the chemical industry**




The most common response was that the chemical industry made things or chemicals. 21% of teachers were able to say that chemicals were combined to produce another product. This was seen as the most informative answer. Although this is quite a small proportion of the group, it was a larger percentage than teachers from other regions. As mentioned before, teachers from this region may be more knowledgeable about industry because there is an established practice of industry links.

Some teachers said negative things about the chemical industry (14%). However, nearly as many teachers spontaneously said good things about industry. The number of teachers who said negative things and nothing else positive about the chemical industry was an extremely small group of 4%. The remaining 10% who were negative, also said either neutral or positive things about the chemical industry. This was less than the number of teachers from other regions, which were roughly 20%. It was also low compared to the 34% obtained in the previous study. The number of teachers who feel there are negative things about the chemical industry is much higher, as will be seen later in the report, when teachers are asked in a closed question about pollution.

A few teachers did not answer the question and instead wrote how the chemical industry related to the curriculum, and this was categorised as ‘other’.

In the previous study, this question was asked in an interview and half of the teachers did not feel they could answer at all. By asking it in a questionnaire teachers were more willing to say something albeit quite simple statements, such as, makes chemicals or negative such as, dirty and smelly. In the previous study, none of the teachers said that chemicals were combined, but in this sample 21% of teachers gave a more complete answer.

Knowledge of the chemical industry was quite poor. Although everyone knew of its existence – no one said they did not know about the chemical industry, only a minority of teachers could provide any detail about the industry.

On the one hand many teachers had no idea what the industry did but on the other hand they were quick to say it was polluting the environment. This points to the fact that any knowledge they have attained has not come from scientific sources likely to give a more balanced view. Parvin found that information was more likely to come from the media and other sources that are far more likely to discuss the negative aspects of the chemical industry, than what the chemical industry actually does.

A few quotes from teachers are provided below in answer to the question 'Describe the chemical industry':

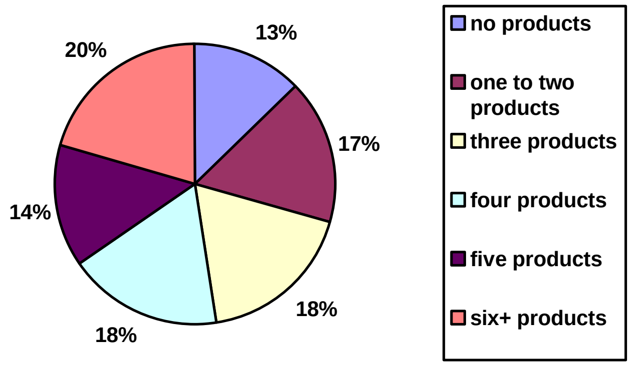
> *"An essential part of our daily life in the manufacturing of products and the research of medicines and new substances."*
>
> *"Indispensable to everyday life but not environmentally friendly."*
>
> *"Uses diminishing fossil fuel resources to make products which are not biodegradable so pollute the earth."*

It was hoped that one of the main outcomes of the training would be that teachers would learn more about industry, and how it relates to science. This could be achieved, not just with class-based training, but also with a visit to industry. This would give them an opportunity to experience the chemical industry first hand, which would help them to develop a more accurate view of the chemical industry.

## 10.2 Products of the chemical industry

Teachers were asked to list products of the chemical industry of which they were aware. The number of products they listed is shown in Figure 10-2.

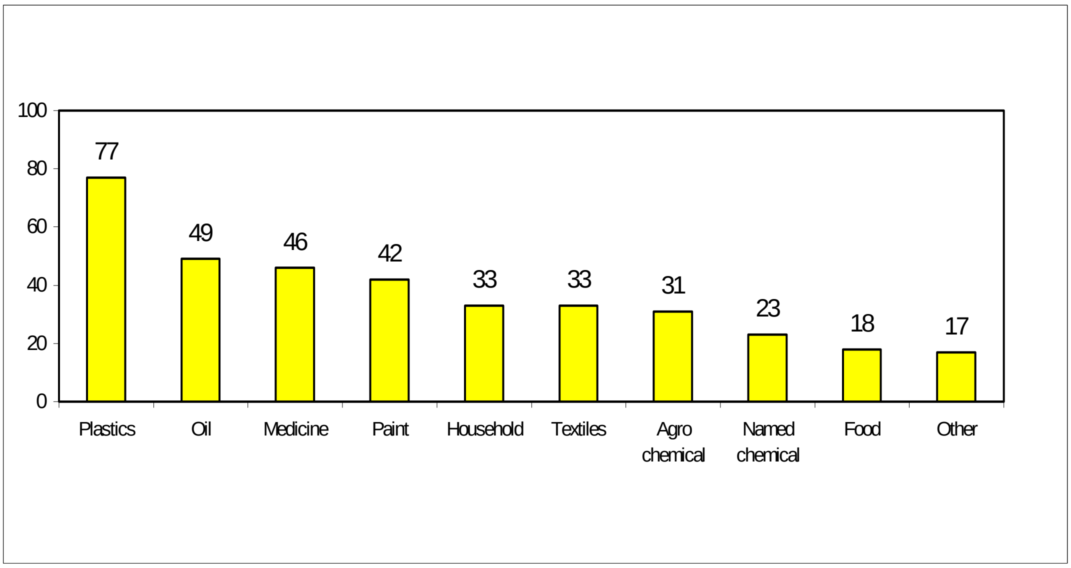
**Figure 10-2: Products of the chemical industry**




The mean number of products that teachers listed was four but one in eight teachers did not list any products at all. About a quarter of the teachers said that the chemical industry produced lots of products or they put a couple of products and then wrote 'etc.' Some teachers may have known more products than they listed, but only wrote down three or four of them. The mean number of products listed for other regions was three, evidence that teachers in this region were possibly more knowledgeable about industry.

A breakdown of the products that teachers listed is provided below. The category 'household' included cleaning products and cosmetics.

**Figure 10-3: Products listed**




Plastic was the most commonly cited product with oil, medicine and paint close behind, all mentioned by more than 40% of the teachers.

About a third of teachers mentioned household products, textiles and agro-chemicals. A smaller number mentioned named chemicals. Fewer than 20% of teachers mentioned food or other products and these were not included in Figure 10-3.

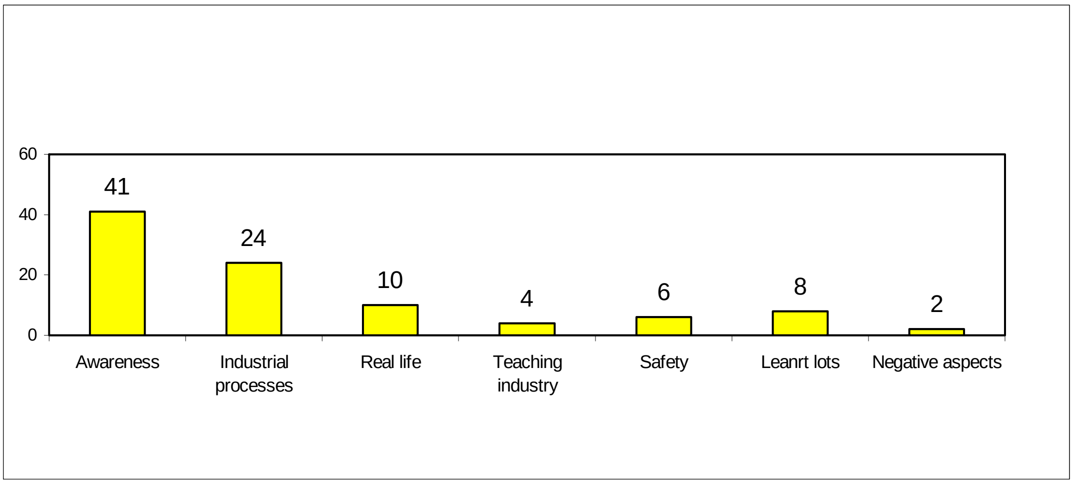
In the previous study, plastics were also named most often by teachers, but only by about half the teachers. The reason plastic is mentioned more frequently here, could be because many of the teachers have selected 'Plastics Playtime' as their CCI topic. Other recent studies in different regions found plastics were named less often than in this region so it may be because local industry includes the manufacture of plastic materials. Oil, paint and medicine were all mentioned more often than in the previous study. The remaining products, household, textiles and agro-chemical were named with approximately the same frequency as in the previous study.

Different regions may have different industries, which may mean that teachers have different products uppermost in their minds when answering the question. In regions where there was a lot of industry you would expect teachers to list significantly more products, which seems to be the case here.

## 10.3 Industrial knowledge gained through the training

Teachers were asked whether they had learnt anything about industry. They were also asked what they had learnt. The results are shown in Figure 10-4.

**Figure 10-4: What teachers learnt about industry**




66% of the teachers stated that they learnt something new about industry during the training sessions. The most common response was that they had increased their awareness about industry. The second most common response was learning about industrial processes.

These were overwhelmingly positive aspects of industry with only one teacher saying she had learnt negative things.

In particular, the visit to industry taught the teachers things about industry, with industrial processes or awareness about industry, being the most common things learnt. The quote below is an example of increased awareness of industry:

> *"Fewer people on site than I imagined."*

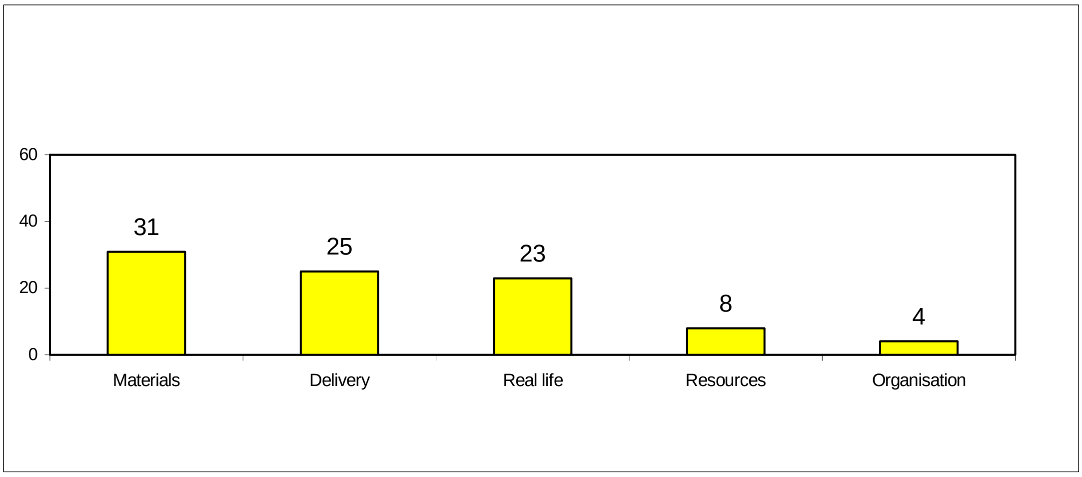
Other teachers learnt about the processes. Quotes are provided below which answer the question 'what did you learn about industry?':

> *"How salt is processed."*
>
> *"Opportunity to view industrial processes."*
>
> *"I had no idea about the processes gone through in order to make the end product."*

It was not possible to quantify how much the teachers learnt about industry. They may have learnt one part of an industrial process or completely changed their knowledge of industry through an increased awareness of the whole process. We only know whether they thought they had learnt about aspects of industry

Teachers were also asked what they had learnt about science. The wording in the original questionnaire was what had they learnt about *teaching* science. The results are shown in Figure 10-5.

**Figure 10-5: What teachers learnt about science**




66% of teachers stated that they learnt something new about, science, or teaching science

If they were asked about *teaching* science, most of the teachers answered 'materials', 'delivery' or 'organisation', and if teachers were asked about science, they were more likely to put 'real life' or 'materials'. 'Materials' refers to the area of the National Curriculum, Materials and their properties.

More teachers thought they had learnt about 'material and their properties (Sc3) than any other area of science. The second most popular answer was 'delivery of science lessons'. Many teachers felt that they could use some of the methods used by the advisory teacher to improve their own science classes. A smaller number of teachers also mentioned that they learnt how to improve resources and planning of science classes.

Some quotes are included below but unfortunately, because the wording was changed it is difficult to draw any firm conclusions from this question:

> *"Use of catalysts."*
>
> *"New strategies and approaches for teaching the practical element of science."*
>
> *"How expanded polystyrene is made."*
>
> *"Practical resources need not be extravagant or expensive! Everyday things are useful and relevant resources."*

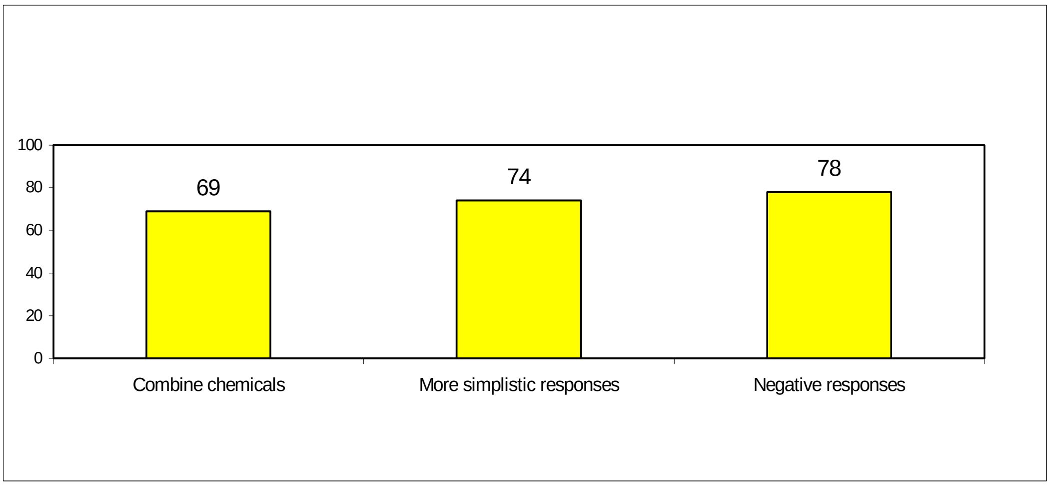
In future, the wording of the question is to be changed in order to help measure the learning outcomes of the teachers. The question on learning about industry is not possible to quantify but it is useful to know what the teachers have learnt.

## 10.4 Differences in industrial knowledge

86% of the teachers said that they learnt something about industry or teaching science, or both. We can take this a step further to investigate whether the teachers who did learn something, differ in any way from the teachers who said that they did not learn anything.

An attempt has already been made to assess teachers knowledge about the chemical industry before the training. This was done by categorising the answers into negative, simplistic or more thorough responses. Using the assumption that those with a good knowledge of the chemical industry were less likely to say they had learnt anything about science or industry, the responses from the three categories were compared. Conversely, those with poor knowledge would be more likely to say they *had* learnt something during the training. The results are shown in Figure 10-6.

**Figure 10-6: Teachers who stated they learnt something about science**




The results show that teachers who were negative at the start of the project were the most likely to state that they had learnt something about science or teaching science. These figures were not statistically significant for this region but were for all region amalgamated together. There was no similar association with regards to teachers learning about industry.

The associations between which teachers learnt about science and other factors were explored to see if other factors affected whether teachers felt they had learnt something or not. It appeared that recent training in science did have a positive effect. Teachers who had not received training in science over the last 3 years were more likely to say that they had learnt something about science or teaching science (83% compared with 58%). This was statistically significant with $p=0.032$.

These results provide some evidence that asking teachers what they know about the chemical industry can be a measure of their knowledge. In addition, asking whether they have learnt anything seems to provide an indication of how useful they found the CCI project.

Teachers who have had recent training in science may be more knowledgeable about science than teachers who had had no recent training.

## 10.5 Chapter summary

A minority of teachers were able to say with any detail what the chemical industry does but most were able to give examples of what the chemical industry produces. This is not a surprising answer. It is a difficult question to answer unless involved directly in the chemical industry.

86% of teachers said they had learnt something about industry or science, or both, after the training. Many teachers gained a more balanced view of the chemical industry by the end of the project.

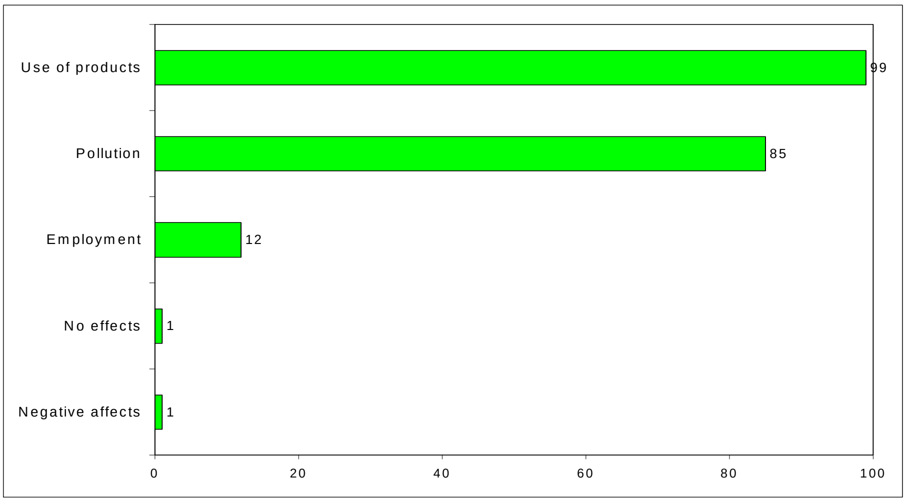
Teachers were more likely to say that they had learnt something about science if they had not had any recent science training. These are probably teachers who had a weaker knowledge of industry at the start of the project.

# 11 Attitudes of teachers

## 11.1 Attitudes towards industry before the training

Teachers were asked their views on how industry affected their lives.

**Figure 11-1: Teachers views on industry**




Nearly all the teachers thought that the chemical industry was necessary to produce the ‘every day’ products that we need. Most teachers (85%) also felt that there was a negative aspect of the chemical industry, namely pollution.

Only one teacher said that the chemical industry had no affect on their daily life and one teacher said that the industry had other negative effects (apart from pollution). Nine teachers said that the industry provided employment. It is interesting to note that teachers from other regions did not mention employment.

One of the reasons that so many teachers thought that pollution was directly affecting their lives, may be that they did not think that industry is doing enough to reduce pollution. The teachers’ attitudes towards the chemical industry would be expected to be more positive if they thought that a lot was being done to keep pollution to a minimum. The teachers realise that the industry produces essential items so their attitudes are not that there should not be a chemical industry.

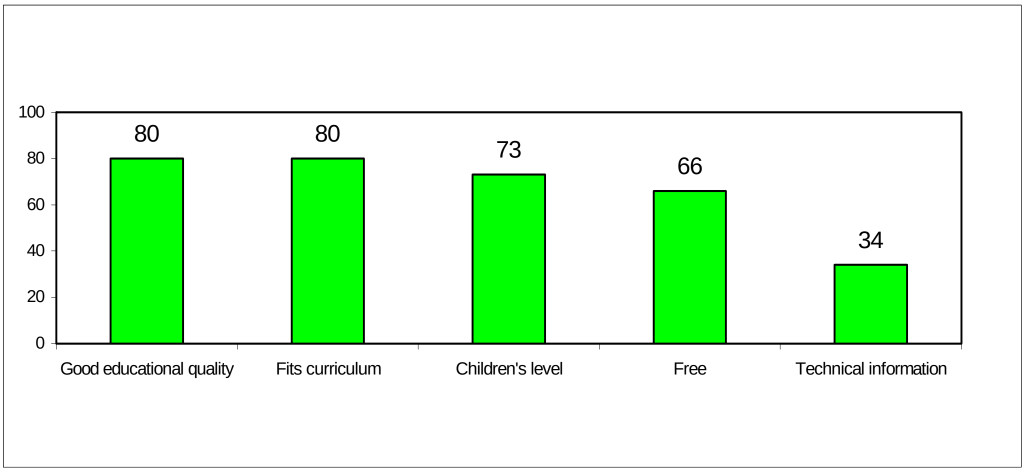
The attitude towards the chemical industry is quite similar to the attitude towards cars. Most people are willing to accept the risk of pollution if it is giving back something very useful. If prompted most people would say that cars are pollutants but when asked to talk about cars, it’s probable that only a small number would say spontaneously that they are pollutants. This is what can be seen in this study. In the last section on knowledge, only 14% spontaneously cited pollution as a concern in the chemical industry, but when prompted 85% of the teachers said that they are affected by pollution.

In the previous study, this question was asked as part of an interview rather than a closed question as in this study so the answers cannot be compared. It is interesting that only a small proportion of the teachers in the previous study cited effects such as pollution, giving a profile of answers similar to the earlier question on what they knew about the chemical industry.

## 11.2 Attitudes towards resources before the training

Teachers were asked whether they had used resources and 41 (55%) said that they had. See Figure 11-2 for reasons why teachers used industrial resources.

**Figure 11-2: Teachers' reasons for using resources**

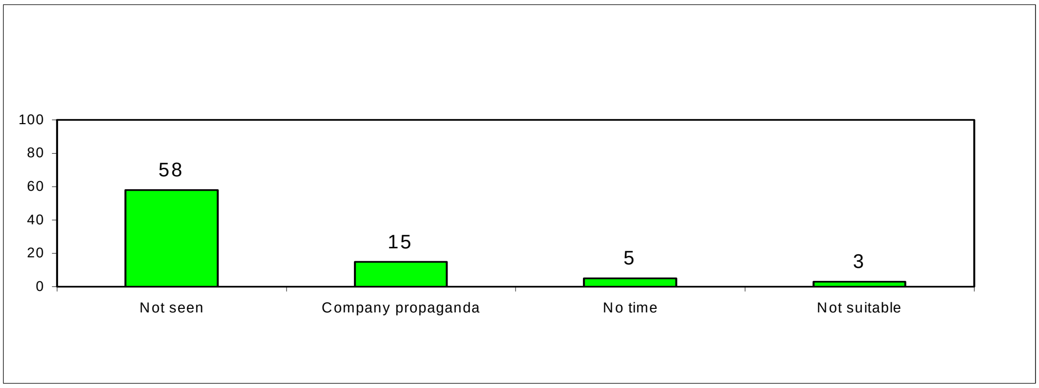



The most common reasons for using industrial resources were because they were of good educational quality and they fitted the curriculum. More than half of the teachers also said they used them because they were at the children's level and they were free. Technical information was not a common reason for choosing industrial resources.

In the previous study teachers said, they would only use industrial resources if they fitted the teaching programme and they were of good educational quality, and the teachers in this study gave very similar answers.

The 33 teachers (45%) who had not used industrial resources were asked for reasons why they had not used them.

**Figure 11-3: Teachers' reasons for not using resources**




The reason the majority of teachers had not used resources was because they had not seen any. Only a very small number of teachers had not used them because they did not like them or they were not suitable. These results were very similar for all the regions involved in the study.

Teachers have very limited time to assess the suitability of educational materials so it would be very difficult for teachers to search for information when they do not know where to find it.

Some teachers may not have thought that useful information was available from companies for such a young age of children. Other teachers may have decided that there was enough information in the curriculum already. Many teachers may not have known the benefit of these materials in putting the science curriculum into context.

Teachers are more likely to have used industrial resources if another teacher in the school has passed them on. Another source of information is science training, received either by the teacher or the science co-ordinator in the school.

Quotes below are examples of what teachers said about using resources before the training:

> *"Many resources distributed by companies have very limited relevance to the primary curriculum as actually delivered."*

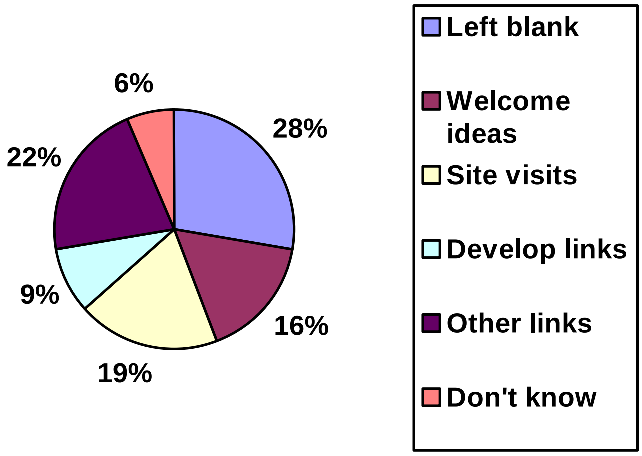
> *"Changing curriculum emphasis makes products obsolete or in need of further materials to fit with requirements."*

To summarise this section, many teachers had not used industrial resources because they had not seen any rather than because they did not like them.

## 11.3 Attitudes towards industrial links before the training

Teachers were asked what types of links they would like to have with industry before being involved in the CCI project.

**Figure 11-4: Suggested links with industry before the CCI project**




Approximately a quarter of the teachers did not answer the question and left it blank. A small number put that they did not know or were very cautious about suggesting links with industry. Some of the teachers wrote down specific links such as site visits. A further 16% said they would welcome ideas. The other links cited were, visiting speakers, practical experience, and community links such as sponsorship.

Over half of teachers said they wished to create a link, which suggests that teachers would like to learn more about how the links could be beneficial to them. Some quotes are shown below in response to the question of what links would you like to have:

> *"Visits to sites or personnel into school."*

> *"Create links with scientific departments of universities, have resident scientist for a year."*

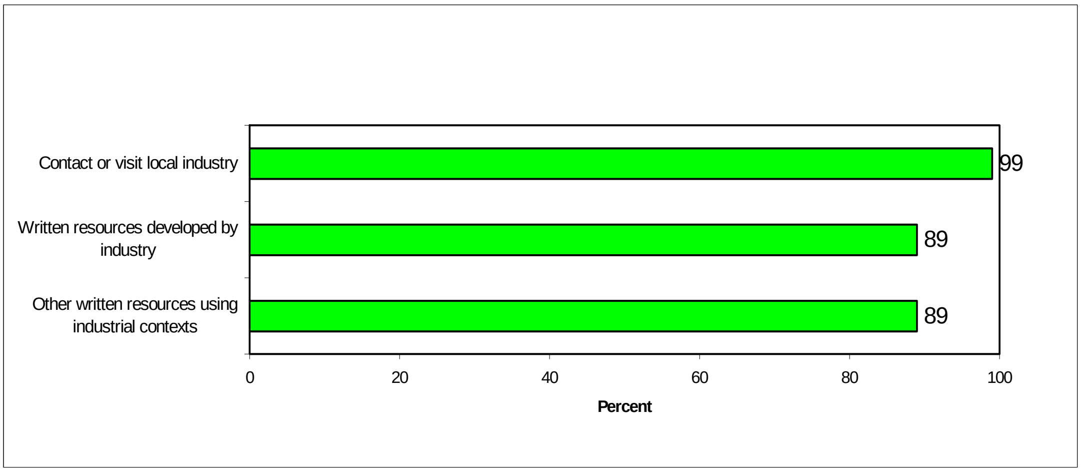
> *"Any links which benefit pupils without increasing teacher workload."*
>
> *"To develop stable, on-going links with local companies. Previous links have not been sustained, as engineers have moved on, the links have been broken."*

The attitudes of teachers towards links were quite positive. Many teachers had specific ideas for links and others would be willing to listen to ideas put to them and therefore learn about how industry helps contextualise the science curriculum.

## 11.4 Attitudes towards resources and links after the training

After the training sessions and visit to industry, teachers were asked about their views on using industrial resources in the future.

**Figure 11-5: Use of resources after the CCI project**




Virtually all the teachers stated that they would like to have contact with local industry and 89% of teachers would consider using resources developed by industry or other sources.

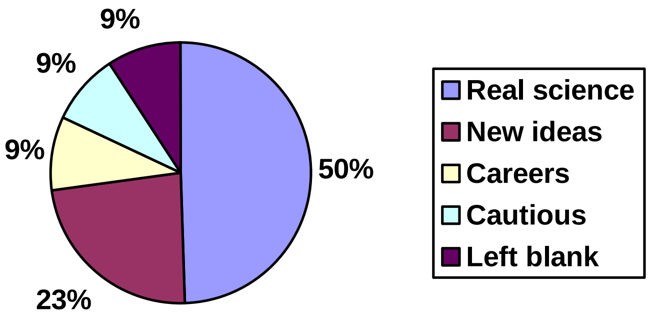
Before the training, the teacher's attitudes towards the chemical industry and resources were quite positive. About half of the teachers had used resources and this was mainly for their good educational quality. Most teachers thought there were positive and negative aspects of the chemical industry and about two thirds of the teachers thought they would like links with the chemical industry.

The response of teachers after they had the training sessions was extremely positive compared with the two thirds who said they wanted links before the training. This positive attitude towards industrial resources was likely, therefore, to be due to the project.

In another region, the response had increased from half of the teachers wanting links to 80% wanting to use industrial resources. In both regions the number of teachers who wanted links with industry increased by about 25%.

The teachers were also asked why they would or would not consider using industrial resources. The results are shown in Figure 11-6.

**Figure 11-6: Reasons for using industrial contexts**




Half of the teachers stated that the reason for using industrial contexts was that it made science real; it brought science to life. The teachers realised that teaching the children science without giving it a context made it more difficult for the children to understand the relevance of science.

An interesting point is that when the teachers were asked for their reasons for using industrial resources, before the training, none of them gave 'real science' as a reason. They were given a list of reasons that did not include real science so they would have had to have added it under 'other reasons' but nobody did this. Maybe, it was because, before the CCI project, the positive aspects of teaching science within an industrial context had never been emphasised.

Before the project, few teachers were aware of the need to relate science to the 'real world'. By the end of the project, the teachers were more likely to say that resources made science more real than any other reason. This indicates a radical change of teachers' views to teaching the science curriculum as a direct result of the CCI project.

A further 23% of teachers gave other reasons for using industrial contexts such as it gave them new ideas for teaching science other than real life context. These reasons included comments like; it made science fun, and, it made science interesting.

1 in 10 teachers also mentioned that using an industrial context, especially visiting industry, teaches children about possible career paths.

1 in 10 teachers left this section blank but this was not because they were negative about using resources. Many teachers who answered 'yes' to all the parts of the question still left the section blank. Below are some of the quotes from teachers talking about industrial resources:

> *"The visit was tremendous, the children have really benefited from having a real vision and purpose to their investigations."*
>
> *"The industrial context helped the children understand the relevance of science is all around them in their everyday lives."*
>
> *"In an industrial area such as Teesside where many parents may have involvement and children have some awareness of industry, it is a valuable opportunity to link science to the 'real world'."*

*"Encourages children to enjoy and interact in science and scientific practical investigations."*

*"Industry adds a new perspective to science, helps children to believe that scientists are not hidden away – and this could be achievable for a job for the future."*

*"It makes the whole process come alive to the children and they are much more likely to remember what they have learned."*

9% of teachers were more cautious and said they might use industrial contexts in the future. Despite the training sessions, this small group of teachers was still not convinced of the relevance of using industry in teaching primary science. A quote from a teacher is included below:

*"Would need a course due to lack of confidence in teaching from an industrial context."*

Time is frequently mentioned as an obstacle to using an industrial context. In the previous study the teachers were revisited after a year and many had changed their teaching practices but very few of the teachers had visited industry again although they had said they were keen to do this. This was because they felt they did not have the time to organise it. It is a hard problem to overcome as it is rare for companies to make the first move to invite schools to visit, which is the one thing that would make the job easier for teachers. CCI advisory teachers or another organisation need to keep acting as brokers in this process.

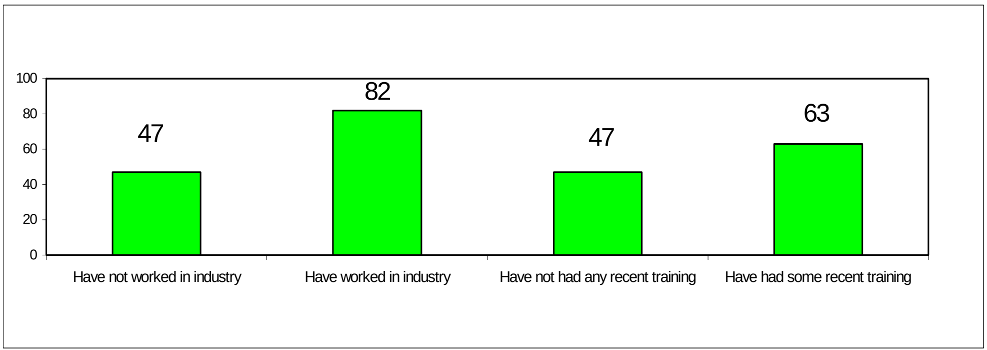
Teachers only make time to forge links with industry if they are very motivated to do so. Such as, if there is a strong link with the national curriculum and/or they have existing interest and knowledge from previous qualifications or training.

## 11.5 Differences in attitudes towards industry

Further analysis was carried out to explore whether attitudes towards industry were associated with any other factors. The aim was to find out whether some teachers were more likely than others to use industrial resources.

Teachers who had undergone training were compared with teachers who had not had any training. In addition, teachers who had worked in industry were compared with teachers who had not. The results are shown Figure 11-7.

**Figure 11-7: Teachers who have used industrial resources**




Teachers who had worked in industry were significantly more likely to use resources from industry (p=0.01). This makes sense, as they would be more likely to be aware of resources available to primary schools. The teachers who had recent training (science or industry) were 16% more likely to use industrial resources. This was not statistically significant for this region but was significant when all regions were amalgamated. The reason for this may be that teachers who have science or industry training are made aware of resources available. It may be that teachers who are more likely to use resources are also more likely to have training and it's more a measure of personality. These would be teachers who were more positive about industry. Those teachers who were more negative about industry may also be less likely to look out for training courses in science or industry, as well as industrial resources.

It was also tested whether being a science co-ordinator increased the probability of using resources, It was not found to be the case.

## 11.6 Chapter summary

Before the training, when prompted, nearly all teachers thought there were positive and negative things about the chemical industry. The general view was that the industry is necessary for the things we use but many teachers also referred to pollution as a mandatory by-product of the manufacturing of these products.

Before they had any training, many teachers had not received any information about the chemical industry either through resources developed by industry or through links with the chemical industry. The majority stated they had never seen such resources.

The 55% of teachers who had used resources were most likely to say that they did so because they were of good educational quality and they fitted the science curriculum.

Teachers who had worked in industry were more likely to use industrial resources.

The change in attitudes towards industrial resources that occurred during the training was impressive. Virtually all the teachers thought that visits would be useful and 89% of teachers wanted to use resources developed by the industry. This was very positive when compared with 55% of teachers who had used industrial resources and 66% who had wanted industrial links before the training. The training sessions had helped the teachers realise the relevance and importance of using different resources about industry.

It has been shown that this training has significantly changed the attitudes of teachers. At the beginning, the teachers were mostly neutral about industry with a small group of teachers who were extremely negative about the chemical industry. After the training, the majority of teachers were extremely positive towards the chemical industry with a small group of teachers that were more sceptical. Some of the initially negative group did end up in the sceptical group but not all. Therefore, the vast majority of teachers had a better attitude towards the chemical industry after the training

# 12 Conclusions

## 12.1 Children's data

The CCI project involved many children from primary years 4 to 6, the majority in year 5. The advisory teacher was able to offer a variety of topics to the teachers and children, to suit their needs and interests. The topic *A Pinch of Salt* was the most popular choice. There was a wide choice of industrial sites for the children to visit in this region.

After participation in CCI, children were able to depict significantly improved and more detailed drawings of the external and internal image of industry. This demonstrates their acquired knowledge of how industry appears from the outside as well as their increased awareness of the processes involved in making products.

Additional data showed that the children were more likely to think that industrial sites were safe, and had fewer people than expected after the project, a more accurate reflection of how industry is today.

Children who had not had a visit were shown images of industry using video and photographs, and for most children, this was enough to learn about and demonstrate positive views of industry.

The classroom also provided an ideal environment to learn about the roles of scientists and engineers. Many of the children, whether they had a visit or not, clearly learnt about the importance of scientists and engineers and their roles on industrial sites. After the CCI project the children were eight times more likely to draw a scientist or engineer and significantly less likely to draw a materials handler, or packer.

Children chose two jobs more often, after the CCI project, 'scientist' and 'engineer'. The proportion of children saying they would like to be a scientist was 2% before the project and increased nearly ten-fold to 19% after the project. Children were much less likely to choose to be a 'materials handler'.

The project raised the children's awareness dramatically, of the variety of jobs held in industry. After the project, nearly half of all the children mentioned that scientists and engineers worked in industry. Jobs such as materials handler were mentioned far less frequently.

The children were aware of the need for scientific testing and had many opinions as to why testing was important.

The children really enjoyed the project with far more children indicating that they enjoyed activities, than indicating that they did not enjoy them. The activities enjoyed the most were those that were practical and contained new information.

## 12.2 Teachers' data

The reaction to the training was extremely positive. Most teachers had nothing but praise for the training received. This is not surprising as half of the teachers had not had recent training in science and a third had no science qualifications. Training in industry was even less common with three-quarters of teachers having no recent industry related training.

It was also found that teachers were more likely to teach about industry as part of the history or geography curriculum, than the science curriculum. Many teachers were not aware of the relevance of teaching science with an industrial context to make the subject more interesting and relevant. Nearly half the teachers had not used any resources developed by industry, usually because they did not know about them.

Teachers increased their knowledge of the chemical industry and of science.

Only a small number of teachers were able to say with any detail what the chemical industry does at the beginning of the project. By the end of the training nine out of ten teachers felt they had learnt something about industry or science. Many teachers gained a more balanced view of the chemical industry as a result of taking part in the project.

Before the training, when prompted, nearly all teachers thought there were positive and negative things about the chemical industry. The general view was that the industry is necessary for the things we use but many teachers referred to pollution as a mandatory by-product of the manufacturing of these products.

Before they had CCI training, many teachers had not received any information about the chemical industry either through resources developed by industry or through links with the chemical industry. The reason they gave for this was that they had not seen any.

86% of the teachers said they had learnt something about science or industry. Teachers were most likely to have learnt something about industry or used industrial resources if, they had not had recent science or industry training, had not worked in industry or were negative about the chemical industry at the start of the project.

A significant change in attitudes occurred towards industrial resources because of the training. All teachers thought that visits would be useful compared with 53% of teachers wanting links before the training. After the project, 87% of teachers wanted to use resources developed by the industry compared with 52% of teachers who had used resources before the training. After the project, the majority of teachers were extremely positive towards the chemical industry with a small group remaining, of teachers who were more sceptical of industry.

## 12.3 Summary

The CCI project clearly achieved its main goals. The children and teachers were far more knowledgeable about industry and the role of scientists after the project. Children were able to depict industrial sites more accurately and the processes involved inside industrial sites. Teachers felt they had learned about teaching science and were more likely to use industrial resources. Teachers and children's perceptions of industry, including safety, improved. Far more children were aware of the roles of scientists and engineers, and aspired to working in these professions in the future. Teachers and children had become much more aware of the link between what happens in science lessons in the classroom and what happens on industrial sites. Finally, teachers and children had enjoyed the project immensely.

# 13 Appendix 1: Questionnaires

- Background
- Pre-questionnaire
- Post-questionnaire

# 14 Appendix 2: Points system for analysing drawings

The post-intervention drawings were compared to pre-intervention and points awarded or deducted according to pre-determined criteria. The list of criteria for outside drawings are listed first followed by the criteria for inside drawings:

- One point for the outside drawings is awarded for the following:
- Move from one to more buildings
- Reduction to one or less chimneys
- Addition of pipes
- Removal of furnace
- Removal of conveyor belt
- Addition of control panel
- Addition of process or scientific equipment
- Addition of cooling towers
- Addition of vessels/tanks
- Addition of storage drums
- Addition of road tankers
- Addition of forklift trucks
- Addition of specific buildings (e.g. warehouse or laboratory)
- Addition of company name
- Addition of specific features (e.g. barbed wire)
- Addition of company name
- Labelling, which demonstrates particular pieces of new knowledge
- Significant change in the number of windows (e.g. from 1 to 10 or vice versa)
- Addition of people doing jobs specific to the industry (e.g. scientist, forklift driver).

In a similar way, points are deducted for elements that have been removed (or the reverse to the statement above) from the drawing:

- One point for the inside drawings is awarded for the following:
- Move from one to more buildings
- Reduction to one or less chimneys
- Addition of pipes
- Removal of furnace
- Removal of conveyor belt
- Addition of control panel
- Addition of process or scientific equipment
- Addition of cooling towers
- Addition of vessels/tanks
- Addition of storage drums
- Addition of road tankers
- Addition of forklift trucks
- Addition of specific buildings (e.g. warehouse or laboratory)
- Addition of specific features (e.g. security barrier)

- Addition of company name
- Labelling, which demonstrates particular pieces of new knowledge
- Significant change in the number of windows (e.g. from 1 to 10 or vice versa)
- Addition of people doing jobs specific to the industry (e.g. scientist, forklift driver).

In a similar way, points are deducted for elements that have been removed (or the reverse to the statement above) from the drawing.

# 15 References

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