



Harnessing enthusiasm for biodiversity to enhance the learning experience 2013

Go on ... let them loose!

Harnessing enthusiasm for biodiversity to enhance the learning experience was made possible as a result of the generosity of the Esmée Fairbairn Foundation, and by the involvement of the teachers and pupils of the participating schools. We are grateful for their support and for the support of the Department of Biological Sciences and the Faculty of Education of the University of Hull. We also acknowledge the assistance of Dr Lisa Scott, Dr Jo Pike and Mr Dave Overton.

Authors:

Dr Graham Scott,
Mrs Margaret Boyd,
Professor Derek Colquhoun

Project contact details:

Dr Graham Scott, School of Biological, Biomedical and Environmental Sciences,
Bioscience Education Research Group, University of Hull, HU6 7RX, UK

g.scott@hull.ac.uk

www.hull.ac.uk/primaryschoolfieldwork

January 2013

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Background

For most biology teachers the decision to take their class outside to learn firsthand about ecological processes should be a natural one. We would expect them to agree whole heartedly with Fisher (2001, page 94) who stated that, *“the laboratory for the study of field sciences is the “field”, anywhere else then the experience becomes second hand, out of context and meaningless”*. There is a strong argument that fieldwork is an essential part of any science course delivering ecological concepts, an argument supported by a number of influential authors who continue to extol its benefits and its effectiveness (Nundy 1999, Lock 1994, Tilling 2004). However, in primary schools in the UK most science is taught by non specialist teachers and this impacts upon current practice and the provision of outdoor learning in these particular key stages. When looking at provision for 2-11 year olds in Devon, Waite (2009) noted a sharp fall in outdoor opportunities for learning, particularly from age 6, that seemed to be reflected in other areas of the country. Reasons for this decline in the quantity of fieldwork that is provided within the UK have been thoroughly discussed (Waite 2009; Rickinson *et al* 2004; Barker 2002) and

have been attributed to a number of factors including, but not limited to, perceived risk, cost, curriculum pressures and assessments (O'Donnell 2006; Waite 2009). One of the factors discussed by O'Donnell (2006) was the role of the classroom teacher, in terms of their personal confidence in what they perceive to be a specialist subject area requiring specialist pedagogies. A teacher's lack of confidence towards science was found to be a major factor in the avoidance of teaching science at primary school in a study of pre-service primary teachers carried out by Howitt (2007). To overcome this issue Small *et al* (2012) provided a short environmental education training course to elementary teachers and found that the self efficacy of the participants was improved, along with their willingness to try the suggested activities. The greatest asset of the training appeared to be the highlighting to teachers of cross curricular connections involving the environment. Increasing the confidence and knowledge of practitioners would seem therefore to be a pre-requisite for improving provision of environmental education in primary schools.

In the face of increasing transport costs and necessarily increased bureaucracy related to taking children out of school, there is an urgent need to explore the value of the easily accessible area around a school and its grounds as a location for fieldwork activities designed to enhance the delivery of environmental education. Howarth & Slingsby (2006) provide an insight into the use of school grounds for simple (and the possibility of more complex) fieldwork investigations. They describe a range of approaches that would introduce students to differing fieldwork skills, from investigating the abiotic

factors in contrasting ponds to looking at the succession of a small piece of grassland over a number of years. There seems to have been some recent enthusiasm to develop areas of the school grounds to provide a diversity of habitats, particularly in primary schools, but once set up they are often not being used to their full potential by teachers as places for outdoor learning.

Following on from many calls for more research into the wider beneficial effects of fieldwork (Rickinson 2004), Scott *et al* (2011) carried out a pilot project to investigate the level to which a short field trip affected the literacy skills of the pupils involved. They found that children demonstrated an increased ability to write about an animal in an ecological context when writing about one they had experienced personally. The experience led directly to Scott's development of the current project. Talking about their fieldwork experience the children involved in that pilot project commented on their own increased motivation and level of interest; two factors that probably led to an increase in their ecological knowledge. Although educators traditionally have not thought of science instruction as a setting for literacy learning, inquiry based science can provide a rich context to build language skills, where the stimulus comes from the learner not the teacher. Learning about the natural world and describing one's own discoveries can be powerful motivators for learning to read, write and speak effectively.

Aims of the project

The primary aim of this project was to evaluate the effect of a simple child led field based learning task on children's scientific knowledge and literacy skills. The activity was designed to take place within school grounds or within walking distance of a school site. To achieve this aim we evaluated the effect of taking part in the activity upon the cognitive and affective domains of the children. We evaluated cognitive benefits by comparing the written work of children (standardised tests) prior to and after their being involved in fieldwork with written work produced by the children in control/comparison classes within the same school. Children in the comparison classes did not undertake our fieldwork exercise but were otherwise taught in the same way. We evaluated the children's engagement with learning and the affective benefit of taking part in our exercise by listening to the observations of teachers talking about the behaviour (in its widest sense) of the children and by analysing the content of thank you letters that the children were encouraged to write to us.

Our secondary aim was to work with teachers to better understand the barriers that may prevent their undertaking fieldwork as part of their professional practice. Throughout the project we monitored the effect upon individual teachers of being involved in this research through semi-structured focus group discussions and interviews, and we worked with them to develop strategies to mitigate the barriers they faced.

As an outcome of our project we aim to disseminate our findings to a wider audience and to promote our learning activity as a worthwhile task that can be

adapted by teachers for delivery in their own school setting. The work has been presented at the annual conference of the Association for Science Education, and submitted for publication in the relevant academic journals (one paper has been published already; Scott and Boyd 2012). Leaflets promoting our project will be circulated to schools in our area and our materials are freely available through our project web-pages.

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The Study

The Schools

Eight schools from Scarborough, Hull and Hornsea, which fall into three different education authorities; North Yorkshire, Hull City Council and East Riding of Yorkshire Council, were involved in the project (table 1).

School	Education Authority	Number on roll	Year group involved in project
St Martin's	North Yorkshire	272	5
Newby & Scalby	North Yorkshire	417	5
Hornsea	East Riding of Yorkshire	457	5
Parkstone	Hull City Council	331	5
Eastfield	Hull City Council	613	6
Thorpepark	Hull City Council	372	6
Wold	Hull City Council	501	6
St. Richard's	Hull City Council	384	5

Table 1. The schools involved in the project

St Martin's were invited to participate in the project because it had been the school that worked with us during the pilot project phase (Scott *et al*, 2011). The other schools were invited to become part of the project because they

were distributed across a range of urban areas and because their size allowed the involvement of two classes in the same year group (year 5 or 6); one that would take part in our activity and one that would serve as an in-school control/comparison. All of the schools have large areas of grassed playing fields and concrete playgrounds; features common in these education authorities. Some have areas which have been specifically developed to provide a diversity of habitats; un-mown grass, log piles, pond, stones etc. One class teacher from each school participated in the project.

The activity

Following a discussion with each class teacher about when in the year they would like our activity to take place and what habitat in particular they might like to focus upon, we visited each school to work with a class for one full day or two half days. Prior to our visit the children we would work with (and the children in a same age comparison class) had all completed a written test designed to measure their literacy levels and their understanding of ecological concepts (such as food webs and habitat features).

During our activity the children were asked to prepare a photographic field guide to the plants and/or animals found in the habitat that their teacher had chosen to focus upon. They were given half a day to carry out fieldwork and half a day to prepare the guide (using Microsoft Publisher) as part of an ICT lesson.

To guide their learning during the fieldwork session (whilst allowing them freedom over the detail of what might be learned) the children were asked to:

- Collect and photograph the plants and/or animals that they encountered;
- To identify their finds using simple pictorial keys (available from the Field Studies Council);
- Record their observations on a worksheet (a description, information about location, information about activity);
- Formulate questions to which they might like to find the answers (what does it eat? how long can it live? for example).

An example of a completed worksheet used to scaffold this task can be found as an appendix at the end of this report.

During the field sessions very simple equipment was used; trays and beakers to hold specimens for observation, inexpensive magnifying glasses, plastic tea-spoons and forceps to handle them, small nets and pooters to capture things, clip-boards and inexpensive identification guides (those purchased as part of the project have been donated to the participating schools). Digital cameras were available in all schools and in some schools a local authority scheme enabled us to borrow sufficient for each group of four children to have their own camera for the day.

During the ICT session the children were asked to create their fieldguide individually (or in pairs) by completing a page template which required a title (the name of the plant/animal), two pictures (digital photographs taken by members of the class) and two main blocks of text. One block based entirely upon their own observations in the field and another which included their answers to the questions that they had set themselves (information sourced from web-sites to which the children were directed). Each page also included one wow-fact: a nugget of information that the children felt the reader really needed to know! Examples of field guide pages can be found as an appendix at the end of this report.

The range of habitats and species chosen was far wider than we might have imagined. Classes visited the rocky shore, school playing fields, school gardens and allotments, a local woodland, the hedgerows along a local bridle-way and a school pond. A total of 45 species of plant and 40 species of animal were included in the 8 field guides that were produced.

Evaluation of the impact of the exercise

Cognitive impacts

Literacy levels

Our hypothesis was that participation in the fieldwork activity and an experience of living plants and/or animals in their natural environment would stimulate interest and engagement that would in turn aid subsequent recall of information. As a consequence of this we predicted that the literacy levels (writing) achieved by the children who had carried out the task (our test

classes) would be higher than that of the children in the control classes. Analysis of pre-exercise test data did demonstrate differences between schools (to be expected given that we were working with year 5 and year 6 classes and across the school year) and differences between girls and boys (a national phenomenon by which girls often achieve higher literacy scores than boys at this age), but revealed no difference between test and control classes.

Having taken into account inter-school differences and the difference between girls and boys, our analysis (an unbalanced nested analysis of variance) did reveal a statistically significant impact of our activity.

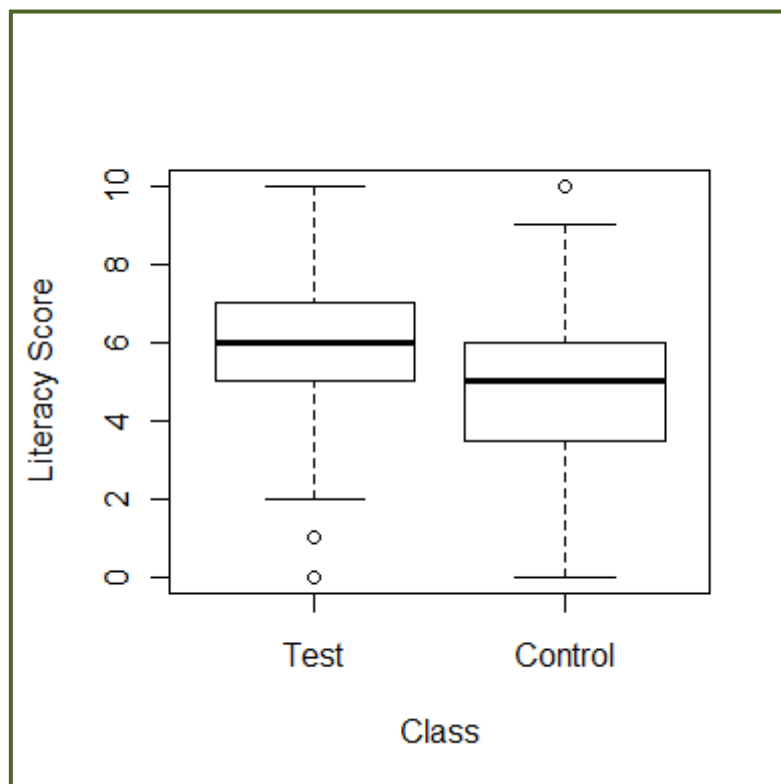


Figure 1. A comparison of literacy scores achieved by children in test classes and control

On average children who had undertaken the fieldwork activity achieved higher literacy scores than children that did not (based upon a comparison of 180 test children and 108 control children) (figure 1). The children in the test classes were routinely using more detailed and topic specific vocabulary in their writing. Their descriptions often contained a number of adjectives and similes rather than just one. They were demonstrating an ability to expand upon simple descriptions. They used appropriate and scientific terms in their descriptions such as *predators*, *prey*, *carnivores* etc., and they made reference to ecological concepts such as interdependence. Although the structure and layout of the written work did not in itself reveal differences between the test and control classes, test class children wrote more detailed pieces, an effect particularly noticeable in the work of lower ability pupils. Teachers commented that some of these less academically able pupils were producing work of a level that had rarely been reached prior to this activity. Although the written work in the fieldguide was not formally assessed for literacy levels, several teachers commented on the higher than expected quality of work produced by their less able pupils.

During discussions participating teachers regularly commented on both the amount and quality of the written work completed by the children; particularly in the case of less academically able children. They felt that this demonstrated that the children had made careful and detailed observations of the living things during the fieldwork.

“They then had to produce the field guide based on what they had found out the previous day. They had access to the photos, the notes they had made and the quality of the work was fantastic, it speaks for itself really. If you have a look at the fieldguide, compare that to what they wrote initially, it’s brilliant”.

Scientific knowledge

Although we did not set out to teach particular aspects of ecology/science to the children we did predict that through making their own observations and formulating and then answering their own questions the children would gain knowledge based upon self directed learning. Because the children each set their own goals in this respect we have realised with hindsight that our analysis tools (written tests) whilst tailored to the habitats each child encountered do make it difficult for us to accurately assess knowledge gained. To further complicate this situation our pre-field work comparison of ecological/science ability revealed no differences between boys and girls and (surprisingly) no differences between schools (in spite of the wide age range involved) but did point to a difference in ability between the children in test and control classes; children that were in classes that were about to undertake fieldwork scored more highly than those who were not. Based upon teacher comments it is possible that anticipation of becoming a scientist and going out doors had a positive effect upon the children at this stage (it is equally possible that the knowledge that the test would not be followed by a field experience had a de-motivating effect upon control class children). However the effect is not only still evident in the post fieldwork assessment

results it is in fact more pronounced (figure 2, based on a sample of 184 test children and 146 control children). This may point to the beneficial effect of our exercise in the context of the children’s learning about ecology, but it is essential that further work, possibly with a refined assessment methodology be carried out before this can be confirmed.

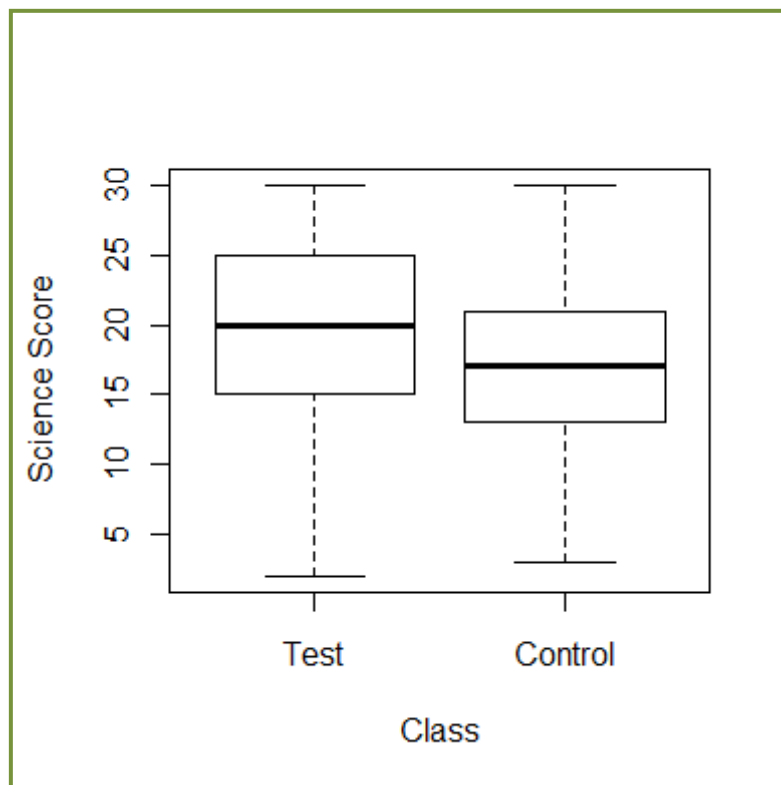


Figure 2. A comparison of science scores achieved by children in test classes and control

The children that achieved higher scores did so primarily because they were able to answer questions that tested their understanding of the ways in which organisms are adapted to their environment and questions about methods of feeding (including the correct representation of energy (food) flow along a food chain). All children demonstrated an ability to use keys to classify and

identify organisms and an ability to use specific ecological terms appropriately.

Engagement with learning

The children's voice

In order that we might capture the children's own perceptions about their participation in the exercise we asked that each of them write us a short thank you letter (see appendix for example). In their letter the children were encouraged to comment on three areas:

- What they had enjoyed about the day(s);
- What they thought they had learned;
- What improvements we might make to a similar day in the future.

From the 191 letters that we received it was clear that there were many aspects of the activity that the pupils had enjoyed. The children regularly used phrases such as “cool”, “great fun”, “had a brilliant time” to describe the session emphasising how much they had enjoyed taking part in the fieldwork. Those that had used pooters to collect minibeasts commented on how much fun it was and many described the creatures being sucked up as “cool”.

“I really enjoyed sucking up the bugs with the pooters I thought it was really fun”

“The best bit of all was finding the animals because most of the ones I found I have never seen before like sea urchins and idotea”

“I really enjoyed going outside the most, it was way better than being in the classroom because we got to touch and pick the plants”

Children made comments in their letters about things that they had learned during the fieldwork sessions. Many children commented on the fact they had found so many different types of animals or plants; their comments suggest that they had gained an appreciation of the biological diversity of their immediate environment.

“I didn’t know that there were lots of animals in the quad.”

“I’ve learnt that there are a lot more animals and plants on the beach than I thought”

“I enjoyed finding out all the different types of trees”.

Children often referred to the specific animal that they had learned new things about.

“I found that there was a minibeast called a shield bug, it was green. I also learned that a shield bug has wings to fly.”

“I learned that the hazel tree has little hairs making the leaves hairy”.

The children also came to realise that although the areas explored during the fieldwork (school grounds and sites within a short walk of them) were familiar to them at one level they were almost wholly unfamiliar with the biological/ecological interest that they provided (a similar realisation was made by the teachers). That said, it was evident that some species were more familiar than others. Those children who investigated minibeast diversity often knew an animal’s common name (e.g. spider or snail or worm). These groups relied less upon the identification tools (they often picture matched instead of using the structured identification questions) than did children working on less familiar species. For example the groups identifying herbaceous plants and/or trees made far more use of the identification charts, diligently working through the identification questions rather than jumping to a picture immediately. Children often commented on how much they had enjoyed using the identification charts and expressed a sense of achievement at being able to name a previously unfamiliar species.

“I learned different tree names because you gave us a key guide in addition to learn from”

“I really enjoyed trying to identify the trees because it helped me learn the different names of trees. I learned a lot about trees and bushes”.

Pupils often referred to the activity as “*being better than being stuck in the classroom*”. They enjoyed being out in the fresh air and being able to explore for themselves. They saw the act of finding the animals/plants as being important and something that would not be possible were materials brought into the classroom.

“When I was in the beach I enjoyed rolling the rocks over to find things.”

“It was nice going out in the sunshine.”

“I really enjoyed looking for different bugs and looking at their habitats.”

The teachers’ voice

Teachers were unanimous in their view that participation in a novel out of classroom activity resulted in higher than usual engagement with learning by their pupils. They noted this particularly in the case of children of lower academic ability and amongst those children that usually exhibited a reduced ability to concentrate on specific learning tasks.

“For that boy there, for him to sit down and concentrate without an adult next to him is the biggest achievement.”

“That little lad in the photo there, he would never work with girls and he is pretty boisterous and in all the photos he’s there, he’s holding something, looking at something, and again he was completely calmed down.”

Affective impacts

For the majority of the children taking part in a fieldwork session was a new and enjoyable activity.



Figure 3. The top ten words children associate with fieldwork

From the thank-you letters that they sent us two key themes emerged (figure 3): Evidence that the children do feel that they have learned something about ecology/biodiversity/science, and evidence that they have had an enjoyable and memorable experience. In their letters the children described what they had learned and how they had used the environment for that learning.

“I really enjoyed identifying the trees because keys were fun to use with the arrows.”

“I learnt that there is a lot of wildlife in our pond and that pond dipping is fun”

“I have learned that finding minibeasts and insects you need to use equipment like magnifying glasses and spoons”

Comments made by the children about how much they enjoyed the activity demonstrated their enthusiasm for fieldwork. They described being engaged with the task at hand and about the benefits of social learning and group work.

“I liked the best being in partners because I might have struggled with the tree names on my own.”

“It was good working with my friends because we all worked well in a group and none of us argued.”

Prior to the fieldwork sessions a number of teachers had expressed concerns about the likely (poor) behaviour of some children. But in post exercise discussions there was a sense that these children had demonstrated higher than expected levels of engagement and improved inter-personal behaviours.

“I kept a boy with me whose behaviour is absolutely off the wall usually, and it was the best I’ve ever seen him behave. He absolutely loved it.”

Teachers also noted that individual pupils (normally requiring one to one support) had showed a tremendous amount of interest in the species that they had found and were observing their characteristics in great detail, something they rarely demonstrated in the classroom.

“And he caught a spider and you would have thought it was the first spider ever to have been caught and he was so proud of himself and he looked at it in such great detail, whereas normally he would have gone yes it’s a spider, here he got his magnifying glass out and said look it’s got zig zags, what are those zig zags for?”

Teachers remarked that some of their less confident pupils actually were able to come to the fore and share their own knowledge with the rest of the class.

“Yes, some children really thrived out there and because they had a lot to share as well, those that might have ordinarily been quite a quiet person actually they were the expert because they knew things.”

The interaction between the children and the environment was a positive one as when asked how they would improve the activity a large number asked to spend more time outside.

“My favourite activity was going outside and finding out more about what plants grow around our school”

Teachers and fieldwork

Prior to participation in the project only two out of the eight teachers described themselves as being confident in the outdoor environment and were able to describe a range of circumstances where they had taken their classes outside to learn.

In order to understand their preconceptions about fieldwork and the developing views of the teachers as they worked with us a series of workshops were held throughout the study and individual teachers were interviewed on a number of occasions. At the first workshop information was collected about how a range of barriers prevented the teachers from taking their pupils outside. Subsequent discussions focused on descriptions of each teacher's participation in the fieldwork activity itself and their responses to it. At the end of the project discussions focused upon the benefits of the activity to teachers (and their pupils), the levels to which barriers to fieldwork could be overcome and the potential ways in which fieldwork might become part of their future practice.

Barriers to fieldwork

To understand the relative importance of the eleven most commonly cited potential barriers to fieldwork in the literature (eg. Rickinson 2004) we asked our 8 participating teachers and their colleagues to rank them (table 2).

Potential barrier	Rank	Potential barrier	Rank
Costs (transport, admission fee, consumables)	1	The behaviour of children	8
Lack of suitable equipment	2	Class size	9
Pressures related to assessments (SATs)	=3	Risk assessment paperwork	10
Concerns around risk	=3	Lack of teacher knowledge about the outdoor setting	11
Adult : child ratio	5	Lack of teacher confidence teaching in an outdoor setting	12
Timetable constraints	=6	School culture/levels of support	13
Lack of a suitable area for outdoor learning	=6		

Table 2. Teacher perceptions of the relative significance of potential barriers to fieldwork. Responses from 47 teachers, rank 1 = most significant barrier.

Following their involvement in the fieldwork activity and again at the end of the project the teachers were asked to reconsider the barriers that they had initially put forward as preventing them taking their pupils out of the classroom. It was apparent that having had a very positive experience of fieldwork the teachers involved had changed their views (figure 4).

“I now feel more confident about doing leaves or doing trees, especially if there are charts about them like the rock pool ones, the same sort of identification resource.”

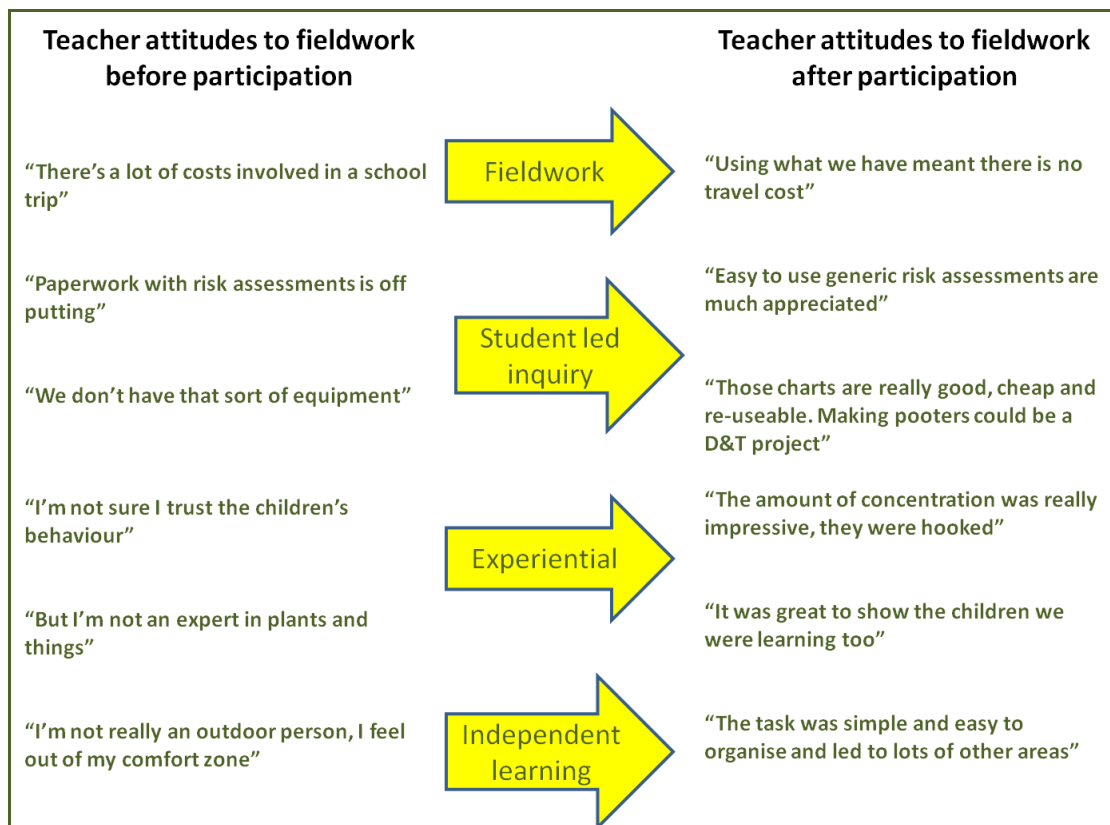


Figure 4. Overcoming barriers; changes in teacher attitudes to fieldwork.

"I know more now and I am much more confident in that sort of thing."

"But I could do that now, now I know the way the activity works."

"It was good, it backed up the anecdotal evidence, much more tangible, because it provided very clear evidence of actually having an impact, showing that outdoor work has an impact not just on their science subject knowledge but on the literacy as well and that they were able to write about it in detail and with enthusiasm."

One significant barrier that had been put forward at the beginning of the project was that teachers felt that they did not have access to a suitable area for fieldwork. This was often linked to the view that suitable areas were always a costly coach journey away. Indeed one school regularly paid to transport children to a pond some distance away even though they had a pond within their grounds. Having participated in the project all of the teachers recognised the enormous potential of their immediate location.

“I think we’ve got a suitable area now and I’ve seen the benefits of that area”

“I think also before there was the fear of not finding anything”

Being helped to overcome preconceived barriers has helped the teachers we worked with to re-evaluate their ongoing practice (and that of their colleagues).

“Letting the children ask the questions and trying to help them ask the questions, it’s quite risky to do but I would certainly try to use that approach in other subjects too.”

“I think when I am planning for science now, if I can take them outdoors I will do.”

“Yes we’ve done it a couple of times, we’ve been down to the beach, we’ve been out into our wooded area.”

Responses to the fieldwork activity

During discussions teachers enthusiastically described their fieldwork sessions and eagerly explained what had taken place and how their classes had responded to the tasks. They all stated that they would repeat the activity with other classes and would explain to colleagues the benefits of fieldwork and offer them practical support. They felt that our activity was manageable and were happy that they could access the resources that would be needed to repeat the fieldwork, even in a different habitat. Teachers had initially been apprehensive about the knowledge they would need to carry out ecological fieldwork and unsure about their ability to identify native animals and plants. Through participation in our activity they saw that it was possible for them to learn alongside their pupils. This novel learning partnership was a characteristic of fieldwork that both teachers and pupils enjoyed.

Teachers reported that children showed great pride in their finished field guides and in most schools they were put on display to be read by other pupils and staff. In a number of schools younger classes had used them for their own investigations, proving that this was an authentic and useable fieldguide.

“From the work that got produced we have got a display going up the stairs..... And it’s really fascinating for some of the children to look at

them, you always see some of the other children stopping and reading the information that we have got”.

One teacher explained that a year after our exercise her group had spontaneously applied their self found knowledge about the tree species of their local woodland when selecting trees at a local nursery to plant in their school grounds. The same group had also discussed at length the ecology and diversity of a woodland scene during a visit to a local art gallery.

Conclusions

In achieving the aims of our project we have demonstrated that even a short fieldwork exercise has the potential to have a positive impact upon children and their teachers. Through our analyses we have demonstrated that:

- firsthand experience of biodiversity in an out of doors setting has the potential to enable children to enhance the quality of their writing;
- children are able to enhance aspects of their own science learning through self directed fieldwork;
- children perceive outdoor learning to be fun and their group work skills to be strengthened through participation in an out of doors exercise;
- participation in a well designed fieldwork task promotes pupil motivation and engagement;

- teachers are aware of the barriers that may prevent their participation in fieldwork based science, but that with a little support they are keen and fully able to overcome them.

We will continue to promote fieldwork to teachers and continue to support teachers to develop their fieldwork practice. However, we feel strongly that if children are to experience the full educational benefits of fieldwork more must be done to support teachers at all stages of their careers to develop the skills needed for them to carryout fieldwork based science as part of their professional practice.

We leave the final word to one of the children:

“the best bit I liked was just being outdoors enjoying the wildlife”

Appendix: Examples of pupil work.

Trees in Raincliff Woods

What is the name of your tree?
Hazel tree

Is it common or rare?
Common

Describe your tree. Think about its size, its trunk, how the branches are arranged. What is the bark like?
The hazel has brown, silver bark. The tree itself has other 9 metres tall. It was over a 100 years old. The branches were zig zaggy.

Describe and make a sketch of a typical leaf from your tree.
The hazel leaf has little hairs that make it hairy. It has teeth along the edges.

Does your tree have berries or seeds? Describe and make a sketch of some.
Not but NO but it has peculiar buds on the end of the leaf. The buds are oval shaped and very small.

Dear: Mr Scott and Mrs Boyd

Thank you for coming and teaching us about underwater life. I very much enjoyed it. It was cool!!

I learnt a lot on that day. It was my best lesson of that week. I want to do it again.

my favourite part was doing the pond dipping, watching the tad poles. I also liked looking at them with the magnifying glass.

Yours sincerely James Pearson

A completed worksheet

Ribwort Plantain

The Ribwort plantain has a flower on the top. It has a long green leaves and a stalk with a pointed head. The Ribwort Plantain can be found in the school garden.

Ribwort plantain is often seen as a nuisance to many gardeners. However, for those looking to attract wildlife its worth allowing it a small place on your lawn: this plant attracts many small butterflies, moths and hoverflies and provides a good source of food for birds in the winter.

You can distinguish it from other species by its rosette of long, narrow, hairy dark green leaves to that can grow up to

This plant is liked by insects and sheep
And disliked by snails and slugs

By Sam page 19

A thank-you letter

Ladybirds

Ladybirds are often found on bushes leaves and sometimes gardens. ladybirds are the most common beetles around. the ladybird is a small red beetle with red dots on the back and it has white dots were its eyes are they have a oval shape body with about six legs

In summer time the ladybirds like to reproduce and they make more babies.

Ladybirds eat greenflies and other small insects. The predators that eat the ladybirds are badgers and some small other animals

They can fly very high and they are fast movers

Completed fieldguide pages.

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Improving Literacy



Fieldwork in the school grounds

