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LEONARDO FLIES AGAIN

INTEGRATING SCIENCE AND ART

Ivor Hickey, Deirdre Robson, Mary Flanagan and Paula Campbell
found that teaching art and science together can be a very positive experience

The subjects of science and art can both be problematic at primary school level. Science seems to lose its attractiveness to children during the later stages of their primary education (Murphy and Beggs, 2003). The reasons for this are unclear, although they may include insufficient practical experiences and an excess of factual learning, targeted towards tests. In contrast, art is regarded as a fun subject by most children but is often neglected in primary classrooms. This may be because its educational value is not fully appreciated or teachers lack confidence in delivering the subject.

We decided to develop an approach combining these two subjects, which we called 'The Leonardo Effect'. We tried it out in 18 primary schools situated in Belfast, Ballymena, Wicklow, Glasgow, Bristol, Swansea and London. Approximately 1000 pupils aged 7–10 were involved. The outcomes were evaluated by questionnaires, interviews and from teachers' recording.

Why integrate science and art?

At the time of the European Renaissance art and science were culturally inseparable and not seen as discrete subjects. For example,

Leonardo da Vinci did not limit himself to art, engineering or biology but employed interconnecting knowledge when necessary, to satisfy his curiosity about how things worked and how they could be improved. Could the same philosophy be employed in current day teaching, with art and science being taught collaboratively and given equal weight? This approach should fit well with the curriculum proposals that are currently being considered throughout the British Isles, with their emphasis on development of skills and closer interaction between subjects. Even more compelling is the emergence of creativity as a key factor in children's learning. Art has always been seen as a creative subject but, although scientists appreciate that a creative mind is essential in taking science forward, science as a school subject is generally perceived as requiring memory rather than creativity.

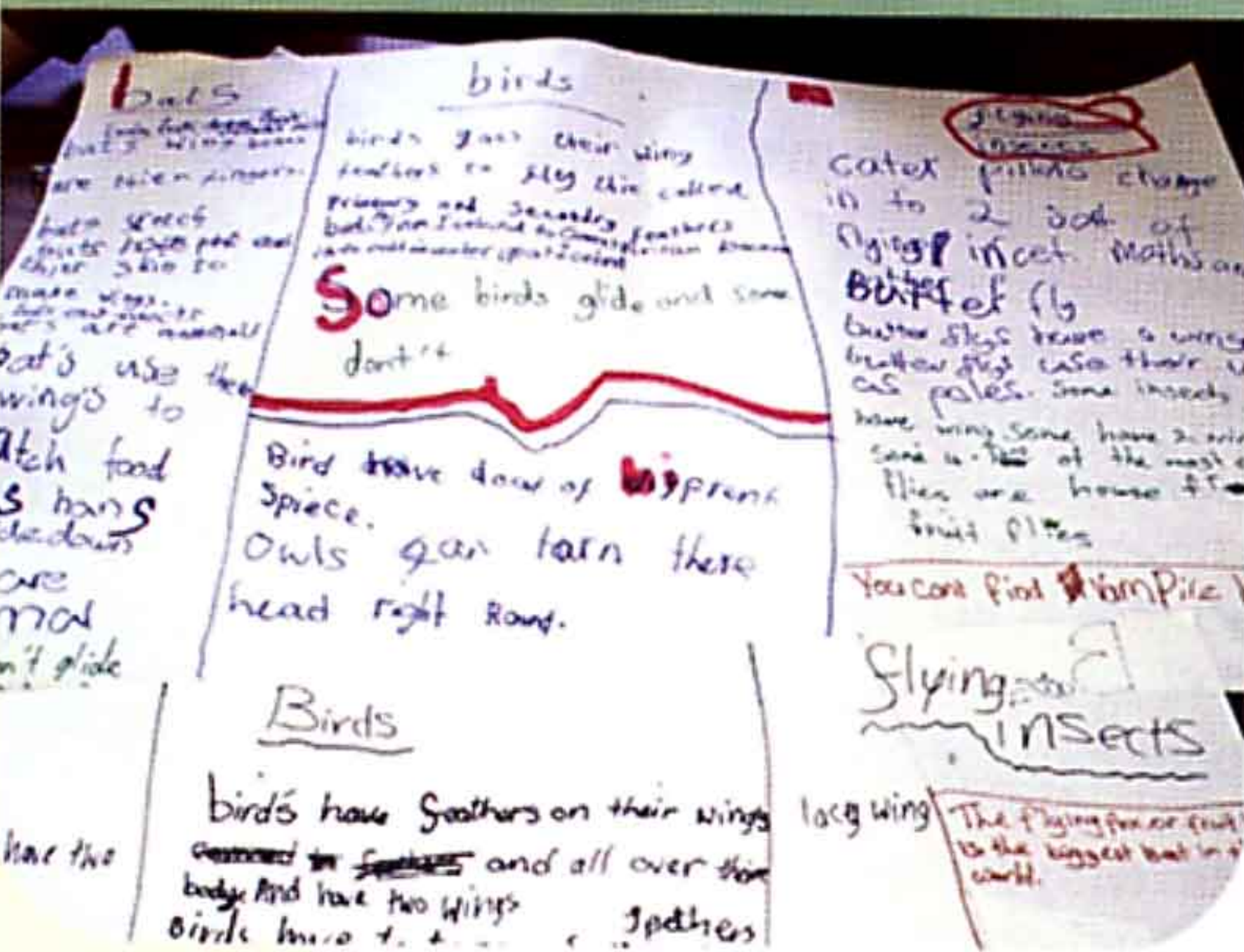
We therefore decided to take on the challenge of seeing whether we could combine these two subjects in



Top Study of birds gets underway

Left A closely observed peacock feather

Below Children gather information about flight



was to involve the children in decision-making and in planning their work. This sharing of responsibility came as a shock to several of the teachers. An essential element in the success of the project was therefore a two-day training programme that teachers and heads/principals undertook before commencing teaching.

Preparing teachers

The training had four main emphases:

- bringing subjects together to help teachers understand the areas of commonality;
- developing joint learning outcomes;
- experiencing the processes and skills which their pupils would be using;
- understanding that creative teaching and learning require experiences and freedom to explore ideas.

Teachers reported that the training sessions were very enjoyable. They were taken out of their comfort zones and were given time to be creative and solve problems. This added greatly to their confidence and enthusiasm and inspired them to take the same approach with their pupils.

The learning programme for 'flight'

The learning programme had four separate phases, namely information gathering,

development of ideas, creation and finally extension.

Information gathering

From the start the children were challenged to 'find out' about flight from multiple sources including books, the Internet, and first-hand experiences such as visits to a museum or bird sanctuary and speaking to experts. This was carried out without subject restriction, as gathering information is equally applicable to art and science. Teachers helped in this process but did not direct it and knew that it was fine to say 'I don't know; let's find out'. The opportunity, at this stage, for open-ended investigation was invaluable and reaped noteworthy rewards. For example, knowledge acquired by the children was greater, commitment to learning improved immeasurably, even the weakest learners found the topic accessible, and the most able faced significant challenges. Children loved finding out and asking questions and then recording what they had found out. Recording was carried out in several ways, including note-making, drawing, photography and video.

Development of ideas

Children's interests were pooled through decision-making, as schools embarked on this more focused phase. In some schools this involved in-depth investigation and experimentation on the structure of wings and learning about the similarities and differences in the bone structure of the human arm and a bird's wing. Leonardo da Vinci's working drawings were very helpful in this, as were fictional stories. In other schools, camouflage was explored and camouflaged habitats created. Movement and pattern, particularly in flying insects, captured the imagination of many children and were explored creatively. One school invested considerable time in considering potential solutions to the problem of a dragon stranded because it was unable to fly!

All these topics produced much discussion, and created subsequent challenges for all concerned, requiring in-depth investigation and experimenting with materials. As a result, specific areas of

order to develop the creativity and the enquiry skills of the children. (A detailed justification of the approach is given in Robson, Hickey and Flanagan, 2005.) The topic chosen for our pilot was 'flight'. The intention was not just to link separate art and science lessons but also to use the tools of both disciplines in any combination to further their understanding. Teachers were encouraged to use joint learning intentions/outcomes covering both subjects where appropriate. Part of our approach

knowledge and skills were explored in some depth. The children appreciated that this was necessary in order to prepare for the 'creation' phase, and they willingly took active roles in suggesting how problems could be overcome. During this phase teachers were encouraged to call in expert advisers, such as an artist, scientist, wildlife expert or parent with specific skills or knowledge.

Creation

When the children had gathered sufficient information, ideas and skills they set about designing and planning a unique 'flying creature or invention' which, most importantly, had to be adapted to a specific habitat. Classes approached this task in many different ways. Some worked on large, whole-class collaborative models; in others, children worked in small groups.



Making a model flying creature

Informed by the two previous stages, the inventions were invested with children's commitment and considerable factual, artistic and technical knowledge. In all cases there was considerable interaction between children, and evaluation and testing of structures.

Extension

This phase allowed extension of children's thinking and embedding of their newly acquired knowledge. Teachers used their professional judgement as to how this should be undertaken. Accordingly, this phase took many different forms. Some produced storyboards, where the creature became the hero of a tale; others produced DVDs, poems, audio stories, animations and dramas. We found that children were very motivated because of the high level of investment they had put into the design and creation of their creature or invention.

Evaluating the approach

In order to evaluate the study we surveyed all teachers, head teachers/principals and parents by questionnaire. Children gave us their opinions in small focus groups. In addition, we asked teachers to keep diaries of the progress of the project in their classes; these provided very valuable insights into how individual teachers felt about teaching in this way.

Outcomes for teachers

Teachers' responses to questionnaires were overwhelmingly positive. Although several had found some initial difficulties in adapting their teaching skills, they all found it very worthwhile. Typical comments included:

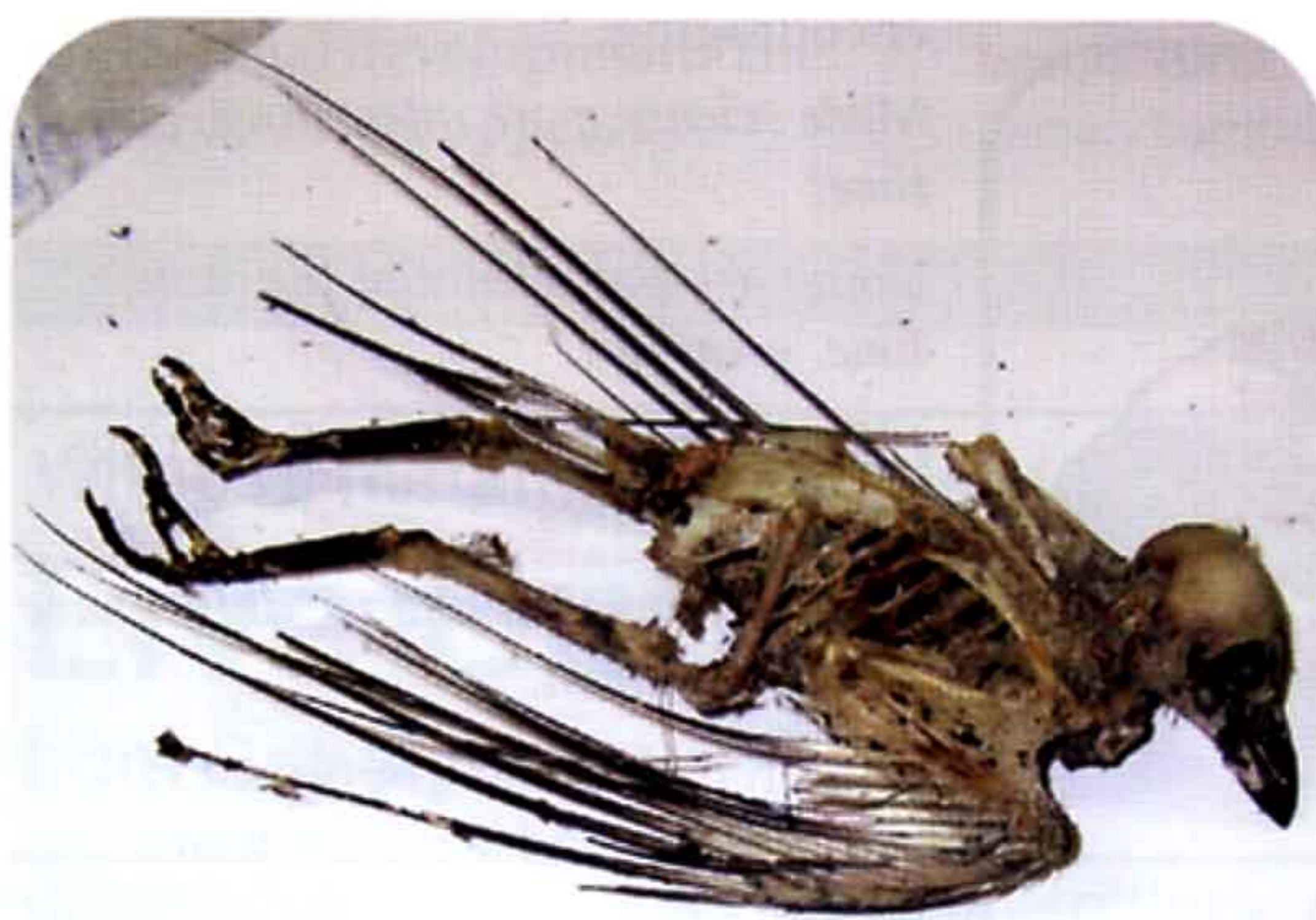
I really used the ideas that the children had given me to help me teach more creatively.

I led the children far less than I would have and the children became far more responsible for their own learning.

At the start of the project some teachers had worries about lesson planning. However, they soon realised that the children's ideas were helpful to the process:

This type of planning allowed children to take routes that motivated them to learn and also kept each lesson motivating.

Teachers became less concerned with organising every aspect of the lessons, thus engaging the children in active learning situations.



Above A dead crow provides first-hand information

Left Painting after careful study of feather patterns

Comments of heads and principals

In the light of the heads/principals' ultimate responsibility for teaching and learning in their schools, it was encouraging to find they were very positive in their comments. Many were keen to

extend the approach to other classes and topics. They raised the point that introducing this method of teaching would require a significant effort in staff development, but that this would be well worthwhile.

Feedback from parents

Parents were asked if they would be supportive of this approach being implemented in their children's education. We expected a significant proportion of parents to oppose this in favour of more structured lessons. We were therefore surprised to find that only five responses out of a total of 214 argued for a more structured style of teaching. This may be a reflection of the fact that almost all families found that the motivation displayed by children had impacted on family life, with children eager to extend their school work into their time at home.

What the children thought

Possibly the most important information came from the children's opinions. They were full of praise for the Leonardo Effect. Comments such as these were very encouraging:

Made science more interesting – big time!

Doing art and science at the same time, great fun.

I like the fact that we can find things out for ourselves.

We remembered it and we didn't have to write it down.

The final quote is important. Initially we had worried that factual knowledge might suffer as a result of the more independent learning style. However, no teacher found this to be the case and several thought the level of factual knowledge attained was improved. When asked if the Leonardo Effect could be used to learn about topics other than flight, children were able to come up with 48 different ideas.

Other outcomes

There were also several unanticipated positive spin-offs from the Leonardo Effect. The most significant was that teachers reported that the project had a marked effect on literacy, especially amongst children who were regarded as weak in that area:

Literacy went through the roof.

Many examples were cited in which disaffected children had developed strong interest in their

Right Children work together on the skeleton of their model



Below The flying creatures and inventions take many different and imaginative forms



schoolwork and behavioural problems had been reduced.

The freedom offered by the Leonardo Effect must remind many teachers of the days before the National Curriculum, and in that sense it is not radical.

However, the strength of the approach is that it depends on the teacher identifying commonalities between subjects and not simply running lessons in parallel on a common theme. The involvement of the children in directing their own learning requires teachers to learn new skills. Teachers found this well worth the effort and several reported that it was a liberating experience.

We are indebted to the teachers who put so much effort and enthusiasm into this pilot. We were delighted that they found it to be beneficial to both their children's learning and their own professional development. The Leonardo Effect appears to

provide a tangible way for teachers to deliver current developments in curricula, and several have used their experience in staff development inside and outside school.

References

- Murphy, C. and Beggs, J. (2003) Children's perceptions of school science. *School Science Review*, **84**(308), 109–116.
- Robson, D. Hickey, I. and Flanagan, M. (2005) Flights of imagination: synchronised integration of art and science in the primary school curriculum. *BERA 2005 Conference Proceedings*. <http://www.stmarys-belfast.ac.uk/downloads/research/flightsoi.pdf>

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