

Children's perceptions of school science

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A study of 8–11 year-old children indicates a progressive decline in their enjoyment of school science

The purpose of this study was to investigate whether the well-documented erosion in children's interest in school science at secondary level has already started in the final years of primary school. We analysed approximately one thousand questionnaires in which children recorded the science topics they liked, their attitudes to science and their favourite subject. In addition, we gathered evidence from oral discussions about science between children and their class teachers.

This article summarises our findings and their implications for the teaching of school science at primary level.

Background

There has been concern over the low level of uptake of science by post-16 students for nearly half a century. Several researchers have indicated that part of the reason for this is that children are 'turned off' science at school when they are quite young. Most agree that the erosion of children's interest in school science occurs between the ages of 9 and 14 (e.g. Hadden and Johnstone, 1983; Schibeci, 1984), even though

ABSTRACT

A survey of over a thousand 8–11 year-old children in primary schools indicated that children in the more senior classes showed a marked decline in their enjoyment of school science. Older children found certain science topics – such as parts of the flower and evaporation – difficult, chiefly because of the complex terminology involved. There were clear differences between boys and girls: girls generally held more positive attitudes towards school science. The authors consider these results in relation to the content and teaching of primary science.

they retain positive attitudes towards science generally and acknowledge its importance in everyday life. The problem of declining interest in school science is international (but not universal) and many reasons have been put forward to explain it, including the transition between primary and post-primary schooling, the content-driven nature of the science curriculum, the perceived difficulty of school science and ineffective science teaching, as well as home-related and social factors.

Research during the last decade has focused on the role of the primary teacher in science. Many findings (e.g. Harlen, Holroyd and Byrne, 1995) have cited problems linked to primary teachers' lack of confidence in teaching science and their insufficient scientific knowledge background. Other studies have criticised the level of the content of some areas of primary science. Murphy *et al.* (2001) showed that even tertiary-level students, including those who experienced compulsory school science from the ages of 11 to 16 and some with post-16 science qualifications, could not correctly answer questions in some primary science topics in tests that had been written for 11-year-olds. These problems, when taken together with the emphasis of national tests on content knowledge, may have contributed to science frequently being taught as facts or as a 'body of knowledge' in the final two years of primary school. Ponchaud (presentation at ASE 2001 Annual Meeting, Guildford) indicated that further pressures on primary teachers in England and Wales that militate against their delivery of good science teaching may include the recent government initiatives in literacy and numeracy that have resulted in the timetabling of science as short afternoon sessions in many schools.

In Northern Ireland, children who wish to attend grammar schools take the Transfer Procedure Test in their final year of schooling. The test is a combination

of elements of science, mathematics and English. The science element requires knowledge of content with very little attention given to the assessment of scientific skills. In preparation for this test, many children in their final years of primary school carry out repetitive practice tests and are being trained to recall scientific facts and information.

In the light of this background, the specific questions being addressed in this study were:

- How positive are primary children's attitudes towards science?
- Which science topics do children prefer?
- When given the opportunity to discuss science informally, what are primary children's views about science?

We were specifically investigating whether children's perceptions changed as they got older, and if there were clear differences between girls and boys.

Methods

Approximately 1000 8–11 year-old primary school children from 44 schools across Northern Ireland took part in this study. The sample comprised 50.1% female and 49.8% male children, which closely corresponds to the percentages in the whole population (49.3% female and 50.7% male). In November 2000, the children completed a questionnaire with the help of teachers who read out the questions to them. To supplement the data from the questionnaires, class teachers recorded the verbal responses of a further 32 children to a series of questions regarding their feelings about science. These teacher–pupil discussions were carried out informally during science lessons in February 2001.

The questionnaire

The attitude items were largely adapted from a survey of attitudes towards ICT, which had been completed by primary school children. A pilot version with 119 10/11 year-olds in schools not included in the main survey was carried out. Exploratory factor analysis (using principal components analysis with Varimax rotation) of the attitude items from the pilot survey confirmed three factors that accounted for 35% of the total variance. These factors were named as:

- enjoyment of science;
- appreciation of the importance of science;
- perceived ability to do science.

The topic list and free-response areas of the questionnaire were designed by a teacher-researcher (Donnelly, 2001).

The children were asked to indicate their responses to the attitude items on a simple 3-point scale ('yes', 'not sure' or 'no') and to each science topic by ticking 'like' or 'don't like'. Children (at the discretion of the class teacher) then completed the free-response area, in which they wrote about what they expected their science lessons to be like in post-primary school.

Teacher–pupil discussions

The sample of children selected for the discussions was based on gender, age and ability. A maximum of two children was selected from each class (12 schools were represented) in an attempt to provide views from pupils taught by a variety of different teachers in a range of schools. Discussions were carried out informally between the children and class teacher during practical classes. Responses from the 32 children were collated and compared with the data from the questionnaires.

Results

The questionnaire

The sample comprised over one thousand children, with approximately equal numbers of girls and boys. Of these, 57% were in the younger age group (8/9 years old) and 43% were in the older age group (10/11 years old). More children in the younger age group (57%) than in the older group (39%) responded that they received help with their homework. Similarly, more younger children (41%) than older ones (24%) replied that they often watched science/nature programmes on television.

Science topics – is popularity related to age or gender?

In the questionnaire, children were asked to indicate whether they liked or disliked each of 16 different topics commonly encountered in the primary school. These topics were:

ourselves	animals
health education	plants
life cycles	solids, liquids and gases
materials	rusting
water cycle	environment
recycling	forces and friction
electricity	energy
sound	light

All topics were liked more by younger children (8/9 years) than by older ones (10/11 years). For 12 of the topics the difference was statistically significant (at $p < 0.05\%$ or lower). The charts in Figure 1 show the differences between the age groups and between girls and boys for six topics. All of these indicate a significant decline in the numbers of older children responding that they liked the topic. Of the topics that yielded significant differences between genders, girls preferred *healthy living*, *plants*, *materials* and *ourselves*, whereas boys favoured *forces and friction* and *electricity*.

Age and gender differences in attitudes to science
Responses to attitude items in the questionnaire indicated that 8/9 year-olds were more enthusiastic about school science than 10/11 year-olds, even though the older children were more confident; for example, see Figures 2 and 3.

Girls seemed to enjoy science more than the boys did and were more appreciative of the impact of school science on their lives outside school (Figure 4).

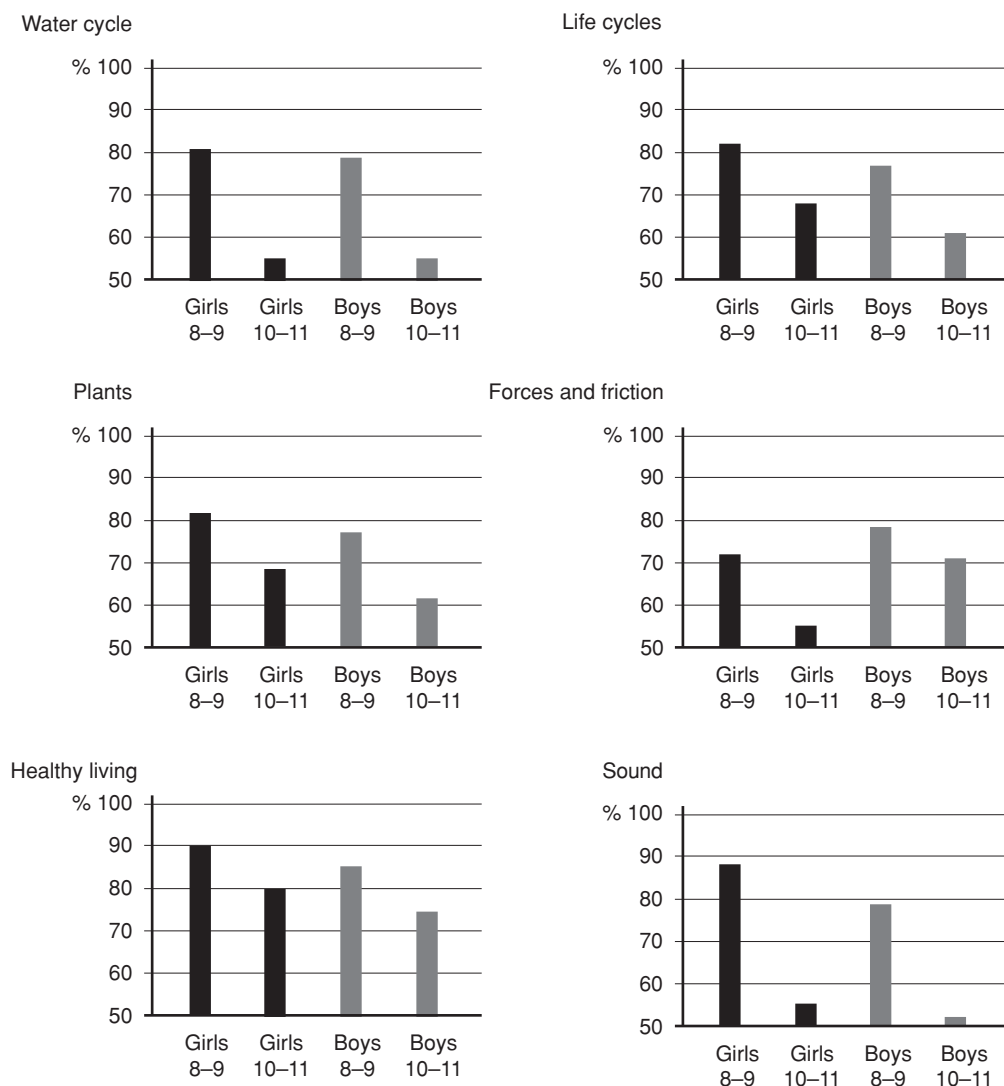


Figure 1 Percentages of children who liked various science topics.

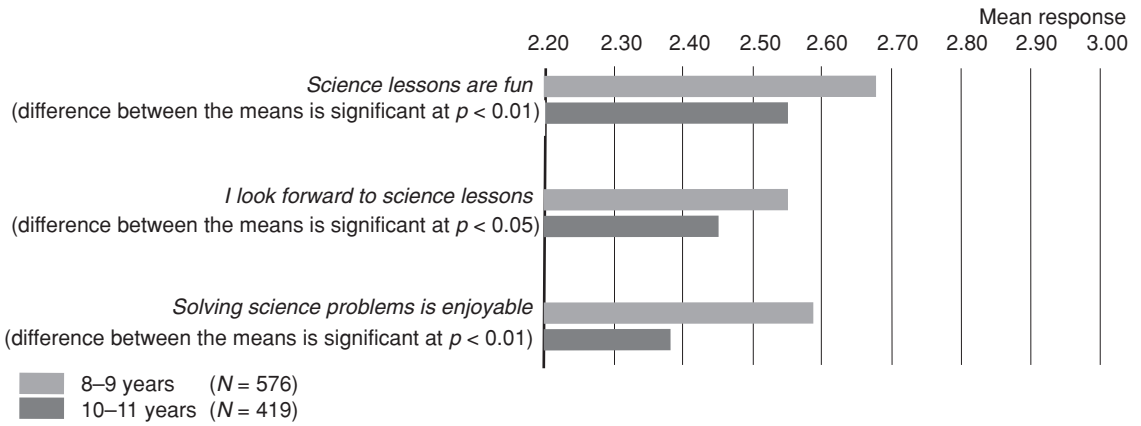


Figure 2 Children's enjoyment of school science.

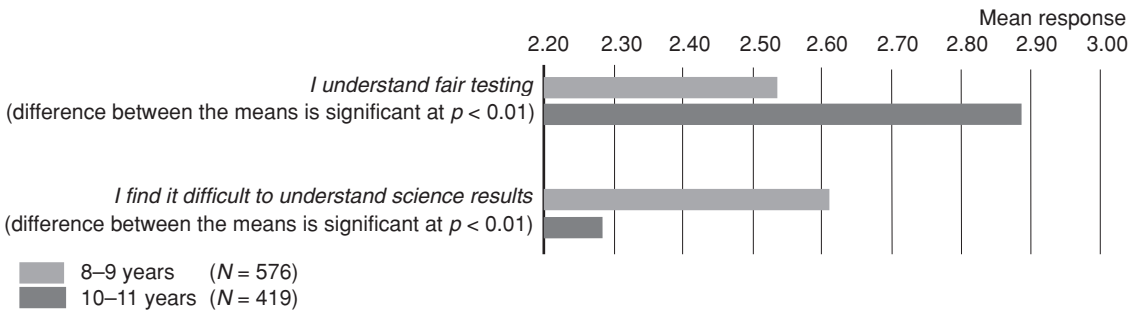


Figure 3 Children's confidence in their ability to 'do' science.

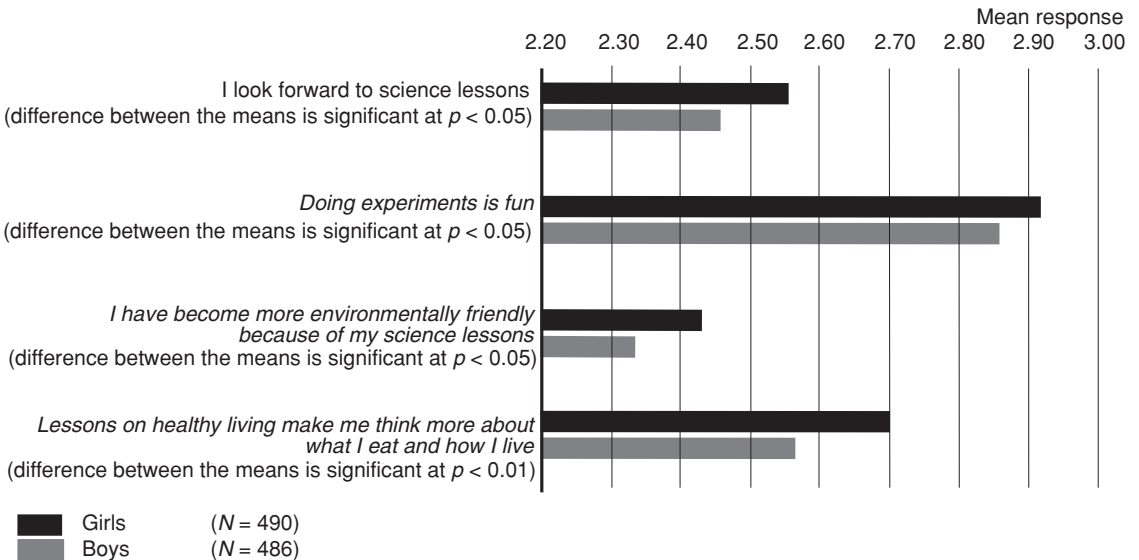


Figure 4 Differences between boys and girls.

Pupil–teacher discussion

The discussions between 32 children and their teachers revealed specifically which parts of science children enjoyed (or did not enjoy), why they felt science was important and what they felt was most difficult about science. A summary of some of the questions and responses follows.

What do you like best about science?

There was a resounding '*experiments!*' from almost all children, regardless of age, gender or ability. Responses included the following (b = boy; g = girl; 8, 9, 10 or 11 = age; h = higher ability, l = lower ability):

I like doing experiments because it's fun and you find out things. It encourages your mind. (b,8,h)

I like doing experiments because you are having fun and learning at the same time. (g,9,l)

The experiments, because you get to do the things yourself. This helps me remember new things. Experiments are fun, you can talk and discuss what you are doing. In technology you get to build and take something home that works. (b,11,h)

I like practical science because it's a better way to understand things rather than just writing them down. (g,11,h)

Is there any part of science you do not like?

The younger group were, again, much more positive in their response, 15 out of the 16 children saying that they liked *all* science. Only 6 of the 16 children in the older group liked all aspects. Typical responses included:

I don't like writing pages after we've finished testing something. (b,11,l)

I did not like 'transfer science' [revision for the selection test – described in the introduction to this article] because we kept covering the same topics over and over again – this was repetitive and boring. (g,11,h)

I didn't like the flower because it has so many parts and their names are very hard to spell. (b,11,l)

What is the hardest thing you have done in science?

Some of the younger children mentioned that '*writing up*' was the hardest thing they did in science. Others were mostly concerned with content detail, for

example, the '*parts of the tongue which tasted sweet, sour, salty or bitter*' (b,8,h), and '*labelling parts of the body*' (b,8,l). Two children mentioned practical activities such as '*separating and filtering*' (b,8,h) and '*circuits – where to put the wires and crocodile leads*' (g,9,l). The older children were far more specific about what they found the hardest. Five of them talked about the flower, two about forces, two about evaporation and two children mentioned practical activities. Typical responses were:

The flower – remembering parts, like ovule and ovary – I kept getting these terms mixed up. (g,11,h)

Forces – pushing, colliding, hard to understand where the force is acting from. (b,10,h)

Evaporation – I was confused by all the long words, like evaporation, condensation. (g,11,h)

Electricity – too many big words. (b,10,l)

Discussion

The results showed that most of the older children (10/11 years) had significantly less positive attitudes than younger ones (8/9 years) towards science enjoyment, even though the older children were more confident about their ability to do science. The reduced popularity of science topics amongst the older children is clearly illustrated in Figure 1. Furthermore, Figure 2 shows that the younger children were much more positive in their attitudes towards science. It is unlikely that these results are due to general attitudes to school becoming more negative. Morrell and Lederman (1998) reported that many studies have shown very little, if any, relationship between overall attitudes to school and to science. She concluded from her own study carried out in the United States that attitudes to school were more positive than attitudes to science and that the difference became greater as the children got older. What is it about science in the more senior primary years that is putting children off?

Practical work

We obtained a deeper insight into what the children thought about science from the teacher–pupil discussions. When asked what they liked best about science almost all children replied '*doing experiments*'. The reasons given included that doing experiments was fun, that they found out things and that they were learning whilst enjoying themselves.

One 11-year-old boy commented that when doing experiments he could do things for himself, which helped him remember '*new things*'. A girl of the same age stated that practical science was '*a better way to understand things rather than just writing them down*'. Even an 8-year-old suggested that doing experiments '*encourages your mind*'. Children, therefore, are telling us how important practical, experimental science is for their learning!

Is it the lack of experimental work that is turning them off science? Other workers have reported on the importance of experimental work both for motivating children and for enhancing their learning in science. Campbell (2001) and Ponchaud (presentation at ASE 2001 Annual Meeting, Guildford) also found that, when asked about what they liked best in science, primary children most frequently replied '*doing experiments*' and '*finding out new things*'. Bricheno (presentation at ASE 2000 Annual Meeting, Leeds) cited the importance of small-group practical work in promoting positive attitudes to science. Ponchaud was concerned that scientific enquiry has diminished in many primary schools. He pointed out that teachers should capitalise on the flexibility of the primary curriculum to carry out longer-term investigations, which would be more difficult to do in the timetable-constrained post-primary school.

Preparing for tests

Could it be the way children prepare for national tests that is putting them off science? A child in our study described this preparation as '*... covering the same topics over and over again ... repetitive and boring*'? Ponchaud reported that anxiety about performance in national tests sometimes leads to excessive routine test preparation in the final years of primary school. In Northern Ireland, the selective system has led to additional 'coaching' for the transfer test being very common – many parents employ private tutors for this purpose. It is not surprising, therefore, that children in this study found 'transfer science' repetitive and boring. We are currently investigating the possibility that preparation for national tests at 11 years of age could be putting children off science. We have extended the present study to compare our results with those found in schools in the Irish Republic, where there is no testing at age 11 in science, and in England, where children carry out national standard attainment tests (SATs) in science, English and maths.

The curriculum content

Alternatively, could it be the curriculum content itself that is the main cause for the erosion of interest in primary school science? Is learning about relatively obscure flower parts, evaporation or electric circuits dreary? Is some of the primary science curriculum too hard for teachers, never mind children? The Office for Standards in Education (OFSTED, 1995) found that:

Some teachers' understanding of particular areas of science, especially the physical sciences, is not sufficiently well developed and this gives rise to unevenness of standards, particularly in years 5 and 6 [age 10 and 11].

In the upper years of Key Stage 2 [which represents age 7–11 year-old children] shortcomings in teachers' understanding of science are evident in the incorrect use of scientific terminology and an overemphasis on the acquisition of knowledge at the expense of conceptual development.

Harlen (1997) was also concerned about international findings which reported children's difficulties within certain concept areas. She summarised findings from a large number of studies and concluded that children's difficulties are chiefly due to the insufficient explanations given by primary teachers. It is interesting to note that virtually all the published evidence cites difficulties with the physical sciences, whereas in our study 'the flower' was most frequently cited as the most difficult part of science. This could be due to a concentration on 'learning the parts' as opposed to learning about the process. Osborne and Simon (1996) demonstrated that primary children's explanations of 'how we see' were considerably better when a science specialist had taught them. We would advocate that the content of the primary curriculum is changed to enable teachers to give an exciting, comprehensible introduction to science. Primary teachers should work with children in the *observation and description* of phenomena such as evaporation and gravity but save any explanation for post-primary science. In the life sciences, primary children could be introduced to the lives of plants and animals, using challenging examples to stimulate their interest and curiosity, as opposed to naming relatively obscure flower or body parts (for example, *ovule* and *scapula*). We feel that primary children should not be taught aspects of science that are too difficult for their teachers.

Gender differences

Girls were more positive than boys about their enjoyment of science and were more enthusiastic about how their science lessons impacted upon their environmental awareness and how they kept healthy. There were also a few significant differences in the topics liked by girls and boys: generally girls favoured topics in the life sciences and boys preferred some of the physical science topics. These results agree with those from many studies: for example, Johnston *et al.* (1999) found that girls were significantly more positive than boys about doing science in the classroom; Woodward and Woodward (1998) reported that girls showed a higher preference than boys for health education although the reverse was true for electricity; and Boone (1997), who carried out a study in China, concluded that girls were more 'pro-science' in their attitudes than boys. We feel that teachers need to be aware of and cater for gender differences in their science teaching.

Conclusion

This article argues that age is a more significant determinant than gender of primary children's attitudes to science, and that these attitudes become

less positive as the children reach the more senior primary classes. It provides evidence that this erosion in interest could be due to lack of experimental work, repetitive topic revision and practice assessments for national tests, and inappropriate curriculum content that does little to awaken children's interest. All the data are derived from children's written or verbal responses. We feel it is time to listen to what they say and try to improve their primary science experience. A report on school science by the Council for Science and Technology (1999) discussed several studies which showed that young people's interests and attitudes to science declined from the point of entry to secondary school in the UK and suggests that:

Tragically it would appear that school has done nothing for them in terms of stimulating their interest in science.

There is a danger of this becoming the case for primary schools. A parallel study to ours, using the same research instrument in English schools (Atkinson and Griffith, Liverpool Hope University, unpublished), indicates that children's attitudes to science in English schools show a similar decline in the more senior primary classes, and that the attitudes to science of children in English schools are significantly less positive than those in Northern Ireland.

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Call for contributions: **Practical work and research in school science**

SSR 312 (March 2004) will contain items concerning science practical, experimental work and research work in schools and colleges. Most teaching of science post-11 occurs in laboratories. Schools and colleges have a history of conducting scientific research. Curriculum developments have used researchers in schools and simulated scientific research with pupils. The recent stress upon the need for an education *about* science as well as an education *in* science may mean that science education could become a much more literary activity than we have had in the past. The value of practical work in schools has been questioned – and yet practical work, experiments and research are motivating and can replicate what it is like to be a scientist. Hands-on is important.

This issue intends to include articles and science notes that:

- report upon, and analyse, developments in practical and experimental work in school science, e.g. new ideas, new methods, new apparatus, etc.
- describe and discuss the value of pupils doing innovative scientific research in schools or on placement
- describe and discuss the value of science teachers doing scientific research in schools or on placement
- comment upon and examine how scientific research can be used in the teaching and learning of science
- explain and debate the pros and cons of practicals and research in school science.

Contributions from individual teachers, science departments, regional or national projects, research scientists, and manufacturers are welcome.

If you have something to contribute or some suggestions, please contact the Editor for this special issue, Mick Nott
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