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# Enthusiasm, relevance and creativity: could these teaching qualities stop us alienating pupils from science?

Sarah Turner, Gren Ireson and John Twidle

**ABSTRACT** The poor attitude of pupils towards science continues to be a topic of concern within secondary schools. This article considers research and highlights what we can learn as teachers to persevere in tackling the problem. Alongside this review, a case study was undertaken with a sample of year 7 pupils (ages 11–12) in English schools who reported that they enjoy the practical element of science but can be distracted by the complicated facts and explanations. Pupils' suggestions to improve their engagement in science lessons were to include more experiments as well as fun tasks and a variety of activities. We consider whether an approach including more of these factors in science delivery could reduce alienation of pupils from the science curriculum and hence attract more pupils to continue their education in science-related courses.

Even with science teachers demonstrating exciting reactions and delivering the 'wow' factor, it is not unusual to hear negative comments from UK pupils about their school science lessons. As pupils progress through their schooling there is a documented decline in positive attitudes towards science (Simpson and Oliver, 1985; Barmby, Kind and Jones, 2008). This is a cause for concern for teachers, as disaffected pupils can disrupt lessons through poor behaviour and distract other pupils. The consequences also pose a future problem for industry: if fewer pupils take science-related subjects post-16 and consequently at degree level, the number of people available to take up science-based industrial employment is reduced. Specifically, research has shown that, although pupils' attitudes towards school science become less positive, their attitudes towards 'real' science and the usefulness of science remain stable (Osborne, Simon and Collins, 2003). Other research reported by Barmby *et al.* (2008) concurs with this finding and, in addition, suggests that girls' attitudes become more negative than those of boys from year 7 (ages 11–12) onwards. What is going wrong with science education at school? Why are pupils feeling alienated from the science curriculum and how could this be turned around? We consider data from a case study with

year 7 pupils in English schools alongside recent research and suggest what teachers might do to address the issue.

## Linking with relevant literature

When pupils were asked what they like to do most in school science lessons, they responded that they liked '*doing experiments*' because practical work was fun and they liked finding things out for themselves (Murphy and Beggs, 2003: 113). With the image of science being that of a 'hands-on' subject, it is no surprise that pupils enjoy this aspect of it. This view is supported by Delargey (2001: 83) when he writes that practical work is an activity that enables pupils '*to solve problems or to discover information for themselves*' and that this independence will allow pupils to be like 'real' scientists.

Consideration of pupils' attitudes towards science is not a new topic amongst researchers or teachers (Hadden and Johnstone, 1983; Simpson and Oliver, 1985). However, Jenkins and Nelson (2005) reported that, although pupils aged 14–15 years find school science interesting, relevant and important, by this age they have made their choices as to whether to follow a career in science. The apt title of their paper sums up this pupil view that science is '*important but not for me*'.

Reflecting these attitudes, examination results data for the UK (June 2008) show that less than 16% of pupils are studying GCE Advanced levels (A-level) in biology, chemistry or physics (Joint Council for Qualifications, 2008). Over the decade 1995–2005 there has been a decrease in the number of pupils choosing to study science A-level subjects. However, there have been encouraging increases in the numbers of pupils choosing to study physics and chemistry since 2008 (Joint Council for Qualifications, 2009). Conversely, biology has experienced a slight decrease in the number of pupils studying it when comparing 2009 with 2008. Despite the increases in 2009, the overall proportion of pupils studying A-level biology, chemistry or physics remains less than 16% of the total number of A-level awards (Table 1).

Inspiring and exciting pupils may help to address the low take-up of A-level sciences and the decline in positive attitudes towards science. This requires teachers who:

- are enthusiastic towards science;
- are able to explain science clearly in the context of pupils’ everyday lives;
- run well-ordered and stimulating science lessons. (Woolnough, 1995: 54)

These attributes should certainly contribute to ‘good practice’ in the classroom. In addition to these teacher characteristics, Owen *et al.* (2008) have identified classroom activities that are unpopular (writing, passive listening) and popular (making things, practicals, puzzles and games). Group work and role-play became less popular with age.

Since pupils are recognising the importance of science then it could be argued that the National Curriculum is delivering what it intended for English schools. It is then the responsibility of the

teacher to devise positive experiences in school science lessons (Woolnough, 1994; Osborne *et al.*, 2003). Engaging pupils is of primary concern to teachers; without this engagement pupils can disrupt others. A potential difficulty for teachers could be their understanding of the changes implemented in the National Curriculum in recent years: the revised National Curriculum in 2000, new General Certificate in Secondary Education and new key stage 4 curriculum in 2006, and the new key stage 3 curriculum in 2008 (QCDA, 2009). Coping with these continuing changes, coupled with confusion about expectations and subject content, could have a negative impact on their classroom teaching.

For teachers, working with an interested and positive group of pupils may lead to increased job satisfaction. For society, the need is for education to supply a potential workforce with the appropriate scientific, mathematical and technological skills. This equips these pupils to be responsible and informed citizens and ties in with the teaching of citizenship education (Brandom, 2007). The Parliamentary Office of Science and Technology (POST) had concerns about pupils’ attitude to science over 14 years ago, writing that:

*Today’s adolescents must provide tomorrow’s scientists, and thus the attitudes and education choices of adolescents are important.* (POST, 1995: 2).

The lack of progress since then is borne out in a further report in 2002:

*It is clear that the major problems lie at key stage 4.* (House of Commons: Science and Technology Committee, 2002: 15).

The new choices at key stage 4 (ages 14–16) and a less prescriptive National Curriculum from 2006, the greater emphasis on teaching creatively, along with a thematic approach and greater inclusion of ICT, could have an impact in future years and address some of the problems. However, some will, no doubt, argue that this further ‘dilutes’ the science curriculum, focuses on scientific literacy and fails to prepare learners for post-16 study.

There appear to be some key areas for teachers to consider and some practical suggestions for use in teaching that may help to avoid pupils feeling alienated from the science

**Table 1** Percentage change in pupils taking science A-levels from 1995 to 2009 as a proportion of the whole A-level cohort (AQA, 2006; Joint Council for Qualifications, 2009)

	% of all A-level entries		
	1995	2005	2009
Biology	7.16	6.88	6.55
Chemistry	5.79	4.96	5.02
Physics	4.76	3.59	3.48

curriculum. This evidence led us to the decision to conduct our own study.

Case study outline

Pupils’ experiences and attitudes towards secondary school were investigated with the aim of improving the transition process from primary (year 6, age 10–11) to secondary school. Pupils completed a questionnaire entitled ‘Attitudes towards secondary school’ at the end of their first term at the secondary school and then again at the end of their first year. The first questionnaire comprised six questions:

- Rank your five favourite school subjects.
- Why do you like these subjects?
- Rank your five least favourite subjects.
- Why do you dislike these subjects?
- What have been your memorable moments during the term?
- What have been your worst moments during the term?

The second questionnaire comprised ten questions relating to which school subjects they liked/disliked and why, their most memorable/worst moments in the year, what they were looking forward to in the following year (year 8), what advice they would give to year 6 pupils, and any other comments on what would have improved their first year at secondary school.

The first questionnaire was completed by 110 pupils and the second by 103. A self-selected group interview (eight volunteers, two from each year 7 class) was carried out at the end of the school year to explore responses to the questionnaire. This interview used pupils’ comments to identify ways of improving the transition procedure. However, some caution is needed in interpreting the findings as some pupils’

personal views may not have been representative of the larger sample.

Results

The data collected from the questionnaires indicated that, at the end of the first term, pupils liked the more ‘creative’ subjects such as physical education, English, art and drama. Chemistry was also highlighted as a subject pupils enjoyed, which was encouraging for the sciences. During the group interview the ‘creative’ nature of these subjects was identified as lessons involving ‘making things’ and ‘doing things’. Chemistry was enjoyed because of the large number of practical activities involved, especially using a Bunsen burner, and doing different, fun activities. Religious studies, Spanish, mathematics, geography and design and technology were the five subjects most disliked. Reasons for this revealed in the interview were the levels of difficulty and a lack of variation in the teaching approaches used. At the end of the school year, biology had replaced chemistry in the top five favourite subjects. However, physics and chemistry were placed in the five least favourite subjects, along with religious studies, Spanish and mathematics. This indicated that the more science (excluding biology) was studied, the less it was liked by the pupils. Reasons revealed in the interview were often peer-related (friends in the same class or friends interested in the subject), due to the increased level of difficulty, achieving success in the subject, or that they liked other subjects better. Pupils’ responses as to why they like or dislike certain subjects provide some useful information for planning lessons and what pupils enjoy (see Tables 2, 3 and 4).

Four categories were devised relating to the pupils’ responses on why they liked science (the

Table 2 Reasons given by pupils as to why they like/dislike biology

Reasons for liking biology	Reasons for disliking biology
Good experiments	Difficult
Like it	Boring
Like animals	Not challenging enough
Interesting	Do not like the topics
Mum’s a GP	Do not like the teacher
Fun	Write a lot
Good at it	Teacher talks too much
Easy	Do not enjoy it

**Table 3** Reasons given by pupils as to why they like/dislike chemistry

Reasons for liking chemistry	Reasons for disliking chemistry
Practicals	Write too much/too many sheets
Fun	Too many words to learn
Different	Not very good at it/hard
Interesting	Complicated experiments
Like the teacher	Room smells
Good at it	Hard homework

**Table 4** Reasons given by pupils as to why they like/dislike physics

Reasons for liking physics	Reasons for disliking physics
Fun	Write too much/hardly do any practicals
Easy	Difficult
Like the teacher	Do not enjoy it/boring
Like to find things out	Do not understand it
Interesting	Hard to remember everything
Like the style of lesson	Maths is a bit hard
Different activities	I am not scientific

percentages indicate pupils giving this as their principal reason):

- practical work (48%);
- liking the teacher (11%);
- being good at the subject (35%);
- future career aspirations (e.g. wanting to be a vet or a doctor) (6%).

Four categories were also devised relating to pupils' responses on why they did not like science:

- no practical work (10%);
- not liking the teacher (18%);
- finding it boring (40%);
- finding it difficult (32%).

The results regarding which activities pupils enjoy concur with other research (Owen *et al.*, 2008), which reveals that pupils like experiments and doing 'different' things in their lessons. Pupils do not enjoy subjects if they are not good at them, if topics seem difficult, if they do not like the teacher or if they have to write too much. Specific questionnaire comments relating to science indicate why some pupils particularly enjoy science, along with reasons why some pupils do not:

*I like chemistry a bit because you do extremely fun experiments and you learn something new every lesson. I don't like physics because my teacher makes everything so boring!*

*I don't like physics or biology as I find them boring. There are so many facts to learn. We do lots of boring experiments in biology and I don't learn anything.*

*I don't like chemistry. We do many practicals but I still find it boring.*

*I don't like biology, chemistry or physics because you just do things out of a textbook. Boring!*

When pupils were asked about their most and least favourite subjects, they revealed enthusiasm relating to the practical elements of science subjects:

[Chemistry] *I like to do practicals.*

[Biology] *I like to dissect things and learn about animals.*

[Physics] *I like knowing how things actually work.*

However, equally negative responses acknowledged the lack of practical aspects and the perception that the subject was boring and not fun:

*Biology is a bit boring.*

*Chemistry does not have enough fun things.*

*Physics does not have enough practical experiments.*

At the end of the school year, the questionnaire results highlighted the decline in

pupils' enjoyment of science relative to other subjects. In addition, some responses to the question 'Is there anything that you feel could have improved this year', related to science:

*Would like to have learnt how to make rockets in science.*

*Would like lessons to be made more fun.*

These are interesting comments as the question was not specific to science and many pupils reflected on the whole year in terms of their friends, activities, awards, sports competitions and some of their lessons.

Some areas of science learning were also raised in the group interview at the end of the year. Pupils commented on lessons keeping them more active than in primary school, more variety in the school day, teachers being nicer than expected, three separate sciences being new subjects, and varied lessons. Sciences were generally liked (although physics was not liked by some because they found it difficult and they did not like the teacher). Reasons why some pupils liked certain teachers were:

- they make learning easy and fun;
- the teachers are active in their lessons;
- the atmosphere created is pleasant.

Some reasons why some pupils did not like some teachers were:

- they are hard to talk to;
- they are unfair;
- they should listen more before they act;
- they are mean and strict.

Overall, the pupils were enthusiastic about secondary school and about their subjects. Negative comments were related to long school days, the amount of homework, punishments, sports and getting lost around the school.

The interview also revealed pupils generally not engaging as much in science as in some other subjects. Reasons given referred to the level of difficulty, that they were bored and the teacher input. The level of difficulty, for some, related to the maths involved and also to the new or technical words that had to be learnt. Pupils enjoyed other subjects because they could express their own opinions freely, they experienced more active lessons, and were involved in a wider variety of methods, including moving about the classroom.

The use of computers in lessons was also favoured. These are all activities that could take place in a science lesson; for example, expressing opinions on global warming, making model atoms or creating a news report on computers.

We believe many teachers will recognise these attitudes in pupils in this age group, and we hope they will provide useful suggestions and challenges to engage pupils in their lessons.

## Conclusions and discussion

The case study showed that many pupils enjoy performing experiments in science lessons. Of those pupils who ranked a science as one of their favourite subjects at the end of the year, nearly half of them linked this to enjoying the practical aspect of the subject. Not surprisingly, pupils enjoy subjects if they are good at them. A smaller number of pupils enjoyed science because they liked the teacher or because it was linked to a career aspiration. Of the pupils who ranked a science as one of their least favourite subjects, 40% of these said this was because science was 'boring'. The other common reason given was that science was difficult. These conclusions, along with comments made in the group interview and written explanations of why pupils like/dislike certain subjects, can inform future science teaching so that we do not alienate pupils and turn them away from science.

Classrooms involve complicated interactions between pupils and teachers. With continually changing circumstances and multivariable situations arising from pupils' reactions, the complexity of pupils' needs makes teaching challenging. Changing examination specifications and curricula add to these challenges, creating anxiety and burdening teachers with the need to 'get it right'. However, addressing some aspects of science teaching by making it more enjoyable through being creative, performing different experiments and explaining concepts clearly are useful points for science teachers to consider. With the abolition of the year 9 National Curriculum assessments (commonly referred to as SATs) in 2008, there may now be more time for teachers to plan and teach creatively without the constraints and pressures of examinations. As stated in the *All our futures* report: teaching creatively involves 'teachers using imaginative approaches to make learning more interesting, exciting and effective' (NACCCE, 1999: 6).



The characteristics of creativity, which pupils evidently enjoy, are:

*First, they always involve thinking or behaving imaginatively. Second, overall this imaginative activity is purposeful: that is, it is directed to achieving an objective. Third, these processes must generate something original. Fourth, the outcome must be of value in relation to the objective.* (NACCCE, 1999: 29)

Developing these suggestions can be time-consuming for teachers and, for some, may be difficult to implement. For some teachers, this approach may be new and they would benefit from training. Practical support and ideas for such styles of teaching may be required, but if fewer pupils are turned away from science, the effort will be worth it. Pupils believe there is a need to learn about science to understand the world in which they live so we, as classroom practitioners, need to aim to achieve the ‘buzz’ of excitement in the science classroom.

One of the challenges for us in promoting positive attitudes could involve the teacher–pupil relationship within the classroom. Curriculum constraints, pressure to achieve targets with examination results and time to develop such relationships in an already busy day all add to the difficulties. A study by Myers and Fouts (1992) suggests the following could help to promote positive attitudes towards science lessons amongst pupils:

- having pupils highly involved in lessons;
- offering pupils a high level of personal support in the classroom;
- displaying good relationships with pupils;
- demonstrating a variety of teaching strategies and unusual learning strategies.

Key findings showing why pupils do not enjoy school science (Barmby *et al.*, 2008) can be drawn upon and used to generate approaches that can be trialled to see whether these aims are effective:

- school science being a practical subject;
- science being clearly explained to pupils at their level;
- science being taught as being relevant to their everyday lives.

The ability of teachers to be creative in a subject that is not generally seen as creative is the challenge. Creativity (in the authors’ experience) could be delivered by incorporating music into lessons, or poetry, role-play, debate, stories, ‘magic’ toys or different and novel experiments, so that pupils who genuinely like the more defined ‘arts’ subjects are experiencing these activities in science. The question remains will this make a difference? We can but try, with the hope that these suggestions develop a more positive prospect for science in society and reduce alienation of pupils from science.

The usefulness of this case study is that it provides an example of real pupils in real situations (Cohen, Manion and Morrison, 2007); as such, readers may relate to the generalisations found and learn from them to inform their own practice. Whether through creative teaching, relevant practical work, improved teacher–pupil relationships or simpler scientific teaching, our hope is that fewer pupils will be alienated from school science and more will be enthralled by the excitement, wonder and realisation that science is fundamental to their understanding of the world around them.

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