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Why aren't secondary students interested in physics?

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Abstract

This article describes a questionnaire study to determine why fewer Year 10 school students are interested in physics than in biology. The major general reasons for finding physics uninteresting are that it is seen as difficult and irrelevant. Certain areas within the physics curriculum are considered to be boring by some students, interesting by others. Other physics topics, however, are reported only in terms of being interesting; 'the universe' is an example. Males and females offer different reasons for finding physics boring, with males enjoying practical exercises and females valuing where physics can be seen as relevant.

Introduction

Readers of *Physics Education* will need no reminder that too few students elect to study physics at A-level and, subsequently, as undergraduates. This has led to a continuing shortage of physics graduates and, in turn, of such graduates becoming teachers. As a consequence, secondary school physics is often taught by teachers whose primary qualification may be in a science other than physics and who, despite their best efforts, may not teach the subject with the same enthusiasm or 'feel' as a physics graduate, and thus the problem may be perpetuated.

Educational research has explored the attitudes of school students to science—their views about the science curriculum, their opinions of how science is taught, their ideas about the scientific process, their perceptions of scientists. However, such research has often not distinguished between the different subjects within science [1], although the evidence of A-level entries and university applications demonstrates that students themselves do draw such a distinction. For example, in 2002 some 31 500 students sat A-level physics compared with the 52 100 who sat biology [2]. At present, teachers have a general impression that over the period of secondary schooling students may lose, or certainly fail to gain, an enthusiasm for physics. There are many reasons for this and some, for example the predilections and home backgrounds of individual students, and the status and remuneration of careers for physicists, are beyond the control of teachers. Other reasons, however, are under the influence of the educational system, if not individual teachers [3].

Although teachers may have intuitive ideas about when and why this happens, there is little systematic evidence. Recently, we have started to track the opinions of students over this period about physics and, as a scientific comparator, biology [4]. We have shown that students enter secondary schooling with an equal liking for biology and physics, perhaps not even distinguishing between them and thinking more in terms of 'science'. However, over the period

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of secondary schooling, whereas their liking for biology remains reasonably stable, their liking for physics declines. This is accompanied by changes in their more specific ideas about physics. For example, they decreasingly see physics as able to contribute to solutions to environmental or medical problems, and increasingly see physics as requiring mathematical ability. However, the biggest difference between students' responses to parallel questionnaire items about physics and biology is that they perceive biology as interesting, physics as boring. Furthermore, the responses to questionnaire items about whether physics is seen as interesting or boring correlate with those to the item exploring their general like or dislike of physics. Thus, it seems that a major reason that underpins students' increasingly negative feelings towards physics is their perception of it as boring. This is significant in that there is evidence that students who find a subject interesting tend to choose it for further study [5].

Students use words such as 'interesting' and 'boring' in a fairly loose manner, so it is not entirely clear what students may mean by viewing physics as 'boring'. The aim of the present study, therefore, was to explore why many school students think of physics in this way—what is driving the generation of this negative view of physics?

Methods

Students' ideas were gathered using a short questionnaire that contained parallel sections about physics and biology. Each section had two items. The first, a closed-form item, asked students whether they found physics (or, in the parallel section, biology) 'very interesting', 'interesting', 'neither interesting nor boring', 'boring' or 'very boring'. This was followed by an open-form item in which students were invited to 'tell us why you think this'. The questionnaire wording encouraged students to write 'as many reasons as you can'. In order to compensate for any possible 'carry-over' effect from the first section to the second, two versions of the questionnaire were produced, one with the questions about biology first, the other with the questions about physics first. The two versions were issued alternately to students. During the completion of the questionnaire, examination conditions prevailed, although no time limit was imposed. The questionnaire was piloted in one school and the responses indicated that the wording was appropriate to the age-group concerned.

The completed questionnaires were scrutinized and four lists of ideas raised by students in response to the open-form items were constructed. One list of views was prepared for those students who had responded to the closed item about physics that they found it 'very interesting' or 'interesting'. A separate list was constructed for those students who reported that they found physics 'boring' or 'very boring'. Two corresponding lists were produced for the biology section of the questionnaire. When the lists were completed, the ideas were arranged in categories and, following this, any ideas that were very similar were pooled. Each pooled idea was then given a code, and an Excel spreadsheet was constructed in which each idea code had a column. The questionnaires were then re-examined and the ideas raised by each student were encoded onto the Excel spreadsheet. The data were then imported into an SPSS data file for analysis. In some cases, ideas were pooled into more general categories.

Results

The final questionnaire was completed by 317 students in English National Curriculum Year 10 from six community comprehensive schools. The male/female ratio was 44/56.

Proportions of Year 10 school students finding biology and physics interesting or boring

The results are shown in tables 1 to 6. The responses to the closed-form items showed that about half of the students found biology very interesting or interesting, and about a quarter found it boring or very boring (table 1). In contrast, only about a quarter of the students thought that physics was very interesting or interesting and about half thought it boring or very boring. There was no significant difference in the responses of the males and females to the closed-form item about biology, whereas statistically significantly fewer females than males thought that physics was interesting. Thus, the results to this section of the questionnaire support the contention that students find physics less interesting than a comparator science subject, biology, and that fewer girls than boys find physics interesting.

Table 1. Proportions of Year 10 school students finding biology and physics interesting or boring.

	Biology			Physics		
	All (%)	Males (%)	Females (%)	All (%)	Males (%)	Females (%)
Very interesting	10	7	12	6	8	4
Interesting	47	45	48	20	28	13
Neither interesting nor boring	22	21	23	26	26	25
Boring	15	18	12	25	20	29
Very boring	6	8	5	24	18	20

Percentages may not total exactly 100 due to rounding. Distributions of responses to questionnaire item about biology between genders were not significantly different. Distributions of responses to questionnaire item about physics between genders were significantly different ($p < 0.001$, χ^2 test). $n = 317$, 44% male, 56% female.

Table 2. Predominant reasons for Year 10 school students finding biology or physics boring.

Category of reason	Biology (%)	Physics (%)
Difficult/hard subject	29	48
Subject too easy	3	11
Do not enjoy subject	12	30
Content of subject	6	20
Too little practical work	14	7
Subject repetitive/predictable	18	6
Subject irrelevant	0	14

Percentages may total more than 100 because individual students offered more than one reason. Data are given as a percentage of those thinking that biology (or physics) was very boring or boring in responses to the closed questionnaire items. $n = 317$.

Table 3. Predominant reasons for Year 10 school students finding biology or physics interesting.

Category of reason	Biology (%)	Physics (%)
Easy subject	18	14
Enjoy subject	32	10
Subject offers a challenge	1	9
Content of subject	59	40
Practical exercises	28	46
Relevance of subject	8	19
Variety of subject	5	12

Percentages may total more than 100 because individual students offered more than one reason. Data are given as a percentage of those thinking that biology (or physics) was very interesting or interesting in responses to the closed questionnaire items. $n = 317$.

Predominant reasons for Year 10 school students finding biology or physics boring

Those students who found biology or physics boring gave a number of reasons, many of which appeared similar for the two subjects (table 2). In both cases, some students wrote simply that they did not enjoy the subject. However, the predominant reason for finding biology boring was that it was seen as a difficult subject although, in contrast, a few students thought the reverse, that it was boring because it was too easy. Another frequent reason for finding biology boring was when it was envisaged as repetitive or predictable. The dearth of practical work was also raised as a reason for finding biology boring. The major reason for finding physics boring, given by almost half of the students who thought this, was that it was considered difficult, although, as with biology, a few students thought that physics was boring because it was too easy. Another frequent reason was that the subject was 'not relevant', either to everyday life or to other subjects. Interestingly, about a fifth of the students who found physics boring named specific topics or areas of the curriculum to support their view.

Predominant reasons for Year 10 school students finding biology or physics interesting

Many of these views were supported in a complementary manner by those students who reported finding biology or physics interesting (table 3). Some students wrote that they found the subjects interesting because they enjoyed them. For both biology and physics, some students stated that they found the subjects interesting because they were easy, although a few students—a higher proportion in the case of physics—found the challenge of the subject interesting. Some students

Table 4. Topics in physics found boring or interesting by Year 10 school students.

Specific content of physics found boring or interesting	Boring (%)	Interesting (%)
Electricity	3	8
Energy	1	8
Forces	2	5
Mathematical aspects	15	12
Circuits		4
Colour/spectrum		1
Magnetism		3
Nuclear energy		3
Solar system/universe		6

Figures are given as a percentage of those thinking that physics was very boring or boring, or very interesting or interesting, in responses to the closed questionnaire item. $n = 317$.

wrote that the relevance, or that the variety of topics within the subjects, made them interesting. However, the two most predominant reasons for finding both biology and physics interesting were the content of the curriculum and the practical nature of the subjects. The former played a greater role in making biology interesting to students; the latter played a greater role in convincing students that physics was interesting.

Topics in physics found boring or interesting by Year 10 school students

Curriculum content was raised as a reason for finding physics both boring and interesting by students (table 4). Some topics, such as electricity, energy, forces and mathematical aspects, were given by different students as a reason for physics being seen as both boring and interesting. Clearly, then, the impact of such topics on an individual student's overall perception of physics depends upon their predilections. Other topics were raised only in the context of physics being found interesting: circuits, magnetism, nuclear energy and the universe were examples. Predominant of these was a liking for areas of the curriculum covering the solar system or 'space'. Although a larger respondent sample may well have revealed some students who raised these aspects as being boring, the majority of students appear to find them interesting aspects of physics.

Differences between reasons of male and females students for finding physics boring or interesting

Responses to the closed questionnaire items confirmed that there were differences in the overall feelings about physics of male and female school students. For this reason, the reasons given by males and females for finding physics boring and interesting were compared (tables 5 and 6). More females found physics boring because it was seen as too easy, because they disliked specific areas of the curriculum, or because it was seen as irrelevant. More of the males reported that they found physics boring because there was too little practical work or because it was repetitive (table 5). The only statistically significance between the males' and females' reasons for finding physics interesting was that more of the males enjoyed the practical exercises (table 6).

Discussion

This study has revealed some of the reasons why students might lose interest in physics over the course of their secondary schooling. It thereby highlights ways in which we might attempt to enhance students' interest in physics.

In terms of the content of the physics curriculum, some topics appear to attract some students but deter others. As such, emphasis or reduction of such subjects might, overall, prove ineffective. Other areas of the curriculum appear to attract some students with little deterrence on others. 'Space' is an example raised by the students in the present study [6], perhaps because of its links to science fiction in the popular media. One strategy, therefore, might be to extend the way in which we exemplify less popular areas of physics by reference to the more popular. Perhaps more could be made of a discussion of the forces applied to a spacecraft during takeoff and in space, and the storage and use of energy sufficient for space travel. It might even be possible to convince students that for space exploration such questions require mathematical, not just qualitative, solutions. The findings here, understood intuitively by science teachers, that certain topics are inherently popular with students while others are inherently unpopular has a bearing on the recent suggestion that science should be taught using study topics. It would be interesting to know whether the topics designed to illustrate

Table 5. Differences between reasons of male and females students for finding physics boring.

Reasons for finding physics boring	Boring (%)			
	All	Males	Females	*p*
Difficult/hard subject	48	42	51	ns
Subject too easy	11	4	16	0.05
Do not enjoy subject	30	25	32	ns
Content of subject	20	10	25	0.05
Too little practical work	7	14	3	0.05
Subject repetitive/predictable	6	14	2	0.005
Subject irrelevant	14	6	19	0.05

Figures are given as a percentage of those thinking that physics was very boring or boring, in responses to the closed questionnaire item. $n = 317$, 44% male, 56% female.

p is the probability that any differences between groups in the table might have happened by chance. 'ns' means that the probability is so high that the particular difference is deemed to be 'not significant' (statistically).

Table 6. Differences between reasons of male and females students for finding physics interesting.

Reasons for finding physics interesting	Interesting (%)			
	All	Males	Females	*p*
Easy subject	14	12	17	ns
Enjoy subject	10	10	11	ns
Subject offers a challenge	9	6	14	ns
Content of subject	40	40	39	ns
Practical exercises	46	56	29	0.05
Relevance of subject	19	14	29	ns
Variety of subject	12	14	7	ns

Figures are given as a percentage of those thinking that physics was very interesting or interesting, in responses to the closed questionnaire item. $n = 317$, 44% male, 56% female.

p is the probability that any differences between groups in the table might have happened by chance. 'ns' means that the probability is so high that the particular difference is deemed to be 'not significant' (statistically).

more general science principles will be selected on the basis of evidence and teachers' experience about whether students are likely to have an intrinsic interest in them.

For both biology and physics, the results of the present study imply that students find practical exercises interesting, and that some students lament the dearth of such exercises. There has undoubtedly been pressure on teachers to reduce the extent of practical work [7]; it is time-consuming in the context of an overcrowded curriculum coupled with an increased emphasis on the use of examination results as the indicator of educational 'success', it requires expenditure for equipment and consumables, and there are safety implications. In the case of biology, there are the additional issues of Home Office legislation and students' concerns about animal rights. Despite all this, most teachers would regret the need to decrease the extent of practical exercises. So, it is worth noting that cutbacks in practical work not only reduce opportunities for experiential learning, they might also influence the popularity of science subjects overall.

Another major influence on whether students find a subject interesting appears to reside in whether they perceive it as 'relevant' [3]. In the present study 'relevance' was given as a reason for finding both biology and physics interesting, and 'lack of relevance' as a reason for finding them boring. This idea was reinforced by the specific curriculum areas that students raised in the context of finding the subject interesting, particularly for biology. One might easily imagine

how school students find the issues they raised in this context—the human body, the 'facts of life', and personal health issues such as smoking and drinking—as relevant to their everyday lives. However, a few students also raised the notion of the degree of relevance of the subject to other parts of the formal school curriculum. One suggestion, then, is for science teachers to place more emphasis on interdisciplinary links, perhaps by raising, for example in *biology* lessons, circumstances in which physics is relevant to popular areas of biology.

Perhaps the most obvious factor raised by students was the link between finding a subject boring and perceiving it as being difficult. Indeed, there is evidence that the perception of a subject as being difficult tends to result in the development of a general negative attitude to that subject. Furthermore, students tend to choose for further study those subjects in which they anticipate they will be able to perform well [8]. The challenge here, then, is to make physics less daunting to school students while retaining its essential nature.

It has been known for many years that girls are less attracted to physics than are boys [9]. In effect, physics fails to attract a large proportion of its potential constituency. The results of the present study suggest that the particular reasons for this may include particular curriculum components and, perhaps not unrelated, the fact that more females find physics 'irrelevant'. The task of making physics more relevant to girls presents an interesting quandary in the present atmosphere of oversensitivity to political correctness, since any attempt to use examples that might be of particular interest to girls could be seen as gender stereotyping. Nevertheless, the issue of which subject areas are of inherent interest to students, especially girls, is worth exploring further if such information has the potential to contribute to increasing an overall interest in physics, and science in general.

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