

## Mathematics Teaching from a Different Point of View

Keith Jones

University of Southampton

*It has been acknowledged for some considerable time that pupils experience mathematics not only in mathematics lessons but across the curriculum. Teachers, however, seem rarely to get such an opportunity to see and reflect upon how mathematics is taught and learnt across different subject areas. In this article I will relate what a group of non-mathematics secondary PGCE students thought of the mathematics teaching in their placement schools. I conclude that, by experiencing other subjects, not only do the students benefit from a broader perspective on teaching but also that curriculum areas such as mathematics benefit from seeing their subject from a different point of view.*

### Introduction

It is April and a group of 21 student-teachers (secondary) have just returned from a major block of school experience. None of them are undertaking a mathematics PGCE, but all of them are interested enough in the teaching of mathematics to undertake mathematics teaching as a subsidiary subject within their PGCE. This means that in the college-based phases of the course they spend half a day a week looking at the teaching of mathematics and during the school-based phases of the course they may do a little mathematics teaching if this is possible given that they are actually training to teach another subject. At most their experience of mathematics teaching in school will be limited to working with one class.

Through asking these particular students about their experience of mathematics teaching I have been prompted into thinking both about particular issues in the teaching of mathematics and about the current development of the PGCE course to encompass a greater proportion of school-based experience. In this article I will examine some of the cross-curricular aspects of mathematics teaching and argue that it is beneficial for student teachers in any one particular subject to have some idea about what goes on in other subject areas.

### Mathematics Teaching as seen by Non-mathematics Student Teachers

Of the 21 student teachers, the overwhelming majority, 19, are science students. Furthermore the majority of these science students are physics specialists (12). Of the remaining science students six are chemistry specialists and one is a biologist. The remaining two students consist of an English student teacher and a Geographer. Given this mix of student teachers the findings that I will relate below are not meant to be representative in any way. Indeed the make up of the group means that the views of mathematics teaching presented below are predominantly from science PGCE students. Given this proviso, what I intend to do is to use the experience of these student teachers to highlight a number of points which I hope will be of interest to teachers of mathematics and to those involved in their training.

So what was the experience of these students of mathematics teaching during their recent period of school-based work? Below are the results of my asking them about

this:

|   |  |
|---|--|
| <i>'Who taught some mathematics?'</i>   | 15 had<br>6 had not                                  |
| <i>'What are your impressions of the mathematics teaching in your T.P. school?'</i> | 5 were positive<br>8 were neutral<br>8 were negative |

Although this is a small sample which cannot be said to be representative, even of the views of PGCE students, the proportion of negative impressions is perhaps worrying. These negative impressions were also expressed quite forcibly. Perhaps by looking at the range of replies to this question in terms of students who did or did not teach some mathematics we could throw some light on this divergence of opinion. The distribution of impressions in the categories of positive, neutral and negative for students who had or had not taught mathematics were as follows:

|                            | <b>positive</b> | <b>neutral</b> | <b>negative</b> |
|----------------------------|-----------------|----------------|-----------------|
| <i>taught some maths</i>   | 3               | 8              | 4               |
| <i>did not teach maths</i> | 2               | 0              | 4               |

The first thing to note here is that those categorised above as not teaching any mathematics did not actually have the opportunity to spend any time in mathematics lessons. The source of their impressions of mathematics teaching will be made clearer below. The second thing to note is that all those with neutral comments had actually taught some mathematics. In order to throw some light on the other responses, and to make it clearer how I have interpreted and categorised the responses of the students, let us look at the range of comments the students made about mathematics lessons:

|                            | <b>positive</b>                                       | <b>neutral</b>                          | <b>negative</b>  |
|----------------------------|---|---|--|
| <i>taught some maths</i>   | "well-organised"<br>"interesting approaches"          | "ability spread"<br>"pitching the work" | "chaotic"<br>"low concentration time"<br>"problems with scale, number skills, manipulating formulae" |
| <i>did not teach maths</i> | "good contact between depts"<br>"maths not a problem" |   | "problems with line graphs, units, pie charts, rearranging formulae"                                 |

### Some Observations

1. A number of the student comments quoted above relate directly to the student's personal experience and the views that they hold of how teaching ought to be done. Well-organised lessons and the chance for them to experience interesting teaching approaches perhaps inevitably leads to more positive comments than mathematics lessons that may appear to be chaotic. It is open to question just what they meant by 'well-organised' or 'chaotic'.

2. Good contact between departments and the impression that the pupils have met the mathematics they are to need in other subject areas, particularly the student's own

subject area, can also, it seems, lead to more positive comments whether you taught mathematics or not. Whether the students view mathematics solely as a service subject is also something that is open to question.

3. Of the student teachers with what I have classified as 'neutral' impressions, their concerns are what can be called professional concerns. These students did not express any negative views. What they are doing is recognising some of the major issues in the teaching of mathematics such as the range of attainment apparent in any class and the difficulty in preparing appropriate work.

4. The negative comments focus more on particular areas of the mathematics curriculum and its intersection with other school subjects. Drawing graphs and manipulating formulae arose as issues both for those who had and for those who had not taught some mathematics. The negative comments specifically from those students who did not have the opportunity to teach any mathematics are primarily about how the pupils the student did teach in their own subject area did not have the mathematics skills that the student teacher thought they should have. I will return to this particular point below.

A possible conclusion based on this evidence is that even if students are not training to be mathematics teachers then some experience of being in mathematics lessons with perhaps some form of teaching responsibility may help to focus the student's attention on issues in the teaching of mathematics rather than exacerbating the potential conflicts between different subject departments. It is to these issues of potential conflict that I turn to next.

### **Mathematics across the Curriculum**

It goes without saying that pupils experience mathematics across the curriculum. Unfortunately it is frequently the teachers who do not. Now, of course, this issue is not new and strenuous attempts have been made to overcome this problem over many years (see, for instance Breslich 1936). However, the problems still remain. The National Curriculum Council (1991), for instance, have reported on a number of case studies carried out mainly to evaluate the implementation of the National Curriculum but which illustrate the problems with cross-subject collaboration and the growing impetus to make it more effective. Amongst the problems highlighted are (perhaps unsurprisingly) timetabling issues, major differences in teaching methods between departments and territorial claims for particular aspects of the curriculum. On the other hand the NCC reports the impetus for more cross-curricular planning as coming specifically from heads of mathematics and science departments. This impetus, the NCC claims, comes not from a concern to plan for the five cross-curricular themes of the National Curriculum but more from the growing awareness of the need to coordinate more effectively the teaching of mathematical or scientific knowledge, skills and processes in other subjects

Indeed many attempts have been made to co-ordinate work across subject departments in secondary schools but the problems do not seem to go away. For example, Hammond (1993) found when he tried to instigate cross-curricular work that "schools do not teach topics they teach subjects". Furthermore he found that setting and option choices often made it quite unlikely that the same pupils were together in different subjects. As a result, while he found that there are schools that successfully carry out some cross-curricular work, Hammond found it more useful to look for and work with cross-curricular skills solely within a particular subject area.

It is a salutary experience to reflect that the very mathematical topics that my students raised as problems with mathematics teaching during their school experience, that is scale, number skills, line graphs, units, pie charts and rearranging formulae, are amongst the very issues raised by a Schools Council report published in 1984 (Denyer 1984) which itself echoes similar concerns expressed by Bausor in 1974 (Bausor 1974). As I remarked above, these concerns are not new yet you would expect that, over time, some progress would be made. In an undated report from the mid-1970s a joint committee for physics education of the Royal Society and the Institute of Physics into the relationship between mathematics and physics concludes that:

*In future revisions of mathematics syllabuses it is to be hoped that consideration would be given to the requirements in terms of content and timing of subjects using mathematics such as the sciences, geography, craft and technical drawing. We recommend that wherever possible there should be direct consultation between the interested parties.*

(Joint Committee for Physics Education, undated p 4)

The implementation of the National Curriculum has been, of course, an ideal opportunity to implement this recommendation. The evidence to date, however, is of an emphasis on individual subjects and little sign of this recommended consultation between these subjects. Even the Ofsted reports on the implementation of the mathematics National Curriculum make virtually no mention of mathematics across the curriculum. So if there is little support to be found in current curricular documentation, is there a role for teacher education?

### Teacher Education

The Government sees the training of teachers as an important component in the drive to 'raise standards' in schools (DfE 1994). It could be that conflicts between subject departments in schools over the teaching of mathematics may deflect energy from the important task of raising levels of achievement in mathematics. It may be helpful for initial training programmes to give secondary mathematics student-teachers appropriate experiences to increase their understanding both of how mathematics is learnt and taught in mathematics lessons and of how it is learnt and taught in other subjects. Useful questions to ask about course designs for mathematics student-teachers include:

- Do the students have opportunities to see how mathematics is learnt and taught in other subjects?
- Do they have the opportunity of seeing practising teachers collaborate across subject areas?
- Is there an expectation that the students attempt some cross-curricular work in collaboration with another subject area?
- Are the students introduced to appropriate curriculum

materials?

For student-teachers in other subject areas such as science, geography and technology it may also be worthwhile for them to have the opportunity to experience and reflect upon the teaching and learning of mathematics both as it happens in their own subject as well as in mathematics lessons and even perhaps more widely across the curriculum. If these are agreed to be important components in the initial training

of secondary teachers then the next issue to be addressed concerns practical course design. Just what mechanisms can be used to help students get a broader perspective on the teaching of their own subject from seeing it through the eyes of a student teacher from another subject area.

At my institution we have, for some time, collaborated with colleagues in science and presented one or two joint sessions for mathematics and science student teachers. We also encourage students to spend some time in other subject lessons during their time in school. This is a small beginning which, given the constraints under which we are working, we would like to build on

in a more systematic way. On the wider front of secondary initial education, it could well be that the problems raised in the previous section regarding timetabling issues, major differences in teaching methods between departments and territorial claims for particular aspects of the curriculum are not peculiar to schools. They may well surface in initial training institutions, albeit in slightly different forms. There may also be additional issues particular to initial teacher education courses. The danger then is that initial teacher education serves only to reproduce subject conflicts rather than work with subject differences in a constructive way.

## Conclusion

The move to a more school-based form of initial teacher education has with it the possibility that has always existed with the school-based element and which has been recognised by many of those concerned, that this education can consist mainly of being socialised into the particular school in which the student is placed. A further possibility is that this socialisation, is, moreover, into the student's own subject department. Without appropriate experiences for student teachers the conflicts which can arise between departments may only serve to repeat themselves. As the report 'Better Mathematics' says so emphatically:

*Most of the problems encountered in working across the curriculum are due to, and exacerbated by, the enormous lack of awareness that exists in schools about what everyone else is doing, and about the nature of different subjects. This is especially true of mathematics where strange preconceptions are rife.*

(Ahmed 1987 p 58)

Perhaps initial teacher education can provide a small move in the right direction of overcoming preconceptions and improving student teacher awareness of the nature of school subjects, including a wider perspective on their own subject. The students that I have worked with, through their experience of what goes on in mathematics lessons, have begun to have some understanding of the issues involved in teaching mathematics. I have also learned from seeing mathematics teaching from a different point of view.

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