

DOES MATHS TEACHING MATTER

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By Simon Blake

When I first moved from industry into teaching ten years ago, the mathematics teacher's role seemed similar to that of my own teachers some twenty years earlier. Over the past ten years however it has changed substantially. Several factors have had a significant impact on the nature of the job, in particular: introducing the national curriculum, increasing amounts of paperwork, the need to recruit more students and pressure to adopt new teaching styles. All have tended to erode the personal touch, to replace the unique teacher-student relationship with concepts such as 'delivering the curriculum' and 'facilitating learning'. Does this matter? Is the new approach an improvement, is it neutral in its effects, or is it – as this article attempts to show – positively harmful to many of our students?

I am currently teaching Mathematics in a sixth form college, and carrying out part-time research into the motivation and achievement of our students. As part of this research, I have asked groups of year 12 students to write about their experiences of studying Mathematics at the college. This exercise was followed by class discussion. Their comments, both written and spoken, revealed that many of them experience more anxiety, frustration, challenge and elation doing mathematics than they do in their other subjects. The content may be emotionally neutral, but the process can be extremely emotionally demanding. It is the process of learning mathematics, rather than what is actually learned, that makes mathematics an emotive subject.

Although this research was carried out in a single institution, and at a particular age (including, however, both A level and GCSE repeat students), many of the results would apply to other places and ages. Some of the reasons why mathematics causes such an emotional response were described by the students. They include:

- *No subject presents students with the stark alternatives of success and failure in quite the same way as mathematics. An answer can be quite simply wrong. If it is, the answers that follow it may all be wrong as well. It is easy to spend hours on work which receives no credit whatsoever. This is naturally demoralizing for the student and contrasts with the experience in arts subjects where most essays will receive some credit.*
- *Mathematics students can spend hours getting virtually nowhere, with nothing on paper to*

show for all the effort. This is hard for them, particularly since it is an experience they tend not to have in other areas of their lives. In adult life it will be a different matter, and arguably the study of mathematics helps to prepare them for the sort of frustrations that they will meet all too often later on. But at the age they are, it is a uniquely frustrating experience.

- *On the other hand, when you do come to understand a particular topic, so that it is possible to rattle through questions, getting them right one after another, then you feel good. The sense of elation that comes from finally understanding what was incomprehensible before can be quite intense.*
- *Mathematics is a sequential subject, where each topic builds on what has gone before. For the student, this means that mathematics gets progressively harder. At each successive stage many of the participants will have already reached their personal limits of ability. Only a minority will be confident enough, and sufficiently able, to go on to the next stage. This applies particularly to the demanding transition from GCSE to A level.*
- *Added emotional pressure is provided by society's expectations and requirements. Many higher education courses (teaching qualifications in particular) and many jobs with promotion prospects in commerce and industry require a grade C or above in GCSE Mathematics. Many university courses specify a high grade in Mathematics at A level as a condition of entry. It is no wonder that, as one student put it, "I worry about not being able to do Maths."*

The qualities needed for success in mathematics – persistence, confidence, and a growing maturity to name but three – are all rather elusive amongst today's teenagers. They have only ever known the consumer society of the 1980s and 1990s, and you cannot do mathematics with a consumer mentality. Adolescence is not naturally a confident time of life; too much is changing too quickly to build up confidence and despite superficial bluster 16 year olds are generally severely lacking in confidence, particularly in this generation. And although other subjects at A level also make demands on students' maturity, the rigorous demands of Mathematics seem to be the ones that sixth formers find most challenging and most threatening.

If we accept that Mathematics is a uniquely emotive subject for many of our students, then there are implications for the way in which it is taught. In the first place, the extent and quality of each student's emotional response to learning mathematics can be significantly affected by the individual school or college, and even more so by the individual teacher. An uncaring teacher can make the frustrations of failure at mathematics significantly worse. Conversely, a sensitive teacher working within a supportive school or college can make the most of any positive achievement, whilst minimizing the disruptive effects of failure.

It is clear that the role of the teacher is absolutely crucial. One writer describes the role of this mathematics teacher as follows:

- *Because effective learning depends so much on states of mind in the pupil ... more will depend on the personality of the teacher than on this or that syllabus or this or that style of teaching. Most people find mathematics books impossible to read without some form of teacher contact. Most people can instantly pick up nervousness of misunderstandings in the teacher's own mind. Most people will turn their mind off if they feel that the teacher has no interest or understanding of the way they think. So the net effect of the psychological issues discussed is to become aware that there are no simple recipes for effective learning and that the teacher of mathematics has a more crucial and demanding task than most educational administrators will admit (Schwarzenberger, 1982).*

That was true when it was written ten years ago; it is even more true today. Students are less equipped mentally to control their own learning, they face an increasing number of distractions, and they have less confidence in themselves. Able and supportive teachers are needed as never before. But, at the same time, the teacher's pivotal role is being marginalized. Now teachers are required to be mere passive deliverers of a centrally determined curriculum. They are increasingly diverted from student contact by piles of administrative paperwork. And their own confidence is sapped by a barrage of criticism from the press, the government and parts of the educational establishment suggesting that they are not up to the job.

If mathematics is to be a positive rather than a negative emotional experience for the student, the first step must be to make it a positive rather than a negative emotional experience for the teacher. They must be supported in public, adequately resourced, freed up to get on with the job of teaching, and given enough professional responsibility to develop their own teaching styles and to select, to some extent, their own course content. You need satisfied, confident teachers to produce satisfied, confident students.

A further implication is that teacher expectations have a strong influence on student learning. That is certainly true in my own experience; I can recall one or two potentially able mathematicians whose self-image has been lowered by low teacher expectations. I can also recall a number of students of average ability who nonetheless performed well in Maths because of high teacher expectations and consequent encouragement.

A third implication is that we must be wary of systematic approaches to teaching which are claimed to have universal application. As an example, consider "independent learning". The principle behind this is unassailable: that students learn better when they feel that they are in control of their own learning. In practice, however, this often reduces to a set of work cards, through which a student must work on his or her own. That is not student centered learning, it is merely student paced learning. The structure is monolithically uniform, with far less flexibility as regards both content and style than would be found in the average teacher-led traditional classroom (Cornelius, 1982). My own experience is that students who have been taught Mathematics under such a scheme up to GCSE year for the teacher contact, variety and warmth of a more traditional approach at A level, with its alternation of individual work, group work, class discussion and teacher-led exposition.

Fourth, the personality of each individual student is a key factor in his or her learning experience. For

example, for anyone who tends to high levels of anxiety:

- *The inhibition produced by anxiety appears to swamp any motivating effect ... anxiety appears to be more easily aroused in learning mathematics than it is in other subjects* (Biggs, 1963)

High anxiety pupils are thrown by exams – their unfamiliar rubrics, time limits, the distant formality of teachers who are invigilating, the sustained pressure, and the sense of the importance of the exam as regards their future career. Low anxiety pupils are not so affected, and will therefore tend to perform better. Of course, if their anxiety is so low as to be non-existent, they may well not bother. There is an optimal level of motivation, which produces the best results under examination conditions. Performance is a function of personality. Part of the job of the effective teacher is to match teaching style to the personality of the student – what encourages one will threaten another; what encourages the second will bore the first. We should expect different students to respond differently to the same input.

Finally, since success at mathematics requires persistence, confidence and maturity; and since, as we have seen, those qualities are not easily come by in this generation; it follows that they need to be developed in each student as an essential part of mathematics teaching. It is no longer possible – not that it ever was – to concentrate exclusively on the subject. All but the very ablest students need personal development as well as, and alongside, formal techniques and skills.

This personal development can be taught explicitly, but it is more often caught from the teacher as a role model. Whether we like it or not, our students do look up to us. At a younger age, children like to get ticks and to please the teacher. At the age of sixteen, they are less obvious about it, but the desire is still there. An additional factor in a sixth form college in a predominantly working class area is that the students are studying for the sort of lifestyle – university education followed by a professional career – that their own parents did not experience. In many cases they are the first in their family to remain in education beyond the minimum school leaving age. The teachers at the college may be the only adults they know who have been where they are going. That is a responsibility, but it is also an opportunity. Teachers have more influence on their students as individuals than they often realize, even at sixth form level.

It is not possible to remove the emotional aspects of studying mathematics for our students. Nor would it be desirable to do so, for they stand to learn a great deal as they handle those emotions, and not just about mathematics. It is, however, possible to structure their learning experience so as to maximize the potential for satisfaction, and to minimize the causes of dissatisfaction. Central to this is the person of the teacher, and the main resources at his or her disposal are not sophisticated techniques so much as his or her attitude to the student; the time-honoured human qualities of empathy, warmth and respect.