1 MATHEMATICS – THE SUBJECT WE LOVE TO HATE

This chapter sets the scene for what follows in this book. Why and how does a general antipathy towards things mathematical get perpetuated in schools and society? What part does school mathematics play in the production and reproduction of such attitudes? We will also begin to question the various roles that mathematics has in the school curriculum and how these might be reconceptualized. Who is well served by school mathematics and how should the twenty-first-century citizen be educated mathematically? This is of course a political question and this chapter introduces the socio-political thread that weaves through the chapters. The important and complex questions introduced here will be explored in greater depth through the first part of the book.

'I HATE MATHEMATICS'

Some years ago I used to mark intermediate level General Certificate of Secondary Education (GCSE) papers for one of the UK examinations boards. There are few highlights to this mundane work, but a handful of papers stick in my memory, and one in particular raised an important question. When asked to complete a trigonometry question in this final school mathematics examination one candidate scrawled a frustrated 'I DON'T BLOODY KNOW' across the page, and on the next page an equally emphatic 'I HATE MATHEMATICS'. The sense of exasperation was clear, and I suspect that this candidate felt they were not doing too well! After my initial amusement the person behind the paper drifted into my thoughts and for a moment the examination paper belonged to a real person. Though probably prompted by anger, these comments reflect a deeper sense that this student has of the power of schooling, assessment and mathematics. The French sociologist, Pierre Bourdieu, described how, 'Often with a psychological brutality that nothing can attenuate, the school institution lays down its final judgements and its verdicts, from which there is no appeal, ranking all students in a unique hierarchy of all forms of excellence, nowadays dominated by a single discipline, mathematics' (Bourdieu, 1998: 28).

This particular student was experiencing the *psychological brutality* of *final judgement* and was not enjoying the process. Bourdieu described such boundaries as the GCSE C/D borderline as a 'magical threshold' whereby two students, separated by the narrowest of margins, can have their future educational and life opportunities differentiated in an instant. Such educational magic divides the 'profane' – grade D and below – from the 'sacred' – grades C and above (to use another sociologist, Emile Durkheim's terms). It might seem harsh to make this division between the sacred and profane but this issue has been at the heart of a long-running debate about the structure of GCSE mathematics. This separation of learners by the C/D threshold is one dimension of the power of mathematics as currently constructed in the curriculum.

Of all the school subjects, mathematics is most likely to hinder progression towards further and higher education and employment opportunities. With its arbitrarily maintained pass marks, GCSE mathematics grade C is the most sacred of examination results. But this is so for schools as well as for individual learners. In our performativity culture (Ball, 2003) where league table position is critical, and dependent upon C-grade attainment, the potency of such mathematical branding is all too apparent. Schools that have succeeded in raising the proportion of students with five or more higher grade passes at GCSE are now faced with the prospect of having to include GCSE mathematics and English as part of the new GCSE Diploma. This will impact certain types of schools more than others, particularly those in more challenging circumstances that have used double GCSEs and General National Vocational Qualifications (GNVQs) to bolster attainment.

SO WHAT COUNTS AS SUCCESS?

Returning to our beleaguered GCSE exam candidate, let us assume, for sake of argument, that this student achieved a grade C. Was that achievement a success? Or perhaps we might ask a different question: had this student's mathematics education been successful? Your response to this question depends upon your criteria for success, and these will vary for different teachers, pupils, schools and parents. At one level, obtaining that magical grade C is good news for the school's league table position. In addition, it probably confers the potential privileges of further and higher education access for the student. However, I would hazard a guess that this candidate will not be keen to continue studying mathematics and will probably be quite happy to see the back of the subject. So although 'successful' in one sense, this student is now another contributor to a culture that generally views mathematics negatively and probably has little interest in using it or understanding how the world is being 'formatted' (to use Ole Skovsmose's 1998 term) through the impact of mathematically rooted science and technology, economics and social science.

THE POLITICS OF KNOWLEDGE

Straightaway we have raised issues about the politics of knowledge, in particular mathematical knowledge, and how this is realized in the school curriculum, pedagogy and more widely in society. G.H. Hardy, the celebrated twentieth-century pure mathematician, famously pronounced that his mathematical work was of no practical use whatsoever. In recent years this has been shown to be far from the case and the abstract number theory of which he was so proud now underpins the security of our technologically networked society. However, it is also equally apparent that beliefs about the discipline of mathematics, particularly those held by influential academics, educators and politicians, have the power to shape the curriculum and societal attitudes more generally. The dominant view among these powerful groups is that mathematics, at the core of the political standards-raising agenda, is one of the keys to future economic prosperity. Indeed the Chancellor, Gordon Brown, has pronounced that science (and I include mathematics here) is the 'bedrock of our economy'. This is not only because of the need for science, technology, engineering and mathematics (STEM) graduates but also a demand for mathematically skilled workforce. So mathematics is at the core of the National Curriculum (NC) owing to its supposed economic and political value.

The mathematics NC claims that 'mathematics equips pupils with a uniquely powerful set of tools to understand and change the world' (p. 14). Along with many of my non-mathematician colleagues I would contest the uniqueness of mathematics to understand and change the world. Although the second part of this description is potentially a healthy goal for any curriculum, the use of the engineering metaphor of 'tools' is constraining. The curriculum needs to move beyond a predominantly utilitarian view of mathematical knowledge, and we will explore this in more depth in Chapter 3. Mathematics teachers should also remember that the changes inspired by mathematics have not all been for the good of humanity: I would not like to guess at how many mathematicians are employed in the design and manufacture of arms, for example.

Many scholars have highlighted how mathematics education functions in society to perpetuate inequality in ways that need critique and redress. This brings us back to the issue of power. The quote from the NC above refers to the equipping of students with a powerful set of tools, but perhaps it is as important for these learners to understand how mathematics is a powerful set of tools used, actively and passively, on them as citizens by various groups. This is the *formatting* power of mathematics.

MATHEMATICS CURRICULAR AIMS

If mathematical applications in society shape our lives in many complex and often hidden ways, then one of the aims of the mathematics curriculum should be to uncover, explain and empower learners to critique those *formatting* processes (Skovsmose, 1994). Such a broadening of the aim of mathematics education is far from straightforward and gets us to the nub of the issues explored in the following chapters, which is the nature and purpose of education, and what it means to be an educated citizen in the twenty-first century. Peter Gill concludes his analysis of the effectiveness of the mathematics NC like this:

> the current curriculum for mathematics fails to meet the claims made for it in mathematical terms and also fails to contribute to the overall ethos of the National Curriculum contained in the *Aims and Values*. Nothing less than a complete overhaul is necessary if it is to serve our pupils and the society they, and we, live in. (Gill, 2004: 115)

I agree with this view and will return to those aims and values in Chapter 5 and the second part of the book. But how might a complete overhaul of the curriculum happen and what would be the impact upon you and your students? This is a big question but, hopefully, one to which there are some possible initial lines of approach. We will get to those by the end of the book. Whilst things remain as they currently stand, many children will be failed by their mathematics education, not necessarily through the fault of any one teacher but because of the structure of school and the nature of the curriculum.

MATHEMATICAL TRAJECTORIES

One such learner is 10-year-old Stacey who, in her final year at primary school, confided to her video diary that she was compiling 'now mathematics, boring, boring, boring. Three things about mathematics, I hate it! I hate it! I hate it!' But just how common is this view of mathematics? Surveys of children moving from primary to secondary school suggest that the greatest cause of anxiety at the transition is mathematics (Galton et al., 2002). This is the case for all but high-attaining boys. What is not clear from that research is whether this says something about the impact of primary school mathematics, the reputation of secondary school mathematics and mathematics teachers or some complex amalgam of these two and other social effects. Stacey, a relatively 'low attainer', did not fare well with her mathematics in the transition to secondary school but her negative learner identity was already well established before the move. Following her comments above she explained:

> The thing that makes mathematics hard for me is that I don't think I'm really good at it … erm … I have to say this prufully, I mean trufully … erm … I know what everyone's thinking, that … I'm the dumbest kid in the class … and me and Sonya really need desperate help. I'm not saying that she's bad or anything but me and Sonya need really desperate help. (Stacey)

Stacey was a surprisingly self-aware child who had some understanding of how traditional, repetitious textbook exercises and exposing, whole-class questioning helped to position her at the bottom of the class. Whatever the impact of schools and teachers, we know from research that there are gender and social-class effects that cause children at different ages to respond differently to school mathematics. I will return to these briefly in the next chapter.

Contrast Stacey's experience with that of her peer, Edward. Despite being in the same class for the first six years of his school life he had somehow developed a very different view of his mathematics education. He ascribed value to his mathematics learning and described how he would regularly discuss mathematical problems with his dad, the apparent reason for this being his father's intention that he get into the local private school for boys. Edward's mathematical ability was not better than many of his peers but his family had particular aspirations and were well informed about the importance of mathematics in fulfilling their ambitions. They understood the value of some forms of knowledge over others in particular contexts. Moreover, Edward had the requisite language and cultural resources to talk about mathematics with apparent interest. His getting into that school was much more about his cultural and linguistic wealth than his self-designated mathematical skill.

Teachers on one of our Master's degree programmes have used a case study approach to explore what lies behind the attitudes and attainment of some of their students. Their case reports are very striking and really do get you thinking about how much life history and social circumstances influence mathematical progress. What you do with that knowledge is a challenge, but one worth thinking about. Better that than ignoring the very real links between life circumstances and mathematical learning.

MATHEMATICS LEARNING AS A SOCIAL PRACTICE

Mathematics education is intertwined with complex cultural and social processes at each phase of young people's learning. We know how language tends to disadvantage and filter out some learners of mathematics (Zevenbergen, 2001), how the UK national Key Stage tests also disadvantage certain social groups (Cooper and Dunne, 2000), and so on. Put together, this knowledge paints a bleak picture of the ways in which mathematics education becomes a gatekeeper to future opportunities. But are these effects present in all disciplines or are they peculiar to mathematics education? There is no doubt that from a sociological point of view many of these factors are generic to schooling. However, what we are interested in here is how these factors play out in the context of mathematics education.

At the end of compulsory schooling these various social factors impact upon patterns of enrolment to, and attainment in, AS and A2 mathematics courses. These trends did not go unnoticed as enrolment on degree-level mathematics courses (and the other STEM subjects) declined in the last decade of the twentieth century (see Tikly and Wolf, 2000a for an analysis of mathematics education at the turn of the millennium). The Royal Society expressed their concern about this, and the media, who rarely miss an opportunity to highlight the apparent problems of mathematics education, also made much of the trend. However, it does not take a learned society or media coverage to convince people of the belief that school mathematics is in some sense in a state of crisis – for it seems this popular belief has existed for some time and just refuses to go away (see the comments in the Cockcroft report, 1982, for example).

It would seem that to many school students, mathematics is one of those subjects that has to be endured. It is not the only curriculum subject that provokes such a response from children, but it does seem to stand out. Children's stereotypical images of mathematics teachers are not terribly flattering. Why is this, is there any truth in them, and how have teachers of mathematics come to have this particular modern-day image? One beginning teacher recently wrote about his experiences of learning mathematics, reporting that four out of five of his teachers were strict. He did not elucidate on the extent to which this personality trait influenced the style of teaching. Is this characteristic more common in mathematics teachers and, if so, is it desirable or possible to change this? An Australian colleague related how children with whom she had worked considered their mathematics teachers to take themselves (and their subject) far too seriously. Is that the same in the UK; in the school in which you teach? Maybe this is because we consider our subject to be so important – even though most mathematics teachers (unlike many other teachers) rarely engage with their subject outside of their work, or know much about how it is used in the world around them.

Many of the beginning teachers with whom I have worked identify their coming to like mathematics with a realization that they were ahead of many of their peers. This brings confidence and a self-assurance that is about distinction, of being 'better than'. For example,

> I have always enjoyed doing Mathematics since I became aware that I was good at the subject … I found it very satisfying to be able to solve the problems and then get it right. I was also able to share my experiences with other students who had been unable to do the homework … I loved the whole structured approach to mathematics and being able to solve the problems in a logical manner. This enjoyment of the subject was consolidated in the 6th form when I began to realize that others struggled with the subject and I was able to help out. (Peter)

This is not necessarily a problem but might become an issue if current teaching practice reproduces this response whereby only a small fraction of students can feel good about their mathematics learning.

Returning to Edward, he too had something to say about the role of ranking in mathematics assessment:

Edward: I didn't do too well in the test about mathematics last time I only got 35 out of 45 and I was quite disappointed about that ... I think it was the nerves 'cause I couldn't really remember doing a proper test before.
Andy: So were you disappointed because you got 35 out of 45 or because other people got more than you?
Edward: Both.
Andy: If you had got the top mark with 35 out of 45 would that have been good?
Edward: Mmm, I would have felt better.
Andy: So it's not only about how much you got but who you did better than?
Edward: Yeah I suppose.
Andy: Who do you want to be as good as?
Edward: I want to be as good as Matt 'cause today we finished mathematics more or less exactly the same time so we're always you know ... top.

Unlike his peer – Stacey – who positioned herself as 'dumbest in the class', Edward was continually working to be at the other end of the ranking. Although Peter is some 30 years older than Edward, the same principle can be seen in their mathematical biographies. During the three decades that have elapsed since Peter left primary school there have been considerable changes in curriculum, pedagogy and assessment. Yet despite the changes there is something about mathematics and its role in the curriculum that has changed little over this time.

The Teaching 2020 project at the Department for Education and Skills (DfES) sought to imagine what schools might be like for the next generation of learners. You might like to think about this and consider what mathematics will be needed by future citizens and how school curricula and pedagogy might develop to meet this change. In thinking ahead in this way your focus should be on upon the mathematics needed to function in a range of social roles, rather than in mathematics classrooms. This is not an easy task. Indeed, this book is merely exploring the question of what mathematics learners need now and that is far from straightforward, without thinking 15 years ahead.

MATHEMATICS LEARNING AS A POLITICIZED PRACTICE

So if mathematics is of such social and cultural importance we need to consider what mathematics should be learnt in school and in what ways it should be taught. Hopefully, you have already thought about this in responding to the questions posed at the outset of Part I of this book. You might also have explored this when you started your teacher education programme but then have settled into the routines of teaching the National Curriculum, probably informed by some textbook scheme or other departmental traditions. Whatever position you are in as a teacher it is still worth asking yourself, 'Why do we teach the mathematics that we teach?' and 'What is the best way to teach what we teach?'

These complex questions have been debated over many decades and have been the focus of large-scale, expensive policy programmes in recent years in the UK. But what politics lies behind the current curriculum? The success of these expensive initiatives is a moot point (Brown et al., 2003) and certainly goes nowhere near the more radical rethink of curriculum that could be considered. Referring to similar reform processes in the USA, it has been suggested that 'true reform … may require doing something not better but different' (Kilpatrick and Stanic, 1995: 15). The word 'reform' signals a political intent here in England but the sense of this US view is very clear; we need to think outside the box of current curriculum trajectory in order to develop an alternative vision for mathematics education in England. I am not the first, nor will I be the last to argue this. As the French essayist Andre Gide has asserted, 'everything that needs to be said has already been said. But since no one was listening, everything must be said again' (a rather apt quote for some lessons I have taught!). So, it is important for us to keep exploring these fundamental questions about curriculum and pedagogy, whether we feel powerless to effect change or not. This is particularly so in the era of global and social upheaval that has been called the information(al) age or knowledge society. Technology is shaping our everyday experiences and although information and communication technology (ICT) has not yet had the impact upon school education that had been predicited, there are still many who expect traditional learning to be transformed by the arrival of increasingly powerful mobile and web-based technologies.

What mathematical knowledge is important now and will be necessary in the future, and in what ways should learners engage with it? We need to be clear that the priorities of mathematics educators and teachers are different from those of professional mathematicians in the academy or industry and commerce. We also need to acknowledge that the politics of knowledge has ensured, historically, that the school curriculum has been heavily influenced by those powerful groups.

Whilst acknowledging that mathematics educators might take multiple standpoints on curriculum and pedagogy, and that these will be different again from policy-makers and professional mathematicians, there is something to be learnt from the latter. It is interesting that of the five quotes in the mathematics NC that offer some explanation of the nature of the subject, all come from mathematicians and academics; hardly representative of the range of users of mathematics![1] Unless of course these represent the intended beneficiaries of school mathematics education – those for whom mathematics will be strongly related to their future careers. However, even though their views are probably irrelevant to most learners of school mathematics, there are interesting contrasts to make between those who do mathematics for a living and those who have mathematics done to them in school. One of these five mathematicians, Andrew Wiles, celebrated for his proof of Fermat's last theorem, describes elsewhere his work like this:

> I never use a computer ... l scribble ... l do doodles. I start trying to find patterns. I'm doing calculations which try to explain some little piece of mathematics and I'm trying to fit it in with some previous broad conceptual understanding of

> some branch of mathematics. Sometimes that will involve going and looking in a book to see how it's done; sometimes it's a question of modifying something a bit; sometimes doing a little calculation and sometimes you realize that nothing that's ever been done before is of any use at all and you just have to find something completely new and it's a mystery where it comes from … (Andrew Wiles, BBC Horizon)

This is not an approach that has been adopted in the National Numeracy Strategy. Whether or not this kind of mathematical practice is typical of professional mathematicians I cannot say, but what I do know is that this kind of exploratory mathematical work is not a common experience for many children in school. This mathematician is an 'explorer' in an unknown and unpredictable landscape, rather than a 'ladder-climber' ascending predetermined, equally spaced NC rungs! What children experience in schools is in some ways a second-hand mathematical history, with little purpose or rationale given. It is the rehearsal of a basic grammar but is not a lived language. It is often received in the same way in which I experienced school history – an uninspiring set of dates and 'facts' to be learnt. But where languages in school have become less formal, and where history is more subjective and contested, mathematics has remained stuck in formality, abstraction and irrelevance. Many children are *trained* to do mathematical calculations rather that being *educated* to think mathematically. This discourse of training is something that has crept insidiously into teacher education as well and was the root of David's earlier criticism of his PGCE course: he wanted to be told; instead he learnt how to think! Philip Davis (1993: 191) made use of similar metaphors when he wrote:

> If mathematics is a language, it is time to put an end to an over concentration on its grammar and to study the 'literature' that mathematics has created and to interpret that literature. If mathematics is a logico-mechanism of a sort, then just as very few of us actually learn how to construct an automobile carburettor, but many of us take instruction in driving, so we must teach how to 'drive' mathematically and to *interpret what it means when we have been driven mathematically in a certain manner*. (original emphasis)

Although Andrew Wiles claims never to use a computer, this could well be due to the fact that he does not carry out repeated algorithmic calculations; he is not an automata or human computer, which is what many children in school mathematics are being trained to become. Mathematics is about much more than algorithms, so it seems sensible to revise the curriculum alongside the emergence of ubiquitous calculating machines that are much better at those kinds of tasks than us humans. However, traditionalists have been reluctant to rescind paper-and-pencil methods. Such arguments are not educational alone but become politicized in a complex and far from transparent way.

Consider another political dimension of mathematics learning. Nel Noddings (2004) suggested that the mathematics classrooms should become more politicized, with the children themselves negotiating curriculum and pedagogy. This would be a radical departure for most mathematics classrooms in England. She builds her argument on the work of Paolo Friere (for example, 1972) and John Dewey (for example, 1916) and offers an attractive alternative view of the mathematics classroom. However, her model is predicated upon a different kind of professionalism and school culture. By contrast, if you teach in an English state school it is more than likely that you are quite constrained by a centralized curriculum and preferred pedagogy. Perhaps you have become so used to how the mandated curriculum and pedagogic 'guidance' of the National Framework for Mathematics shapes the day-to-day mathematical learning experiences of children that you no longer question what happens in classrooms. Moreover, these 'strategies' are policed by Ofsted and the network of consultants (many of whom seem, in my experience, to be incapable or unwilling to see any fault with the costly system of surveillance and control of which they are a part). This all contributes to what has been described as the deprofessionalization of teachers' work. Gradually we are becoming a generation of teachers that do not have the motivation or know-how to question and critique the system in which we find ourselves. I hope that in reading this book you agree that these are important issues and are worth discussing. The notion of a critical mathematics education is one to which I will return.

Another benefit of a more democratic approach was highlighted by Edmonds and Ball (1988: 128) when they asserted that 'the only way to make mathematics relevant to pupils who study it is to involve them in deciding what they want to learn and how they want to learn it'. Unfortunately, but understandably, this is a rare practice in the many schools mathematics departments with which I am familiar.

Questions

In your experience of school mathematics teaching how predictable are classroom teaching and learning styles? How often do teachers make choices about the curriculum and how much freedom and creativity is brought to bear on lessons? In order to answer these questions you will need to consider carefully all of the *normal* things that take place – why do these things happen and how do they benefit mathematical thinking and learning?

Could Andrew Wiles work in these classrooms? Does anyone discover or invent new (for them) mathematics?

How political/democratic are these classrooms and in what ways do they contribute to the education of future citizens?

MATHEMATICS LEARNING, CULTURE AND THE MEDIA

What is the role of mathematics in the general education of today's young citizen? Considering this question is one of the broad aims of the book, and I am of course assuming that mathematics education should, as a priority, be serving this aim. Your beliefs about the purposes of schooling and of mathematics education will clearly have a bearing upon your classroom pedagogy. Much research suggests that teachers' beliefs about the nature of mathematics and how it is best learnt are importantly related to their classroom practices, albeit in a rather untidy way (for example, Cooney and Shealy, 1997; Richardson, 1996; Schoenfeld, 2002; Thompson, 1992). Throughout this book you will reflect upon your own beliefs about mathematics education, recognizing that at times they will be contradictory to mine and to those of your colleagues. You might return to the questions posed at the outset of Part I and reconsider them as you proceed through these chapters.

It is not simply, or even primarily, the beliefs of teachers that have shaped the curriculum. Politicians and professional users and creators of mathematics have also played a key role. At this point we should also acknowledge that another, much larger, group has considerable influence (albeit a diffuse one [Noyes, 2004a]) and that is the general public. Public images of mathematics, mathematics education, mathematics teachers are longstanding. These images are non-homogenous but do have some recurring characteristics (Sam, 2002). So it is generally acceptable to be able to claim to be non-mathematical or innumerate but socially far less acceptable to claim to be illiterate. This is not a new view: 'most people are so frightened of the name of mathematics that they are ready, quite unaffectedly, to exaggerate their own mathematical stupidity' (Hardy, 1941). If Hardy was right, how does such a fear of mathematics come about?

Despite the fact that we know from the Basic Skills Agency report (Bynner and Parsons, 1997) that poor numeracy (we will consider this term in Chapter 4) is more closely related to poverty than poor literacy, negative attitudes to mathematics continue. Although much evidence of society's antipathy towards mathematics is anecdotal, it somehow seems to have become deeply embedded in our collective cultural psyche.

Images of mathematics and mathematicians are writ large in well-known films such as *Good Will Hunting*, *A Beautiful Mind* and more recently *Proof*. Not only do these films perpetuate particular notions of masculinity (Mendick, 2004), but mathematical genius is intermingled with eccentricity at best, and serious mental illness at worst. Rarely is the mathematician a balanced, healthy individual, and these films are more about the lives of the mathematicians than the work that they did.

When it comes to the print and news media the headlines and scare stories often do little to ameliorate the poor image of mathematics. The British Broadcasting Corporation (BBC) has reported on the publication of the Smith report (2004) as an 'action plan to rescue mathematics' (BBC News, 4 February 2004); on a survey reporting over 50 per cent of 16–18-year-old 'students struggling at mathematics' (BBC News, 2 May 2005a); on 'the secret shame of maths teachers' (2 September 1999) in primary schools; and on mathematics being stuck in a 'spiral of decline' (28 June 2005b). Meanwhile, in the *Guardian* newspaper Linda Nordling prefaced her report on the scarcity of skilled mathematics graduates suitable for research posts with 'maths was never the most popular subject at school' (*Guardian*, 5 July 2005a). So what general impression should we get of the state of mathematics education? Not a positive one but, rather, a sense that the discipline is in trouble.

Simon Singh is a 'champion' of mathematics yet his interpretation of the rationale for the aforementioned films is that 'Hollywood thinks mathematics is sexy' (*Guardian*, 24 October 2005b). Surely a more critical view is needed where the impact of such 'role models' is questioned. He goes on to suggest, rather melodramatically, that:

> mathematics in Britain could become extinct over the next few decades because fewer people are studying mathematics as each year passes, which means there will be fewer people who can teach it, so even fewer will be able to study it and eventually the tradition of Brits doing clever things with numbers will disappear forever.

His argument is supported by the evidence of declining numbers taking A level mathematics in recent decades. In the same press article Singh tells us that this should concern us because 'the repercussions on the UK economy will be enormous as we fail to find enough people with the skills who can help Britain compete in the information age'. The proposed solution is to have a sufficiently qualified and trained new generation of mathematics teachers. Of course the supply and education of mathematics teachers is important, but to simplify the problem to this one issue and to overlook the issues of curriculum and pedagogy that we are thinking about here will not get us far. No doubt the daily press is not the place to enter into such discussion, but at the same time we need to be aware that this is the level of debate to which young people's parents are exposed.

Having sounded a rather negative tone, there are examples of the widening debate called for by mathematicians (whose concerns are usually for those elite students who will fill their courses and follow in their mathematical footsteps). This debate has included the questioning of compulsory mathematics: should all young people be required to study GCSE mathematics? Why? Terry Bladon's comments on this matter of removing mathematics from the core curriculum from age 14, were widely and sympathetically reported (for example, BBC News, 21 April 2003). For some time academics have added to this debate in the national press on more philosophical grounds (for example, BBC News, 3 October 2000). There is an important discussion that needs to take place and is happening in part. The debate revolves around the usefulness of mathematics and its importance for the general education of teenage students, which is an important matter. But strangely, the curriculum and its associated pedagogies, assessment regimes and resource supports are not questioned. Perhaps such drastic solutions would not need to be debated if the curriculum and underpinning pedagogic rationale were instead the focus of discussion.

MATHEMATICS LEARNING FOR OPPORTUNITY

The problem with suggesting that not all students continue with mathematics until the end of their schooling is that currently this would prohibit their access to the learning and life opportunities which are predicated upon attaining a GCSE grade C or above. So despite society's antipathy towards mathematics there is the acknowledgement that somehow mathematics has power, or rather, success in school mathematics has the power to change one's future life trajectory. This is primarily at the level of the individual, whose GCSE C grade or above allows him or her into many further and higher education opportunities or who with an A level can apparently command greater earning power.

I am not convinced that the NC or other recent mathematics education policy has done much to reduce the negative perception of mathematics held by many children and adults. The mantra of raising standards that has been the hallmark of education policy in recent years has not improved things. Slightly higher grades, and any associated feeling of success, might have had an impact on attitudes but the evidence suggests that mathematics is still considered to be harder than other subjects. Why this should be remains a mystery but surely relates to the politics of knowledge, to the idea that somehow mathematical and/or scientific knowledge is loftier.

So, mathematics education is far from being sorted. Moreover the problems go deeper than image. In trying to address the 'crisis', the Smith report (2004) has highlighted possible directions for the development of mathematics education. Many of these are concerned with shoring up the current system. The shortage of teachers is a central concern, as is the content of the curriculum. However, sadly, what is lacking in the report is a more critical and considered view on the purpose of school education and of the mathematics curriculum.

More pertinent to the direction of the discussion here is the work of critical mathematics educators like Eric Gutstein (2006). In his book, *Reading and Writing the World with Mathematics*, he explains that the acquisition of mathematical power through a 'pedagogy of access' is only one facet of a socially just mathematics curriculum. There is a need to accompany this with a 'pedagogy of dissent' by which he means those practices which are concerned with understanding the place and power of mathematics in society and giving all learners the skills to use their mathematics as engaged citizens. I referred to the National Curriculum earlier and its assertion that mathematics might be used to 'understand and change the world'. This is precisely what Gutstein is advocating is and an important theme of the following chapters. However, I suspect that Gutstein and the research mathematicians quoted in the NC might have slightly different takes on what this might mean!

SUMMARY

In this chapter I have briefly surveyed the landscape of mathematics education and have highlighted some of the particular problems and features that will be explored in greater depth through the rest of the book. It should be clear that the issues which most concern me are those relating to the political purposes and related pedagogies of school mathematics. I use the word 'political' in a broad sense here, recognizing that the school curriculum is contested by powerful groups, in accordance with their own interests. School students do not get a say in what they should learn and, generally speaking, the powerful groups that do get to influence curriculum content are those that have already benefited from it. We should be concerned for those students who will never, under the current regime, see how mathematics might be a powerful tool with which to understand and change the world. These students are not only those who currently fail to meet the arbitrary required grade C standard but the many that do actually achieve this, but for whom it was purely an educational hoop-jumping exercise. Before proceeding you might consider the following questions.

Questions

How important is it to you that school mathematics engages with real issues of relevance to learners?

- To what extent do you do this already?
- Can you find examples of apparently relevant mathematics that is actually unrealistic?

What might it mean to use mathematics to understand and change the world?

- Can you think of some examples?
- How, if at all, do mathematics lessons in your school enable learners to develop the knowledge, skills and understanding that will make this happen?

KEY TEXTS

The three texts listed below have different national contexts (the USA, Germany and the UK) and audiences. The authors have very different roles and relationships to mathematics. You might not want to read these at this stage and I will refer to the first two in more depth during the later chapters. The Smith report is more pertinent to mathematics teachers in the UK and the executive summary provides an outline of the main recommendations that are already impacting upon the learning and teaching of mathematics in schools and colleges.

Smith, A. (2004) *Making Mathematics Count*. London: HMSO.
Every teacher will have heard of the Smith report but it is worth reading, as the implications for teachers of mathematics are considerable. It is available, or can be purchased, online. Even a read of the executive summary would be informative.

Gutstein, E. (2006) *Reading and Writing the World with Mathematics: Toward a Pedagogy for Social Justice*. New York: Routledge.

This book is a semi-autobiographical account of Gutstein's work with disadvantaged students in Chicago. He describes the political nature of his mathematics teaching and how his pedagogy has increased motivation for many of his students. There are descriptions of the kinds of tasks that he used to enable the students to learn to 'read and write the world' mathematically. It is easy to read and I would encourage you to read it – even if you cannot agree with everything that Gutstein advocates.

Heymann, H.W. (2003) *Why Teach Mathematics: A Focus on General Education*. Dordrecht: Kluwer.

This thesis is a thorough, thought-provoking vision for development of German mathematics education, with a lot that is relevant for the UK. Although from a different political tradition to Gutstein, many of the ideas complement one another as Heymann asks questions about the usefulness of secondary mathematics. The cost of the book is prohibitive, but if you are seriously interested in these issues it is worth borrowing.

NOTE

1 The quote from Professor Robert Worcester, Chairman of the Market and Opinion Research Institute (MORI), is of relevance here: 'if you want to take part in tomorrow's world, you'll need mathematics and statistics just as much as grammar and syntax' (NC: p. 15).