Studies on Mathematics Education and Society

BREAKING IMAGES

ICONOCLASTIC ANALYSES OF MATHEMATICS AND ITS EDUCATION

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21. Beginning again

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In this book, we started from the position that the doing of mathematics and mathematics education are human activities, with all that that implies. As the book was developed, the notion of 'images' of mathematics and mathematics education, both influencing, and being propagated by, human actors became salient. We suggest that an analysis of such images may shed important light on the many acknowledged discontents of mathematics education. For too many people, their actual and remembered engagement with mathematics in schools is unnecessarily alienating rather than the enlightening and empowering experience that it could be.

The title of this volume refers to breaking images of mathematics and mathematics education. We began by advocating, in alignment with new developments in what qualifies consensually among those in the field as 'philosophy of mathematics', a radical shift from the chimerical quest to define mathematics as some kind of entity. In particular, we reject what is called the Platonic view that the entity of mathematics exists, in some way, independently of human beings. Instead it is argued throughout the book that the appropriate framing is to describe what people do when they 'do mathematics'. Further, what counts as mathematics is socially negotiated and these negotiations are historically contingent and subject to cultural diversity. Accordingly, such a shift in perspective necessitates historical and cultural lenses. As stated at the outset, mathematics and mathematics education are situated within historical, cultural, social, ethical, and political – in short, human – contexts.

We argue that mathematics education and its discontents cannot be adequately addressed internally, by yet another empirical study of

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children struggling with fractions and the Holy Grails of the teacher-proof textbook, the perfect curriculum, the all-revealing test. Nor is there some complete architecture of cognitive development which, when fully developed, will render mathematics education straightforward. The discontents highlighted throughout this volume demand consideration of external contexts; the problems are human problems, and cannot be solved by technical means alone.

The aspiration to disassociate mathematics from the perceived contamination of human limitations has a long heritage, within which Platonism has played a dominant role. There is the image from early in the modern scientific era of the universe operating like a clockwork mechanism, suggesting that if one possessed total knowledge of every aspect of the universe at any given time, the future could be predicted. The desire to eliminate human imperfection can be seen in the progressive waves of formalism in mathematics, logical positivism in science, behaviourism in psychology. Unwarranted power of numbers is pervasive; psychology is heavily implicated through the conflation between 'X' and 'an inescapably imperfect measure of X'; the ignoring of that conflation underlies failure to acknowledge the limitations of psychometrics. An obvious example, with massive implications, is the idea that intelligence can be measured as a single number.

Similar issues of (de)humanisation arise in relation to mathematical modelling, whereby the relative precision of models of physical phenomena may be projected onto models of phenomena involving human complexities. Hence the formatting of our lives, accelerated by information technology, by models to which few have access, and over which even fewer have any control. The above considerations have been complexified by developments in Artificial Intelligence and the phenomena of the post-truth era, in which constructed images of alternative realities can dominate.

Over the five-year gestation of this book, in the creating of its diverse chapters, the phrase 'image of mathematics' has become increasingly salient. This phrase is necessarily nebulous but speaks to very real phenomena. The images of mathematics that people acquire through schooling and social life, and the images that people project in furtherance of ideological aims, have extraordinary power in both school mathematics and in the control of societies by state apparatuses. While

explicitly or implicitly touched upon by many of the contributors in this volume, the intimate relationship between mathematics education and capitalism in its many forms remains to be thoroughly explicated. The reader of this book will have picked up multiple resonances of how these factors play out in practice. One theme that has been stressed is that the writing of the history of academic mathematics by the winners has contributed, to a significant and consequential extent, in the creation of an image underpinning intellectual White supremacy.

Our collective objective of questioning accepted wisdom about mathematics and mathematics education may be served by describing and interrogating such images. The word 'image' has numerous connotations, including: pictorial representation; idol, object of veneration; the conscious attempt to create a positive impression of a person or object, idea or picture in the mind. Obviously, there are many pictorial representations that reflect images of mathematics. That topic merits a series of books in itself. There is also the fascinating field of the fictional and non-fictional portrayal of mathematics and mathematicians in books, plays, and films.

Then there is the use of 'image' to refer to an object of veneration. In relation to mathematics, we have highlighted two aspects at various points in the book. Common among mathematicians, and uncritically accepted by many non-mathematicians, are what we consider inflated notions of the intellectual superiority of mathematics compared to other intellectual achievements. Among all groups in society, there is an associated public image of mathematical geniuses. Secondly, there is an often unexamined assumption that the doing of mathematics is inherently beneficial to humanity, as a driver of 'progress' and so on. Such beliefs are commonly held by those with power, which helps to explain the unreasonable political effectiveness of what might be termed 'mathematical propaganda'. Belief in the intrinsic goodness of mathematics forms an integral part of the whole outlook of modernity.

'Images' are also social constructions for politicians, religious leaders, film stars, and others and there is a field of expertise in the art/science of fabricating such social constructions that can become more important than the 'real people' (whatever that may mean). Such activities have an obvious affinity with advertising material goods and the public relations industry systematised by Freud's nephew, Edward

Bernays, in the 1920s. Especially prominent in the advertising copy for mathematics are under-examined slogans such as 'mathematics for all' and 'mathematics helps you to think'. Algebra and calculus are products that have been sold hard, yet most people do not use school algebra to any significant degree, and calculus even less. And the assertion that they are essential to national achievement is undermined by looking at the works of civilisations predating their development as formal tools.

In Plato's parable of the cave, people look at shadows projected on the wall from an independently existing reality. In this book, we have joined in a general rejection of Platonism as a philosophy of mathematics. We suggest that the images perceived by people are human constructions, including those intentionally designed for ideological reasons.

And so to the core of our argument, which focuses on a cluster of images of mathematics and mathematics education, including images of mathematicians, mathematics learners and learning, mathematics teachers and teaching. These images influence the thinking and actions of mathematicians, scientists, philosophers of mathematics, mathematics learners and teachers, the general adult population, people with power to apply mathematics, and those with power to influence mathematics education.

It has often been commented that working mathematicians do not allow themselves to be distracted by philosophical considerations, even less by ethical and political issues (G. H. Hardy being an influential apologist for this position). If mathematicians were quarantined, their political and emotional detachment would not matter so much. Let us simply assert (the supporting evidence and arguments are scattered throughout the book) that when mathematicians put their thumbs on the scales of school mathematics, they can do a lot of harm (with honourable exceptions, of course, many figuring prominently in this book). The Bourbaki movement in mathematics, and its spillover into school mathematics (by no means entirely the fault of Bourbaki) represents the extreme case that may be characterised as confusing the foundations of mathematics (in the sense of the old philosophy of mathematics) with the foundations of mathematics education.

The institution of formal schooling is so familiar we forget how artificial it is as a cultural construction, removing children from their families during a large part of their development. For mathematics, a

pervasive aspect of this artificiality is the chasm between what children experience in the mathematics classroom and what they experience in life. In school, too many people learn to fear and hate mathematics – to be more accurate, the interpretations and images of doing mathematics with which they are confronted and the demands placed upon them. Far too many individuals and groups of people, through classroom interactions and through testing, may have their self-images damaged as people who 'cannot do mathematics' and, by implication, as intellectually deficient.

In many ways, what could be termed natural rights of children, in particular sense-making and valorisation of the multiple forms of diversity, are violated. The example of Pythagoras (considered by a consensus of contemporary scholars to have been neither a mathematician nor a scientist) illustrates a failure to adhere to ethical standards of historical accuracy, insofar as that is possible. At the systemic level, work continues on a counternarrative to the Eurocentric myth of the origins and development of academic mathematics, that may be regarded as a manifestation of white intellectual supremacy.

What also deserves more penetrative research is the extent to which school mathematics, particularly in the early years, is foundational in forming people's worldviews – for example, that everything can be measured one-dimensionally and then ranked, that 'everything is linear', and that numbers as such have unimpeachable authority, no matter how flawed are the models that produce them. The fascination of mathematicians with the infinite may innoculate people against grasping the implications of living a finite life on a finite planet.

Whence do people get their images of mathematics? Mostly in school, but also out of school; mostly the latter tends to reflect and reinforce the former. People who failed to master abstract algebra, or fell at the early hurdle of fractions (when does anyone, really, *need* to compute 4/7 + 7/11??) are easily intimidated by what mathematics appears to them to be, yet have a feeling that is somehow of great significance and demands reverence. With immense political implications, a sense of the limitations of mathematical modelling is not generally nurtured in, or out of, schools, especially in relation to anything involving human complexity.

After school, a small minority pursue further studies within mathematics and are likely to be enculturated into the discipline. Many

more use mathematics in their studies or work; in those cases they are likely to encounter and learn mathematics in context, often using specialised representations and formulations, rather than recollecting related, but decontextualised, elements of school mathematics. Increasingly, the mathematics needed for work is embedded in software.

The majority of people do not use significant amounts of formal mathematics, and the mathematics they use in 'everyday life' is learned in context. They remain open to the socio-cultural influences that shape images of mathematics in the media, in the very particular genre of books, plays, films about mathematicians, in the echo-chamber of asocial media (see the previous chapter in this volume), and so on. We suggest that most politicians, even those closely involved in educational policy and governance, are not much different from the general population and largely share their images of mathematics and mathematics education. They often have a minimal understanding of mathematics associated with a strong tendency to defer to mathematicians as authorities.

Accordingly, we envisage a programme of sustained research and analysis, building on the very considerable work already done.

The guiding framework for this effort would be that the framing of school mathematics shows a continuity from the images established in elementary school, developing progressively through later life into adulthood, and ultimately looping back into school mathematics. Contributing to the closing of this loop is the influence of those with political power, including mathematicians, who, to a considerable extent, shape school mathematics. In our opinion, mathematics education in schools will not fundamentally improve until this feedback loop is disrupted. One focus for the research program that we are advocating could be deciding which parts of the cycle are open to such disruption and how that might be achieved. We hope that more mathematicians will emerge from their ivory towers and recognise their consequential roles and ethical obligations in this project. In the same spirit, we welcome the philosophers of mathematics who have stopped endlessly mending their nets and actually put out to sea.

Meanwhile, we observe the manifestations of the vast chasm between the projected image of mathematics as the epitome of rationality and the collective irrationality of our species in failing to confront a confluence of existential crises.

All of these are human problems.