Why mathematics educators *should* be bothered about poverty

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In this paper I draw on literature to make a case for why the economic conditions in which learners of mathematics live should be of much greater and explicit concern for mathematics educators.

THE POLITICS OF POVERTY

> Maths is a painful experience for far too many children and adults. Instead of introducing children to the science of patterns, a fascinating set of ideas, and a way of interpreting the world, children are led through hours of repetitive procedures that they come to believe is maths. [...] For mathematics is becoming more and more important for the future of society and our children. Without mathematical know-how young adults are disadvantaged and vulnerable (Boaler 2009, 213).

Whilst I support Jo Boaler's argument, I do not see that all young people are disadvantaged and made vulnerable by a lack of mathematical know-how; some young people are more at risk than others. Internationally there is a long history of under achievement in mathematics illustrated by many young people not enjoying the subject and not taking up further study after compulsory schooling and the problem remains entrenched. One thing is clear, success at mathematics is not evenly distributed across sections of society. I do accept the UK obsession with ability grouping is not a universal practice, yet where pupils are rigidly segregated by ability, those groups at the bottom tend do to be populated by pupils from more disadvantaged backgrounds; they have less experienced teachers, fewer resources and have widely different experiences (Jorgensen, Gates, & Roper, submitted). Studies have shown that poverty has a stronger influence on achievement than instructional quality, leading to a policy imperative that if we want all pupils to do well "*minimizing social inequities must be a fundamental component of education policy*" (Georges, 2009).

In this paper I describe some of the ways in which politics and economics affect the complex web of influences which we need to unpick and articulate. However I do *not* want to argue everyone should be bothered about the effect of poverty; it depends on your politics. Some will be, some won't be and some will claim to be bothered but do nothing about it. For a number of years there has been a growth of interest in mathematics education and social exclusion. Various researchers and some policy makers have asked questions about the way in which mathematics attainment is distributed within a stratified social structure and how we might ameliorate that. I want to argue this is not just about professional predilections or approaches, but is part of the political and ideological struggle which Karl Marx drew our attention to

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over 150 years ago. Whilst some researchers are concerned about this, many are not and the literature is full of examples of studies that are class-blind, based upon the assumption that pupil backgrounds are irrelevant to learning; that if we make learning better for some, we make it better for all. Whilst I personally feel this blindness is dangerous, that is because I position myself on the political left rather than because I have any particular insight. I see three stances taken in our discipline which mirror, albeit a bit crudely, the political spectrum.

- **A radical stance** - Taking social class seriously, challenging the status quo;
- **A moderate stance** - Taking the status quo seriously, seeking to be more equitable in classrooms;
- **A conservative stance** - Rendering class invisible and unproblematic.

Too often we overlook this elephant in our classrooms and try to pretend we are all in it together and striving for the same things. I have argued how maths teaching is a political act and how teacher beliefs are themselves political (Gates 2000; 2001; 2006; 2010). So what you teach and how you teach it are intimately linked to your own political beliefs. I am encouraged by the argument of Wilkinson and Picket in *The Spirit Level* (Wilkinson & Pickett 2009) that inequality is bad for all of us. Treating people unfairly will reduce social cohesion, leading to social unrest and conflict. Alternatively if we treat all pupils fairly and equitably, attainment overall will increase. This leads me to articulate some of my concerns and current questions.

- How does mathematics education stratify the pupil population?
- How is this stratification evident in mathematics classrooms?
- How can new pedagogies improve the learning experience of all pupils?

To show deference to Karl Marx, we need to do more than just interpret the world; we need to try to change it and there are examples of programmes aimed at changing things for the better. One US study looks at how mathematics is organised in effective schools that serve the poor (Kitchen 2003; Kitchen et al. 2007). Looking to "*get real*" about reform for high poverty communities, Kitchen suggests three challenging policy changes. The first is over whose interests mathematics education serves.

> Transforming the mathematics education culture to value the mathematical preparation of the majority over the achievements of a select few requires mathematics educators to connect with movements that promote mathematical literacy for those who have been excluded in mathematics (Kitchen 2003).

The challenge is the idea that we should value the interests of the majority over those of a select few - this runs counter to our system. But it surely raises the question - can we *both* value the achievements of the few (who do well) as well as the many (who do less well)? Kitchen seems to believe we can't and I agree. There is much in the maths education literature that claims to be socially just because it improves learning for everyone. But unless one *explicitly* strives to reduce the gap between rich and

poor, then one cannot claim to be socially just; rather you are merely giving everyone a chair to stand on. This raises a second, political, challenge:

> Acknowledging that mathematical education is a political endeavour requires the mathematics education community to recognize the reform movement should be situated in the context of the larger movement for social and political justice. (Kitchen 2003)

This too runs counter to our culture and not everyone wants to situate maths education reform in a movement for social and political justice. Kitchen's final claim is a little less controversial and possibly achievable.

> Proponents of reform need to question the role of an education in mathematics, particularly at schools that serve high-poverty communities. (Kitchen 2003)

So here is a realistic empirical question. What is the role of mathematics education in such communities? To even ask that question is to take a political stance though - where do those pupils struggling with maths, come from? What backgrounds do they have? What needs do they have? Pellino (2007) argues "*the social world of school operates by different rules or norms than the social world these children live in*", and summarizes much of the literature on the effects of poverty by drawing our attention to some of the characteristics of children in poverty. They experience: high-mobility, hunger, repeated failure, low expectations, undeveloped language, clinical depression, poor health, emotional insecurity, low self-esteem, poor relationships, difficult home environment, a focus on survival. Haycock (2001) concludes "*We take the students who have less to begin with and then systematically give them less in school*."

THE POVERTY OF LEARNING AND TEACHING MATHEMATICS

For 50 years since Rosenthal and Jacobson's classic study (1968) it has been known that teachers' expectations impact upon pupil learning and work since has underscored this particularly in maths (Boaler et al. 2000). School is a very segregated experience for young people. Pupils from different backgrounds experience it in very different ways**.** In poor areas, mathematics teaching is often a struggle, a battle for survival. Pupils fail to learn and resist attempts. Why might this be? I want to make a suggestion it might be the curriculum. We learn by interconnecting ideas, by looking at exceptions, by exploring, questioning, playing with concepts. Does this sound like the majority of bottom set maths lessons experienced by the poor? I think not.

An OFSTED study of Finnish mathematics teaching describes how international comparisons have highlighted Finnish children's success in mathematics; in 2000, 2003 and 2006, they were ranked very highly in mathematics (OFSTED 2010). In Finland, low attainers did better than their compatriots in the UK and the the gap between lower and higher attainers was lower than elsewhere. Some key features in the mathematics classrooms identified by OFSTED included pupils being regularly engaged in *realistic problem solving* expected to *create mathematical expressions* to

describe and solve such problems. This is quite unfamiliar in England. Yet some other aspects related more to a different cultural context. There was no school uniform, relationships between pupils and teachers were relaxed reflected in the use of first names, there was no ability setting as in the UK and no national assessments. These differences were also reflected in many classroom pedagogical strategies.

The language we use also creates the context in which we see the world. So while we talk of *low attainers, slow learners* – we impose a pathology on children that not only makes them the problem but sees it as a creation of their own devices. However many prefer to use this terminology exactly because it focuses on learning but it is also a focus away from politics. I think I prefer a range of terms – *resistant learners* for those pupils who are forced to fight back; *restricted learners* for those who are not quite resistant, but who are denied the possibilities that other have; *reliable learners* who just seem to get on with it; *rewarded learners* for those whose attempts are rewarded by a range of strategies – good teachers resources.

We need to ask here then, who gets what mathematics, and this is a tricky question. I want to just look at one example here (Boaler 2009). Gray and Tall (1994) looked at children working with single numbers (e.g. 6 + 12) and identified a series of stages:

- Counting all (counting the 6 then continuing on with the 12)
- Counting on (starting at 12 then counting on 6)
- Using known facts (just knowing 6 + 12 is 18)
- Deriving facts (breaking up and reorganising: 12=10+2, 6+2=8, 10+8=18)

They found those struggling with maths were using stage 1 and rarely getting to stage 4. In reality – teachers where restricting their horizons by focussing on basics before "*moving on*". What we find – and what Gray and Tall found - and what we probably all know is ... poor kids don't compress much. They tend to feel distant and unconfident in mathematics due to repeated failure to grasp what it's all about. They thus feel unable to control the mathematics or their learning of it. I argue this is because these learners have rarely been encouraged to take control over anything. These pupils who do not fit the ideal pupil mould experience a mathematics education that is considerably structured, restricted and controlled. The pedagogical jump here made by teachers is to assume that pupils who are doing less well are not (cap)able of *higher order* thinking. In a series of studies this has been explored (Zohar 1999; Zohar et al. 2001; Zohar & Dori 2003) and the conclusion - teachers do not really believe weak pupils (invariably pupils from poor backgrounds) can think in higher order ways (See also Ader 2009).

THE POVERTY OF OPPORTUNITIES

So to understand the differential performance of pupils from low SES backgrounds, we need to look into the classroom practices to ask difficult questions about the experiences of learners from certain social-economic groups. Of course much literature in mathematics education talks not of social class, but of levels of

attainment. This is an example of what Bourdieu calls *misrecognition* (Bourdieu, 1989, p. 377) where social power is exercised by making itself unrecognisable (Bourdieu, 1990) - and thus representing a denial of the economic and political interests at work. There are though some robust examples of inquiries into social class. One such is Sarah Lubienski who studied mathematical experiences of pupils with an eye to looking at pupils' backgrounds (Lubienski, 2000a, 2000b, 2007). Whilst she naturally expected to find SES differences what she actual found were very *specific* differences in two main areas – *whole class discussion* and *open-ended problem solving*. These are two well-researched pedagogical strategies and classroom practices which at least in professional discourse are held in some esteem. Discussion based activities were perceived differently by pupils from different social backgrounds. High SES pupils thought discussion activities were for them to analyze different ideas whilst low SES pupils thought it was about getting right answers. The two groups had different levels of confidence in their own type of contributions with the low SES pupils wanting more teacher direction. Higher SES pupils felt they could sort things out for themselves – as their parents do in life presumably. I suspect this is not an uncommon feature of many schools but where does it emanate? Here then social class is a key determining characteristic largely absent from much literature on discussion based mathematics.

A second area where Lubienski noted differences was that of open-ended problem solving. The high level of ambiguity in such problems caused frustration in low SES pupils which in turn caused them to give up. High SES pupils just thought harder and engaged more deeply. It is well known that middle class pupils come to school armed with a set of dispositions and forms of language which gives them an advantage because these dispositions and language use are exactly the behaviours that schools and teachers are expecting and prioritise (Zevenbergen, 2000). High SES pupils have a level of self-confidence very common in middle class discourses whilst working class discourses tend to be located in more subservient dependency modes, accepting conformity and obedience (Jorgensen, Gates, & Roper, submitted).

Middle class pupils after all tend to live in families where there is more independence, more autonomy and creativity (Kohn, 1983). Studies of parenting suggest different strategies are used in different class background. Low SES, working class parents are more directive, requiring more obedience. Middle class parents tend to be more suggestive and accommodating reason and discussion. (Lareau, 2003) The middle classes grow up to expect and feel superior with more control over their lives.

THE POVERTY OF PREPARATION

One popular justification for learning mathematics is its usefulness and applicability to "the real world". Yet many young people experience mathematics from a very unreal world – the world of the school classroom. This world has specific rules, practices and objects all of which work insofar as they make school mathematics work as a system in and of itself. Pupils solve equations without ever having a

purpose, other than to get a solution through applying a set of procedures in the correct order. The solution is not a solution to any real problem and it is questionable whether any of the procedures learned in school mathematics would solve any problem that young people encounter either as adolescent pupils or as young workers.

Now of course school mathematics is school mathematics – and is experienced in a somewhat similar context by almost all pupils whatever their social background. However, what is different for different pupils is the form that school mathematics takes. Some pupils will remain within a somewhat abstract world where the systems of thought of the school will be exactly what they need to move onto a next stage – be it further study of mathematics or higher education. For others however, those whose trajectory will be moving toward employment in some form, their school mathematics will be at odds with what everyone knows is needed to practice. Young people who move into employment move from one set of practices to another quite different set.

In a structural way this is no different from the workplace; there you find jobs to be done, manuals to help, tools to use timescales to keep to, and a team of people to work with. Here however, they are often referred to as systems tools, artefacts and protocols (Gagliardi 1990). These became "*crystallised operations*" (Leont'ev 1978) and the work activity not only structured the tools and artefacts, but becomes also structured by it (Pozzi et al. 1998). Recent work on workplace mathematics has shifted a focus away from a more conceptual, cognitive approach where we look to how school mathematics can be used in other settings, to a more situated and cultural approach. Not only has this changed the way we see mathematics in use, but it has also contributed to a change in how we see mathematics itself (See Pozzi et al. 1998 for more details); what we do now know is that school mathematics is quite different from workplace mathematics. Many young people coming from school fail to see the nature of mathematics as conventional and idiosyncratic when used to undertake practical tasks. Because mathematics is "shaped" by the workplace context, rather than procedural, this leaves them unprepared for tasks in which mathematics is embedded and functional.

SO WHAT?

So what does the literature suggest we might do about this? I will end with four strategies that go some way to alleviating the systematic and structural failure at mathematics of pupils in poverty:

1. Engender positive, respectful social and pedagogic relationships with low SES pupils, to explicitly foster self-esteem and resilience in working with mathematics.
2. Treat low SES students to the same high expectations, with a demanding and rigorous mathematics curriculum that expects all pupils to succeed and understand.

3. Recognize and embrace the diversity in the student body, valuing the talents and abilities of low SES learners, encompassing a respect for different life worlds and their contributions to mathematics. Get to know the families, and provide differentiated support.
4. Create and use meaningful tasks involving inquiry and cooperative learning, where low SES learners have some control and responsibility.

A challenge for all of us is to fight the demons that cause us to expect little from learners from less affluent backgrounds and, more specifically for a PME audience, to recognize the influence that poverty has on all aspect of teaching and learning mathematics. Engaging explicitly with class and social differences in learning has been shown to have the potential to open up greater opportunities for higher order thinking (Jorgensen et al. 2011), and for raising the intellectual quality of pupil cognition (Kitchen et al. 2007). Class, in some guise or another, is always a latent variable whose invisibility obscures possibilities for action. However this remains not merely an epistemic or empirical question, but a political and an ideological one and your response to this paper, will be similarly political.

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