TEACHING MATHEMATICS FOR SOCIAL JUSTICE: TRANSFORMING CLASSROOM PRACTICE

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This discussion paper draws together a theoretical analysis of the potential of school mathematics to be either exploitative or empowering and the findings from a recent research project. It reports on how the participatory action research project impacted upon the thinking and classroom practice of a group of five secondary mathematics teachers. It considers the implications for transforming classroom practice in relation to teaching mathematics for social justice on a wider scale.

INTRODUCTION

The world is facing a crisis involving financial instability and political turmoil. Increasing income inequality is leading to greater social unrest, disquiet and a lack of trust in political leaders who have failed to deliver on their promises to promote social mobility and democratic reforms. So what has this got to do with mathematics education? I suggest two links. Firstly, school mathematics contributes towards perpetuating inequities existing within society, and secondly, mathematics education has the potential to develop the thinking and skills required for future generations to address global challenges we face. In this paper, I explore these two claims further, before discussing implications for the transformation of mathematics teachers' classroom practice with reference to the findings from a recent research project.

SCHOOL MATHEMATICS AND SOCIAL INEQUITY

Bourdieu argues that the primary function of schooling is to ensure that social divisions and unequal power relations are reproduced from one generation to the next (Bourdieu & Passeron, 1990). He claims that children from wealthier backgrounds acquire greater 'cultural capital' through their upbringing, placing them in a better position to make the most of the opportunities offered, and behave in ways that are valued, by schools (Jorgensen, Gates, & Roper, 2014). This process is disguised by presenting schooling as a meritocracy in which success is attributed to the natural talent of some students, rather than to structural advantages they may be afforded within the education system. An example of how mathematics plays a leading role in this process is the prevalence in England of 'setting', in which students of similar prior attainment are grouped together, despite little or no empirical justification for doing so. Setting relies on the notion that mathematical ability is innate and fixed, which is used to legitimise placing some children in lower sets, where they often experience an impoverished curriculum that reinforces their belief that they are weak mathematically (Black, Mendick, & Solomon, 2009).

Nardi and Steward (2003) highlight disturbingly high levels of alienation from mathematics amongst secondary (age 11 to 16) students. Noyes (2012) attributes this to the predominance of a transmission-led orientation towards mathematics teaching.

Skovsmose (2011) warns of the ascendancy of the *exercise paradigm*, in which the teacher explains a mathematical procedure before students practice a series of almost identical closed questions and are then tested on their understanding. Not surprisingly, school mathematics is frequently perceived by students as being boring and irrelevant (Boaler, 2009; D'Ambrosio, 2006). However, children from wealthier families, often with higher levels of *cultural capital*, are more predisposed towards learning mathematics, even if its purpose is unclear, since they are more likely to appreciate its status as a *critical filter* that regulates access to higher education and future employment (Black, Mendick, & Solomon, 2009). A disengaging mathematics curriculum can therefore exacerbate gaps in achievement between children from different social groups, explaining the enduring correlation between mathematics attainment, participation and family income (Boaler, Altendorf, & Kent, 2011).

The international mathematics education community has called consistently, for over thirty years, for a more engaging mathematics curriculum, with a greater focus on *progressive* teaching approaches (Cockcroft, 1982; NCTM, 1989). These involve encouraging collaboration, discussion, investigation, communication, justification and reflection amongst students. Proponents of such approaches argue that they result in deeper levels of conceptual understanding, an appreciation of why mathematical procedures work and how to apply them to solving problems in unfamiliar contexts (Boaler, 2009; Swan, 2006). These skills prepare students better for problems they encounter in real life, and are increasingly demanded by universities and employers (ACME, 2011). So why have calls for more progressive teaching approaches been consistently ignored by educational policy makers? Part of the reason is that politicians, who tend to be preoccupied with the contribution mathematics makes to promoting economic growth, have begun to intervene to a much greater extent in curriculum change (Wright, 2012). Skovsmose (2011, p. 9) argues that the exercise paradigm cultivates a *prescription readiness*, preparing students for *"participating in work processes where a careful following of step by step instructions without any question is essential"*. Gutstein (2006, p. 10) claims that the current disempowering mathematics curriculum merely reflects a capitalist economy's need for *"low-skilled, compliant, docile, pleasant, obedient service workers"*. It is hardly surprising, given the current economic and political crisis, that governments are not overly keen on establishing curricula that promote widespread critical thinking amongst their populations. However, for those with a genuine concern for issues of equity and social justice, there is a clear need for a more engaging and empowering mathematics curriculum that will provide learners with the type of mathematical skills and understanding they require to lead an active and fulfilling life, to avoid being exploited, and that will enable society to solve the problems it faces on a global scale.

MATHEMATICS EDUCATION FOR EMPOWERMENT

D'Ambrosio (2006) contends that, through colonisation, a form of *academic* mathematics was imposed by Europe on the rest of the world, subordinating indigenous cultures and displacing other more meaningful forms of mathematics. He argues,

therefore, that mathematics educators have a responsibility for helping to address the growing crises facing humanity. Given schooling's tendency to reproduce inequities within society, and the apparent reluctance of governments to challenge this situation, what can the mathematics education community do to disrupt this cycle? How can researchers and teachers work together to develop an engaging and empowering mathematics curriculum, based on a *humanist vision* of education, that advances equity, social justice and sustainable development (UNESCO, 2015)?

Gutstein (2006) claims that progressive teaching approaches are a necessary, but not sufficient, pre-condition for such a curriculum. Bernstein (2000), however, highlights how these pedagogies can be problematic as the *rules of the game* in the mathematics classroom are less clear to students when more open-ended approaches are adopted. This can further disadvantage children from working-class backgrounds, who generally find it more difficult to identify relevant meaning from classroom tasks (i.e. follow *recognition rules*) and respond in an appropriate manner (i.e. follow *realisation rules*). However, the potential of progressive pedagogies for promoting engagement with mathematics suggests that, rather than avoiding them altogether, strategies should be explored for making the *rules of the game* more explicit. This reflects Skovsmose's (2011) argument that *critical mathematics education* should be preoccupied with students reflecting *on* mathematics, i.e. considering its nature and status in society, as well as *with* and *through* mathematics, i.e. using it as a means to explore their own situation and participating in mathematical inquiries that involve making their own decisions. Boaler (2009) describes school mathematics as an impoverished re-contextualisation of mathematics in which students have limited opportunities to experience the work of real mathematicians. Black, Mendick and Solomon (2009) argue that progressive teaching approaches encourage more students to develop positive relationships with mathematics and to study it beyond compulsory level. An empowering curriculum, however, necessitates going beyond inducting students into the somewhat artificial world of school mathematics by enabling them to exploit mathematics as a way of making better sense of their world. Drawing on Freire's ideas of *conscientisation*, Gutstein (2006) advocates *reading and writing the world with mathematics* in which genuine mathematical understanding develops alongside students exploring social issues and taking part in social action.

Critical mathematics education demands that greater consideration is given towards power relations that exist between researchers and teachers, as well as between teachers and students. Much educational research is conducted *on*, rather than *with*, practitioners and fails to take into account the constraints they face in the classroom (Bishop, 1998), often being conducted in *prototypical* classrooms in which social justice issues are less obvious (Skovsmose, 2011). Whilst there is growing interest in researching social justice issues in mathematics education, many such studies tend to be theoretical or philosophical in nature (Wright, 2015). Proponents of action research argue that working collaboratively with practitioners to develop an *understanding of theory-in-practice* generates knowledge that is more likely to be relevant to other practitioners

and lead to positive social change (Torrance, 2004). Action research has the added benefit for participants of deepening understanding of their own situation and developing a critical understanding of research processes, making them better *"equipped to engage with and be discerning consumers of research"* (BERA, 2014, p. 5). Poststructuralist researchers, however, offer a critique of action research by maintaining that *universal truths* (such as *empowerment*) are non-existent and that *situated truths* exist only within a discourse (MacLure, 2003). A response from a critical perspective would be to reject the notion that knowledge generation can be objective and accept the partiality of action research as a practice that is *"explicitly political, socially engaged, and democratic"* (Brydon-Miller, Greenwood, & Maguire, 2003, p. 13). From this perspective then, poststructuralist research, at best, merely seeks to explain the status quo whilst, at worst, offers an excuse for ignoring existing inequality, injustice and exploitation.

Skovsmose and Borba (2004) offer a *critical research* model of participatory action research, which shares a *"research-resonance within critical mathematics education"* (p.209). It recognises mathematics education and research as fundamentally political practices. It rests on the assumption that the *current situation* should not be taken as given and that a more desirable alternative, i.e. an *imagined situation*, should be sought. It incorporates processes that help teachers to develop a critical understanding of the *current situation* and to investigate an *arranged situation*. This involves trying out aspects of the *imagined situation*, whilst taking into account the constraints of the *current situation*, in order to examine the feasibility of the *imagined situation*.

THE RESEARCH PROJECT

I report below on a research project, based on the critical research model, which aimed to explore how a concern for social justice amongst mathematics teachers could be translated into classroom practice. Invitations were sent out to those who had recently completed the initial teacher education course on which I was a tutor. It was made clear that participants should be committed to the following framework for *teaching mathematics for social justice*, reflecting the theoretical discussions above:

> 1) Employ collaborative, discursive, problem-solving and problem-posing pedagogies which promote the engagement of learners with mathematics;
> 2) Recognise and draw upon learners' real-life experiences in order to emphasise the cultural relevance of mathematics;
> 3) Promote mathematical inquiries that enable learners to develop greater understanding of their social, cultural, political and economic situations;
> 4) Facilitate mathematical investigations that develop learners' agency, enabling them to take part in social action and realise their foregrounds;
> 5) Develop a critical understanding of the nature of mathematics and its position and status within education and society. (Wright, 2015, p. 27)

A research group was established in June 2013 comprising five teacher researchers, Anna, Brian, George, Rebecca and Sarah (all pseudonyms), who were nearing the end

of their first year as newly-qualified secondary mathematics teachers, and myself. All five taught in ethnically diverse comprehensive schools in inner-city London, with above average numbers of students who spoke English as an additional language, had statements of special educational need, and were eligible for free school meals. The first meeting of the research group focused on teacher researchers engaging with the theoretical ideas and research findings underpinning the project and relating these to their own practice. The remaining six meetings involved planning and evaluating a series of classroom activities, as part of three participatory action research cycles, and reflecting further on thinking and practice in light of these experiences. My role was mainly that of facilitator, for example by introducing relevant research findings and inviting teacher researchers to present selected readings to the rest of the group for discussion. The research group drew on previously existing resources to develop their own ideas to try out in the classroom (see Wright, 2016 for a collation of these). Teacher researchers made use of notes kept in research journals, and feedback collected from student surveys, when presenting their evaluations of classroom trials to the rest of the group for discussion.

I conducted a series of interviews with each teacher researcher, at the start, mid-point and end of the project. These were *empathetic* in nature, i.e. based on building relationships of trust to allow for the emergence of more meaningful representations of teacher researchers' views (Fontana & Frey, 2008). Data was collected through audio-recording and transcribing the research group meetings and interviews. The collaborative nature of the project meant it was not appropriate to collect data from observing lessons, as I felt this would have adversely affected the power dynamics between myself and teacher researchers. Instead, I sought to co-construct the stories of teacher researchers' participation in the project through interaction and dialogue (Kvale & Brinkmann, 2009). A thematic analysis was carried out on the transcripts, which involved breaking them down into units of meaning, summarising each of these and then assigning it a category. Inductive coding was used for this purpose, i.e. an initial reading of the data was used to derive the categories, examples of which included *students' engagement* and *constraints on teaching*. The categories were then used to compare units of meaning by looking for commonalities, differences and relationships between them, allowing themes to emerge (Gibson & Brown, 2009). The thematic analysis was iterative in nature as emerging themes were related back to the underlying theories to generate new analytical questions that influenced my choice of future interview questions. Initial findings were presented back to teacher researchers during meetings and interviews for their comment and to prompt further discussion. Whilst there is insufficient space here to describe the research project methodology in full, more detailed accounts can be found elsewhere (Wright, 2015). I summarise below the findings that are most relevant to the discussions in this paper.

SUMMARY OF RELEVANT FINDINGS

All five teacher researchers reported significant improvements in the engagement of students with mathematics resulting from the activities and teaching approaches tried

out during the research project. This was most noticeable amongst lower-attaining students and those who previously lacked confidence or behaved poorly in mathematics lessons. A particularly striking example was the response of one student in Anna's Year 8 bottom set, who was in her last week before being moved to a special school because of her poor behaviour. The class had been asked to discuss how a total hourly wage bill of £100 should be shared out between five workers in contrasting jobs, before relating this to wealth distribution in real life:

> But in terms of her enjoyment of the project … she was asking so many questions, she was putting forward so many views, she was working in a team. She was just like a dream child for the whole project. (Anna, Meeting 3)

The positive response of students reinforced the teacher researchers' commitment to the progressive pedagogies employed during the project. However, one aspect of the framework that they acknowledged having not previously considered was the promotion of students' agency. Rebecca described the transformation in her thinking arising from the *Making a Change Project* she devised, in which groups of students were asked to choose a social justice issue of interest to them, explore it in detail, identify a change they would like to see made and then use mathematics to back up their argument. The first time she tried this activity, she was frustrated when students made unrealistic demands, such as amending the school rules on body-piercing, and when logistical difficulties meant some students did not complete the task. However, when she fed back her experiences at the next research group meeting, the idea was embraced enthusiastically by other teacher researchers and became the focus for the next action research cycle. The group designed a more structured activity that retained the element of student choice whilst providing more guidance on how to generate a powerful mathematical argument. For example, students were asked to contrast two statements, such as *"one in five people go to bed hungry each night"* and *"there are lots of people in the world who are hungry"* (Wright, 2015, p. 69) to help them appreciate the difference between mathematical and non-mathematical statements. Rebecca reported how, when she tried the activity again, students came up with more realistic demands for change and made more effective use of mathematics to support their arguments. Feedback from students suggested the activities helped them recognise the relevance of mathematics to their everyday lives and they welcomed the opportunity to exert greater control over their own learning.

All five teacher researchers articulated how they initially focused their concern for social justice issues on raising the mathematics attainment of disadvantaged children (the initial teacher education course they chose to study had a policy of placing them in schools in the most deprived areas of London):

> I've chosen to teach in a school where it's classed as a challenging school, because the kids stereotypically wouldn't be expected to achieve very much. … So I think, in the sense of bringing about social justice through education, I'm involved in that just through being at this school. (Anna, Interview 1)

However, through engaging with relevant research literature, the teacher researchers began to appreciate the complexity of the relationship between social justice and mathematics education, and how structural issues could act as barriers to learning for their students. They began to ask themselves questions, often for the first time, about the nature of mathematics and the processes of schooling. Whilst George was alone in expressing concerns about setting (which was used in all their schools) at the start of the project, all five became increasingly critical of this practice. Rebecca began to question the rationale and fairness of grouping together students with generally weaker communication skills and poorer dispositions towards learning, whilst Anna proposed doing away with setting altogether were she to become head of department.

The teacher researchers also began to recognise their own tendency to teach lower-attaining students in a more structured way, often due to challenging behaviour they exhibited, which Rebecca described as the biggest constraint on trying out different approaches. Brian highlighted the importance of establishing a balance between encouraging all students to develop critical understanding and independence, and the need for lower-attaining students to acquire the social norms and dispositions towards learning required to become successful learners. He highlighted the value of building relationships of trust so that students would have faith in teachers when they were asked to question commonly accepted beliefs about learning mathematics:

> I'm able to almost take a step back … and say 'Why are we doing this?' … And why will there be some lessons that seem irrelevant, and some lessons that seem completely unrelated to your lives? What's the broader aim there?' … And working with them in a way that allows them to both access what we're trying to learn in terms of skills sets and mathematical content, but also develop the broader skills that they need for life, and that allow them to make the most of opportunities that are there for them. (Brian, Interview 3)

The teacher researchers began to identify the conditions that deterred them and others from adopting more engaging and empowering approaches to learning mathematics. They highlighted the high levels of monitoring of their performance by managers, with a focus on short-term and easy-to-measure progress of students, and the pressure to get through the scheme of work in order to prepare students for regular tests. However, they reported how the collaborative nature of the research group provided the incentive and mutual support necessary to begin to overcome these constraints:

> It's given me the confidence to step off the scheme of work treadmill, of getting through different topics or chapters … and it's also provided that additional incentive to do it, and to take the risk … you know you're going to be allowed to talk about it in a way that says that messing up doesn't matter (Brian, Interview 3)

The teacher researchers concurred that the research project radically changed both their thinking and classroom practice. They described how the sustained nature of the research project, and its focus on relating theory to practice, had a greater impact on their teaching than other professional development they had experienced. They particularly welcomed the opportunity to meet with colleagues from other schools,

which exposed them to a range of different perspectives. They acknowledged the key role I played in introducing them to research theory, challenging their assumptions and providing a safe environment in which to develop ideas. All five, acting on their own initiative, became involved in disseminating ideas from the research project more widely within their schools, reflecting growing confidence and satisfaction with the direction in which their practice was developing. They experienced increasing levels of interest in the research project from other teachers as news spread about its positive impact on students' learning. George described this as the *multiplier effect*.

CONCLUSION

The research project provides evidence to support the claim made by Boaler (2009) and others that progressive teaching approaches can increase students' engagement with mathematics, particularly for those alienated from the subject or lacking confidence in their own ability. It highlights the need for teachers to establish relationships of trust so that they can challenge students' assumptions about learning and help them appreciate the *rules of the game* in the mathematics classroom (Bernstein, 2000). Enhancing the extrinsic motivation of all students to achieve in mathematics, whilst cultivating the behavioural and learning dispositions they need for success, can compensate for generally lower levels of *cultural capital* and intrinsic motivation possessed by those from disadvantaged backgrounds (Bourdieu & Passeron, 1990). The project therefore expounds on strategies that can potentially reduce gaps in attainment between students from different social groups. It points to how students can develop the mathematical skills and agency required to present a powerful argument for change, without necessarily taking part in the kind of direct social action advocated by Gutstein (2006). It therefore offers a vision of a teaching approach that fosters the type of critical mathematical understanding required for young people to better understand their situation and environment, and that equips them to take action in future to help resolve the crises currently threatening society.

The research project also highlights the potential of the *critical research model* (Skovsmose & Borba, 2004) for carrying out systematic and collaborative research with practitioners that generates relevant knowledge transferable to a wider range of contexts. It does so by focusing on typical constraints that teachers face in the classroom and showing how these can be overcome with the aid of mutual support provided by the research group. Through engaging with underlying theories, and relating these closely to classroom practice, it demonstrates how teacher researchers are able to acquire agency and self-efficacy as they gain a deeper understanding of their current situation and greater control over the extent and direction of their developing practice. It also shows how teachers benefit from being involved *in* research, rather than merely engaging *with* research findings, for example by developing a critical understanding of research processes. The reluctance of governments to advance pedagogies that promote critical thinking, particularly in times of crisis, magnifies the importance of *bottom-up* approaches to transforming classroom practice such as that proposed by the critical research model.

It should be noted that the research project was unfunded and relatively small in scale. Whilst there was significant interest shown by other teachers, the project was restricted to those who had already expressed a commitment towards teaching mathematics for social justice. Despite its limited scale, however, it provides a useful model and starting point for future larger-scale funded research projects. These could generate opportunities for even greater levels of collaboration, for example by providing additional time for discussion, reflection and peer observations amongst teacher researchers. Whilst the period of one year, over which the research project was sustained, witnessed significant impacts on thinking and classroom practice, an extended time frame would enable the longer-term impact on students' achievement and on teachers' professional development to be evaluated. Future projects might also explore how to transform the thinking and practice of teachers beyond those already exhibiting the same levels of commitment to teaching mathematics for social justice as those in this project, for example, by working with all mathematics teachers within a school, or with entire mathematics departments across a number of schools. The following question is posed for further discussion at the MES9 conference with a view to formulating ideas for developing future research projects of this nature:

> What would a research project look like that would transform classroom practice, in relation to teaching mathematics for social justice, on a wider scale?

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