

Teacher researchers, mathematics classrooms and social justice

Pete Wright, Institute of Education, University of London

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Abstract:

This study reports on the establishment of a research group, with five teacher researchers, for the purpose of exploring ways of translating a commitment towards teaching mathematics for social justice into related classroom practice. There are many constraints faced by teachers involved in curriculum innovation, including scarcity of available time and energy, due to heavy workloads, and pressure to get through schemes of work. Increased levels of monitoring and scrutiny, together with regular testing, promote 'low-risk' teaching strategies, and discourage innovative practice, for fear of hindering students' performance.

The focus of this study is the extent to which the format and operation of the research group, alongside a participatory action research model, impact upon classroom practice.

Seven meetings, facilitated by me, were held over the course of a year, focusing on raising awareness in the group of issues related to the research, then planning and evaluating classroom interventions as part of three participatory action research cycles. Audio-recordings were made of these meetings and three semi-structured empathetic interviews conducted with each teacher researcher. This data was supplemented by student surveys designed and administered by the teacher researchers themselves.

The aim of my research is to challenge the current situation and to bring about change. I draw upon a critical paradigm to argue that my role, as university-based researcher, in instigating and facilitating the inquiry, is vital to ensure it is transformational. I reject any pretence that this project, in common with other research, can be truly impartial or objective. I argue that such a stance is compatible with grounded theory methods, which I draw upon for my analytical framework. Through a process of interpreting, identifying themes and constructing meaning from the data, I narrate the stories of the five teacher researchers.

Initial findings from the project suggest that the collaborative and participative nature of the research group proved emancipatory and empowered teacher researchers to overcome many of the constraints described above. The research project promoted the self-efficacy of teacher researchers in addressing issues of social justice in their mathematics classrooms and strengthened their belief in the legitimacy of their endeavours. There was evidence that the processes involved in the participatory action research design enabled teachers to develop agency amongst students, raise levels of engagement with mathematics and build an appreciation of how mathematics can serve as a tool to understand the world.

A critical perspective on current practice in teaching mathematics

There have been numerous calls from the mathematics education community, over the past thirty years (and longer), for the school mathematics curriculum in England to be made more engaging and relevant for students, and for a greater focus on promoting conceptual understanding and problem-solving skills (Cockcroft, 1982; NCETM, 2008; Boaler, 2009). The mathematics curriculum, however, remains stubbornly resistant to change with too many classrooms characterised by factual recall and procedural understanding, leading to the alienation and disaffection of learners (Nardi & Steward, 2003; OFSTED, 2012). The high stakes nature of mathematics assessment, and resultant pressure to teach to the tests, discourages teachers from taking risks and being innovative, and from questioning the apparent lack of meaning and purpose of school mathematics.

Anxiety towards mathematics is exacerbated by the gatekeeper position it occupies, with attainment in school mathematics determining access to higher status post-compulsory education courses and higher paid employment (Black, et al., 2009). While differences in mathematics attainment by gender have narrowed over recent years, the most significant difference in attainment between groups remains that between students from different socio-economic backgrounds (Noyes, 2008). These differences in attainment, which Bourdieu and Passeron (1990) attribute to schools privileging the 'cultural capital' which students from middle class backgrounds tend to accumulate, serve to reproduce inequities within society.

The privileged position mathematics holds within the curriculum is perpetuated partly by myths that it is a value-free and neutral subject, based solely on logical thinking and deductive reasoning, which can be used as a general measure of intellect (D'Ambrosio, 2008). This view is widely held amongst teachers, the education community and general public. Policies of successive governments have emphasised the importance of mathematics education for promoting economic growth, leading to a predominantly functional mathematics education for many students, particularly those from lower income families (Gutstein, 2006). Whilst mathematicians in higher education institutions lobby for an increased focus on mathematical reasoning and problem-solving skills, often this is restricted to areas of mathematical proof, and abstract algebraic and geometrical reasoning, which they argue are most appropriate for preparing students to study mathematics at degree level (Andrews, 2012).

Very little thought has been given by educational policy makers towards making the learning of mathematics a pleasurable and enjoyable experience, addressing issues of equity, or developing mathematical understanding and reasoning which empower students to play an active and fulfilling role in society. Whilst these aims remain aspirational goals within official curriculum documents, and resonate with many academic articles published by mathematics researchers (Gates & Jorgensen, 2009), they do not reflect the current situation in schools. This research project aims to work with teachers in order to develop an alternative vision of mathematics education which includes how teaching the subject is inseparable from addressing issues of social justice. It is based on a critical perspective which maintains that the research should not accept the status quo as a given, and should aim to bring about positive social change.

The project focuses on the following research question:

How can a commitment towards 'education for social justice' amongst mathematics teachers be translated into pedagogy and classroom practices which promote such aims?

Conceptualisation of teaching mathematics for social justice

My initial conceptualisation of teaching mathematics for social justice, adopted at the start of the project, was based upon Skovsmose's (2011) notion of reflecting 'with', 'through' and 'on'

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mathematics. Reflecting 'with' mathematics involves using mathematics as a means of inquiry for students to understand, and hence be in a better position to change, their own social, political, economic and cultural situation. This aspect is informed by Gutstein's (2007) real world projects, which he used with students in a US school to help them to 'read and write the world with mathematics'. This in turn is based on relating Freire's (1974) ideas, on literacy and conscientisation, to the mathematics classroom. Reflecting 'through' mathematics involves learning mathematics in an open-ended way in which students make decisions about, and take responsibility for, their own mathematical learning. It involves adopting collaborative, problem-solving, and problem-posing pedagogies, such as those advocated by Boaler (2008) in the 'Railside Project'. Reflecting 'on' mathematics involves developing a critical awareness amongst students of the nature of mathematics, its position within the curriculum, and its status within society.

Research methodology and design

My methodology rests upon the assumption that mathematics education is a fundamentally social and political practice: "*mathematics education is a covert battleground in which the discourses of different practitioner and professional groups compete for dominance*" (Ernest, 2004, p. 82). It is equally important to consider power relationships and ideologies in mathematics education, and in carrying out research into mathematics education (Valero, 2004). Therefore I adopt a research design which resonates with the aims of the project and pays particular attention to my role as a university-based researcher and the roles of the teachers participating in the project.

My research design is based upon a 'participatory action research' model, which is socio-political, participative, collaborative, emancipatory, critical and recursive in nature (Atweh, 2004). It involves researching 'with', rather than 'on', teachers, in a genuine collaboration, which generates research data that is "*crucial to developing an understanding of theory-in-practice*" (Torrance, 2004, p. 199). Skovsmose and Borba (2004) propose a model of participatory action research, which they refer to as 'critical research' which aims to uncover 'how' and 'why' a situation could be different and shares a "*research-resonance within critical mathematics education*" (p. 209).

A research group was established in June 2013, consisting of five teacher researchers, Anna, Brian, George, Rebecca and Sarah (all pseudonyms), and myself. Planas and Civil (2009) highlight how raising the awareness of the teacher researchers is a necessary precondition for meaningful change to take place in the classroom. The first meeting of the group therefore focused on discussing my initial conceptualisation and the research design, both of which I presented to the group. My role in facilitating the group was crucial in order for teacher researchers to develop a critical understanding of their own practice in relation to the theoretical framework, and to begin to articulate what desirable alternatives might look like.

Six more meetings of the research group were held between September 2013 and July 2014, at which activities, to be tried out in the classroom as part of three action research cycles, were planned collaboratively. Teacher researchers subsequently shared their experiences of teaching the activities, and related their evaluations back to the initial conceptualisation. Research journals were used to record teacher researchers' observations and thoughts throughout the project, and a student survey, designed and administered by the teacher researchers themselves, was used after each activity to collect data on the impact of the project on students. I conducted three semi-structured empathetic interviews (Kvale & Brinkmann, 2009) with each teacher researcher at the beginning, mid-way through, and at the end of the project. The teacher researchers were asked to write a short report, including their thoughts and experiences on their involvement with the research, at the end of the project. The research group meetings and interviews were audio-recorded, transcribed and analysed

using a thematic approach, drawing on methods from grounded theory. These included assigning categories, generated inductively, to units of meaning and using the 'constant comparative method' to re-read and analyse the data enabling themes to emerge (Gibson & Brown, 2009). The findings were then related back to the theories underlying the research in order to generate further analytical questions and give new meaning to the data (Jackson & Mazzei, 2012).

Research findings

My analysis of the data showed that the research project, based upon the critical research model of participatory action research, had a significant impact on the engagement of students with mathematics and on the development of the teacher researchers' thinking and classroom practice.

Through discussing their experiences of trying out previous activities in relation to the initial conceptualisation, teacher researchers designed an activity, which they called the 'Making a Change' project. This involved groups of students choosing a social justice issue of interest to them, researching it, and using mathematics to construct an argument to support a change they would like to see made. The final lesson involved the groups presenting their argument to the rest of the class, who evaluated the presentations on the basis of which one made the best use of mathematics in supporting the argument. In common with other activities, there was a significant increase in engagement amongst all students, but especially so amongst students who were previously disaffected or alienated from mathematics.

Making mathematics more meaningful, and more relevant to students' lives, appeared to be more likely to convince them that it has a worthwhile purpose. There was growing appreciation amongst teacher researchers that this is particularly important for students who have accumulated less cultural capital, who are less likely to conform to expected behavioural norms and who are generally less disposed towards learning mathematics purely for the sake of learning it, or because they recognise its position as a gatekeeper qualification. The other powerful aspect of the Making a Change project was its potential for developing student agency and helping them realise the extent to which mathematics can be used to interact with, and influence, the world around them.

A really enjoyable part of this project was giving students the chance to present an argument for something they wanted to see change. The response of the pupils to this task was so positive that I think it is something I would try to conduct in one way or another with all of my classes. When given a set of arguments pupils were quick to state that those containing statistical content were stronger than those lacking it. As a result with little encouragement other than some careful scaffolding, they produced presentations saturated in mathematical content. Producing their own arguments and listening to those of others led to many expressing surprise at the utility of mathematics. Some claimed they would never again ask, 'What's the point?' or 'Where will we use it in real life?' but I hope they don't stick to this.
(Brian, Short Report)

Teacher researchers attributed the impact the project had, on the development of their thinking and classroom practice, to the collaborative and participatory nature of the research group. They described how being presented with and discussing the initial conceptualisation, which was periodically returned to during the project, challenged their previous assumptions about the nature of school mathematics and their views of the aims of mathematics education. They particularly valued the opportunity to meet with colleagues from different schools, with a common interest, in order to share ideas, thoughts and experiences. The mutual support provided by members of the group enabled them to identify and overcome many of the constraints they encountered in their schools, as well as providing legitimacy to their endeavours.

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Being part of the research group has introduced me to a lot of new ideas – the one that sticks with me is the idea that maths is not value-free, because I remember it seeming so strange an idea when I first heard it during the meeting, but yet it made so much sense. I've always enjoyed learning new things, and I think the meetings were my favourite part of the project because I invariably arrived exhausted after rushing up from school, but left feeling like I'd learned something. The collaboration with people in other schools teaching similar things was a big morale boost as well as being incredibly useful. I think my enthusiasm would definitely have waned after the first few badly planned activities if I had been trying to do this on my own. (Rebecca, Short Report)

Teacher researchers grew in confidence in developing their practice in a direction that they were comfortable with. They described how the project enabled them to re-engage with the reasons why they had come into teaching in the first place, typically a desire to address issues of inequity and injustice through education, which they felt they had lost sight of due to the exam-focused nature of the curriculum and the pressure to teach to the tests. They began to challenge structural inequities that they had previously been unaware of, for example they developed a critique of the use of setting by ability in mathematics, which was the norm in all four schools in which they taught.

For me, while there were numerous clear benefits for current learners in my classroom, the true impact of being part of this project is something that will be seen in the long term. Specifically, I believe participation in the project will impact the learning of my future students due to the following; the positive impact on my professional understanding of how maths can be taught in a way that creates beautiful learning opportunities which learners enjoy, the opportunity to develop my skills as a collaborative and reflective practitioner, and the (unanticipated) modification of my own conceptualisation on the nature of maths as a subject. (Anna, Short Report)

Teacher researchers' confidence was evident by the end of the project in the extent to which they began to share and disseminate ideas from the project across their schools. It was noticeable how positive the response was from colleagues in their departments who showed increasing levels of interest in the project as they became aware of the positive impact the project had on both students and teacher researchers.

Conclusion

The initial conceptualisation of teaching mathematics for social justice serves as useful starting point for teachers to reflect on their own practice and to begin to formulate alternative approaches to teaching mathematics. The research findings demonstrate the potential of the conceptualisation for increasing levels of engagement with mathematics amongst students, particularly those who are alienated from mathematics, as well as for developing students' mathematical agency. It offers a framework for translating the abundance of theories about social justice and equity in mathematics education into classroom practice.

The critical research design offers an effective model of participatory action research that resonates with an aim to bring about positive social change. It enables teacher researchers to engage in research, as well as with research, producing findings which are relevant, as they offer insight into how to overcome constraints existing within the current situation. The collaborative and participatory characteristics of the research model enable teachers to develop agency and self-efficacy through controlling the extent, and the direction of, changes in their thinking and classroom practice. It offers a highly effective model of professional development, as well as the potential to promote teaching mathematics for social justice within schools.

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