Teaching mathematics for social justice: translating theory into classroom practice

Pete Wright
Institute of Education, University of London

There is growing consensus, amongst teachers, teacher educators and researchers, that a more engaging and relevant school mathematics curriculum is needed, with greater emphasis on problem-solving skills and the development of conceptual understanding. Too much focus on factual recall and procedural understanding has led to unacceptable levels of disengagement and disaffection amongst learners.

This paper reports on initial findings from a project involving a group of teacher researchers who share a commitment to addressing the alienation of learners, raising their awareness of the nature of mathematics and the reason for learning it, developing student agency and an appreciation of how mathematics can be used to better understand the world around them.

I make use of a participatory action research methodology to explore how being part of a research group can help teachers to begin to develop their classroom practice in ways which resonate with a commitment to teaching mathematics for social justice. I identify four themes emerging from an analysis of an initial series of semi-structured empathetic interviews with the teacher researchers that provide a useful theoretical framework for the development of the project and useful insight for others wishing to carry out research in a similar field.

Keywords: mathematics education, social justice, action research.

Rationale behind the research project

Teachers hold a range of views on the aims for teaching mathematics including developing an appreciation of the beauty of the subject and enabling learners to develop important reasoning and communication skills in preparation for solving problems in 'real' life. However, these aims are increasingly in conflict with the educational policies of successive governments, which have placed renewed emphasis on basic skills and the functional aspects of mathematics.

Consensus amongst mathematics teachers, teacher educators, academics, local authority advisors and school inspectors in England, is that a more engaging and relevant mathematics curriculum is needed with greater emphasis on problem-solving and conceptual understanding (ACME, 2011; Ofsted, 2012). However, the high stakes nature of mathematics assessment, and resultant pressure to 'teach to the test', means that most mathematics classrooms remain based on the teaching of a school mathematics curriculum lacking relevance and interest, focusing on factual recall and procedural understanding, and leading to the disengagement and disaffection of learners (Nardi and Steward, 2003).

Gutstein (2006: 10) describes the demands of modern capitalist economies for "an ever-growing army of low-skilled, compliant, docile, pleasant, obedient service sector workers … [to perform] tasks that do not require workers to do mathematics in the same ways as the people they serve", explaining why many students, particularly

those from low-income and ethnic minority families, receive a predominantly functional mathematics education.

This research project is intended to challenge this status quo by promoting the teaching of mathematics for social justice (TMSJ), an aim that is best overlooked, and at worst discouraged, by current policies, practices and discourses. With the aim of bringing about desirable change in the teaching of mathematics, the following question is posed: "How can mathematics teachers translate a commitment towards 'education for social justice' into pedagogy and classroom practices which resonate with such a commitment?"

Whilst there is an abundance of research literature on mathematics education and social justice, most studies tend to be theoretical or philosophical in nature. What limited published research is available, focusing on translating such ideas into classroom practice and pedagogy, is based mainly on studies from the US, where conditions within schools are significantly different to those in England.

A 'participatory action research' methodology

My methodology is based on the premise that mathematics is a human construct, created by a need to make sense of the world. As such it is value-laden rather than neutral, with its content determined by those in positions of power, such as those who fund research into new areas of mathematics. I consider privilege, equity and social justice to be critical to the study of mathematics education, which is fundamentally a social and political practice (Ernest, 2004).

The primary aim of my research is to bring about desirable social change, in this case working with teachers to help them translate their commitment to TMSJ into practice. Such a stance necessitates considering the power relationships between all participants in the research, including teachers, students and school leaders, and recognising the important role that I, as researcher, will play in constructing knowledge and meaning. From the acceptance of my position of partiality in the research process, reflexivity, i.e. being able to stand back and observe your own subjectivity from a distance, is essential in establishing validity (Reason, 1994). Ladkin (2005) argues that concepts such as inequity and social justice cannot be fully understood without experiencing them, necessitating the construction of knowledge through action.

Bearing in mind the focus and aim of my research, I have adopted an action research methodology based on fostering collaborative relationships between myself as researcher and teachers. Torrance (2004: 199) highlights how a collaborative approach between academics and teachers through action research generates research data that is "crucial to developing an understanding of theory-in-practice".

A 'critical research' design

The TMSJ Research Group was established in June 2013, comprising five teacher researchers, who responded to my invitation, and me, as university-based researcher. I had sent out invitations to former student teachers who completed their PGCE mathematics qualification and gained qualified teacher status in 2012, all of whom I have worked with in my role as a university-based teacher educator. An accompanying leaflet included detailed information on the aims of the project and made clear the requirement that research participants should share a commitment towards TMSJ and be prepared to attend seven research group meetings, participate in

three interviews, keep a reflective diary and try out at least one classroom activity per action research cycle (three in total).

I have based my research design on Skovsmose and Borba's (2004) 'critical research' model, which aims to carry out research 'with' others rather than 'on' others and to uncover 'how' and 'why' a situation can be different. The model involves participatory action research cycles based on current, imagined and arranged situations. The 'current situation' (CS) is, in this case, the reality of mathematics teaching in schools as described above. Because of the importance of developing a critical understanding of the CS, and acknowledging that this situation should not be taken as given, teacher researchers were encouraged at the initial meeting to reflect upon, and develop a critique of their own classroom practice. The 'imagined situation' (IS) is a vision of what could be, in this case what teacher researchers envisaged as a desirable alternative to the CS after engaging with my conceptualisation of TMSJ. The 'arranged situation' (AS) represents an attempt to put some aspect of the imagined situation into practice, bearing in mind the reality and constraints of the current situation. The aim of the three critical research cycles, to be spread over the 2013-14 academic year, is to coordinate the sharing of ideas and the planning, teaching and evaluation of classroom activities. I anticipate that, through evaluating the success of these interventions (AS_1, AS_2, …) and discussing their significance in relation to the imagined situation, teacher researchers will begin to develop their own conceptualisations of TMSJ (IS_1, IS_2, …), and develop their own classroom practices (CS_1, CS_2, …).

An initial seminar-style meeting was held in July 2013 at which I provided further information about the project. I presented my research methodology and my initial conceptualisation of TMSJ (described in the next section below) for further discussion and invited teacher researchers to relate this to their current classroom practice. Planas and Civil (2009) highlight the critical role that the university-based researcher should play in establishing and facilitating a research group of teachers, in particular, by raising teachers' awareness of issues of social justice, promoting collaboration and sharing of ideas amongst group members, taking responsibility for the collation and analysis of data and reporting research findings.

My initial conceptualisation of 'teaching mathematics for social justice'

During my fifteen years of teaching mathematics, I witnessed first-hand the effects of educational policies which serve to marginalise and alienate certain groups of students in the mathematics classroom. I have seen how the dominant school mathematics discourse has changed, from the promotion of student-centred learning and mixed-ability teaching in the mid 1980s, towards a culture of rigid testing and setting based on prior attainment. This has strengthened my commitment towards mixed-ability teaching, collaborative inquiry-based learning and empowering students through mathematics.

In developing my own conceptualisation of TMSJ, I draw upon Gutstein's (2006) work on 'reading and writing the world with mathematics', in turn based on Freire's ideas on literacy and conscientisation, and upon Skovsmose's (2011) model of 'critical mathematics education'. Gutstein's (2003) 'real world projects' and Boaler's (2008) *Railside Project* aim to develop student agency, through using mathematics to understand and change the world around them, and making decisions and taking responsibility for their own learning in mathematics. Skovsmose (2011) describes these processes as reflecting 'with' and 'through' mathematics. However, he

also contends that students need to reflect 'on' mathematics by developing a critical understanding of the nature of mathematics and its role in society.

Ernest (1991) characterises epistemologies of mathematics as being either 'absolutist', i.e. based on a view of mathematical truth as objective and unquestionable, or 'fallibilist', i.e. based on a view of mathematical truth as a human construct and open to constant revision. He argues that a 'public educator' ideology, which is similar to what I describe as a commitment towards TMSJ, is associated with a 'fallibilist' epistemology, and is the only ideology of mathematics education to acknowledge that the assertion that mathematics is 'value-free' in nature is a myth.

I also draw upon Bourdieu's theory of reproduction (Bourdieu and Passeron, 1990), which regards one of the school's primary functions as reproducing the social order and maintaining unequal power relations between different classes and groups in society. Mathematics contributes to this process by functioning as a 'critical filter', with success in school mathematics providing much higher levels of access to further education and employment opportunities (Black et al., 2009). Mathematical attainment remains strongly correlated to social class, more so than to any other difference such as ethnicity or gender (Noyes, 2007). Bernstein's (2000) analysis suggests a danger that well-meaning attempts to encourage student-led learning and collaborative problem-solving pedagogies, might actually contribute to stronger reproduction of inequities as a result of middle class students benefiting from less explicit recognition and realisation rules. However, rather than avoiding the use of such pedagogies, I argue that the solution is to make the 'rules of the game' and rationale behind classroom practices more explicit to students.

In summary, my conceptualisation of TMSJ includes five aspects: using collaborative, problem-posing and problem-solving pedagogies; emphasising the cultural relevance of mathematics and recognising learners' real-life experiences; using mathematical inquiries that enable learners to develop greater understanding of their social, political, economic and cultural situation; developing agency that enables learners to realise opportunities which these situations provide; developing a critical awareness of the nature of mathematics and its position and status within education and society.

Data collection and analysis

Following the initial meeting of the research group, I completed a series of semi-structured empathetic interviews with teacher researchers in September 2013. A thematic analysis approach was used to analyse the data from these interviews, making use of "meaning condensation" and "meaning interpretation" (Kvale and Brinkmann, 2009: 207). This approach draws on methods from 'grounded theory', described by Gibson and Brown (2009: 26) as "the process of developing theory through analysis, rather than using analysis to test preformulated theories". Such methods are consistent with my methodology as there is no pre-existing hypothesis, on how to translate a commitment towards TMSJ into practice, to be tested.

Since my intention is to analyse and report teacher researchers' experiences as a "readable public story" (Kvale and Brinkmann, 2009: 181), interviews were audio-recorded and then transcribed using a literary style by, for example, ignoring pauses, fillers, intonations, colloquialisms during conversations. By reading and re-reading the transcripts, and listening again to the original audio recordings, the meaning within the transcripts was then condensed by breaking down the text into units of meaning and summarising these as simply as possible using descriptive text. Drawing

upon the "constant comparative method" (Gibson and Brown, 2009: 28), I then assigned a category to each unit of meaning, allowing me to re-read the data, focusing on selections of text which shared the same category, in order to explore commonalities, differences and relationships between the units of meaning. This process enabled me to draw out four themes from the data, whilst avoiding the danger of losing meaning through the use of codes and categories in too rigid a way.

Jackson and Mazzei (2012: viii) outline the need to avoid the "simplistic treatment of data and data analysis in qualitative research that … reduce complicated and conflicting voices and data to thematic 'chunks' that can be interpreted free of context and circumstance". As an alternative they suggest "plugging in" the data to the texts of theorists whose work underlies the research. This process, characterised by "reading-the-data-while-thinking-the-theory" (p.4) allows new analytical questions to emerge that can give new meaning to the data. I conclude this paper therefore by relating the four emerging themes back to the research question and the theories underlying my initial conceptualisation of TMSJ in order to identify wider themes and create meaning from the data (Kvale and Brinkmann, 2009).

Emerging themes

Four themes emerged from the analysis of the first set of interviews with teacher researchers, whose names have been replaced below with pseudonyms. The first theme was that of changing epistemologies of mathematics. All teacher researchers had a close relationship with mathematics and considered themselves successful learners of the subject. However, involvement with the project had led teacher researchers to begin to question seriously, often for the first time, their previous assumptions about the nature of mathematics. Each of them described a shift from a perception of mathematics as 'value-free', e.g. as a child Anna saw it as just calculations and algebra, towards a view of mathematics as more 'value-laden'. Rebecca highlighted how the apparently value-free nature of mathematics had been part of its attraction for her when she was at school. However, her new-found desire to help students to see the relevance of the subject to their real life situation had made her begin to rethink her relationship with mathematics, potentially placing her in a position of epistemological conflict. The suggestion to make the nature and status of mathematics more explicit to students, as discussed at the first research group meeting, was welcomed with interest by teacher researchers, although this was a new idea for all of them with the exception of Brian, who had previously discussed with students their feelings towards the subject.

The second theme emerging from the data was around beliefs in developing student agency, related to a common desire amongst teacher researchers to change society for the better, described by Anna, Brian and George as the primary reason for becoming teachers. Student agency was seen as having two characteristics. Firstly, there was a strong belief that students should take responsibility for their own learning, for example, by posing their own problems and developing their own problem-solving skills and mathematical reasoning. Sarah and George, in particular, placed a strong emphasis on helping students to see the rationale behind learning specific mathematical procedures, thus making school mathematics more meaningful. Secondly, agency was seen as empowering students to use mathematics as a tool to make sense of the world around them, particularly important, as highlighted by Rebecca, given the amount of information in the modern world including misleading arguments based on the misuse of data. Thus teacher researchers saw it as legitimate

to tackle social justice issues within mathematics lessons, including common misperceptions of the level of benefit fraud (Anna), levels of global inequality (Brian), water usage and sustainability (George) and exploring data about lifestyle (Sarah). There was general agreement that the boundaries between mathematics and other subjects are too rigid and such barriers should not stand in the way of tackling issues such as those outlined above.

The third theme to emerge was an appreciation of the opportunity provided by the research project to share ideas and work collaboratively with other teachers in a research group, described by all five teacher researchers as a key motivation for taking part. There was a wide range in levels of previous engagement with social justice issues amongst teacher researchers, with Rebecca beginning to consider their relevance to teaching for the first time, whilst Brian and George had been active in development organisations in the field of education for a number of years. However, all teacher researchers demonstrated a strong commitment to learning from each other and a strong desire to engage with research on participatory action research and TMSJ. They saw the project as coming at an ideal time in their careers, all having just completed their NQT year, when they were beginning to see themselves as established classroom practitioners and to consider the direction they would like the development of their classroom practice to take. Anna, Ben and George saw the project as an opportunity to re-engage with the reasons why they came into teaching in the first place. The collaborative nature of the project was also seen as a way of providing mutual support for overcoming challenges to bringing social justice issues into the mathematics classroom, including the additional time, energy and creativity required to plan such lessons and pressure to get through the scheme of work and prepare students for high-stakes school mathematics examinations. Brian described how high levels of monitoring and scrutiny of lessons by senior staff within the school resulted in 'low-risk' teaching. He saw collaboration with others through the project as giving legitimacy to tackling issues of social justice in his mathematics lessons that he might otherwise be more reluctant to do.

The fourth theme to emerge related to dominant discourses within mathematics education around 'ability', equity and attainment. All five teacher researchers had recently completed an initial teacher education programme that promoted a discourse of addressing educational inequities by focusing on raising attainment of students in schools with relatively disadvantaged intakes. Related to this was a perceived conflict between focusing on raising the mathematical attainment of students and teaching mathematics for social justice, e.g. Anna articulated a reluctance to lose the focus on preparing her students for exams. A focus on raising student attainment at the expense of tackling structural inequities and injustices was described by some teacher researchers as counter-productive, e.g. George highlighted the mismatch between the demands of higher education and employers for more creative independent thinkers, and a curriculum and system of schooling which stifles creativity and promotes compliance. Most teacher researchers suggested that raising issues of social justice would be easier with higher attaining groups of students due to their generally better behaviour and dispositions towards mathematics, and that it would need to be approached differently for lower attaining groups. This is ironic considering that students in lower attaining groups are generally those most disadvantaged by the current school system that TMSJ sets out to challenge. The assumption that setting in mathematics should be the norm in secondary schools, despite little research evidence to suggest that it works, generally went unchallenged by teacher researchers, although this may reflect the fact that it is something that they

are currently powerless to change and is beyond the remit of the project. George did acknowledge that teachers' own views of 'ability' and expectations of students should be considered as problematic.

Conclusion

By 'plugging in' the four themes emerging from the interviews to the theories underlying my initial conceptualisation of TMSJ, four wider themes have emerged which I use to develop further the theoretical framework underlying the project.

Insight into changing epistemologies of mathematics amongst teacher researchers might be gained from relating this development to Ernest's (1991) association between a 'fallibilist' view of mathematics and a 'public educator' ideology. The teacher researchers, whose views of mathematics are very much under self-review and liable to change, have already demonstrated a strong commitment to TMSJ. This suggests that Ernest's association is less clear-cut, perhaps reflecting the nature of school mathematics, in which questions about its nature, and the rationale for its study, are rarely considered.

A strong belief in developing student agency resonates with Gutstein's (2006) ideas on 'reading and writing the world' with mathematics, i.e. using mathematics to explore issues of social justice relating to students' real life situations is essential for making mathematics more meaningful and developing mathematical understanding.

The high levels of interest of teacher researchers in the collaborative nature of the project, and the research methods employed, highlights the potential of a participatory action research methodology for engaging teachers in research, as well as generating research findings based on the genuine interaction between theory and practice (Reason, 1994; Torrance, 2004). The active involvement of the teacher researchers 'in' the research process, including a willingness to engage critically with the research methodology, contrasts with the views of those advocating evidence-informed practice who are more likely to emphasise the need for teachers to engage 'with' research findings, i.e. implement what other researchers have shown to work.

Bourdieu would argue that the predominance of setting within mathematics classrooms, whilst being used to support the claim of the existence of a meritocratic system, is in reality disguising the primary function of schools, which is to reproduce inequities and hierarchies within society, hence the need to stifle creativity and promote compliance (Bourdieu and Passeron, 1990). He claims that teachers who wish to challenge this situation are in a contradictory position as, by the very fact of being teachers, they are giving legitimacy to the schooling system.

These wider themes will inform the development of the research project and help to capture the stories of how teacher researchers' conceptualisations of TMSJ, their own relationships with mathematics, and their success in developing student agency, evolve as they develop their own classroom practices and strategies for working within the constraints of the current school system. They also provide insight for other teachers and researchers, sharing a similar interest and commitment towards TMSJ, who wish to explore ways of translating such a commitment into practice.

References

ACME (2011) *Mathematical Needs – Summary*, London: Advisory Committee on Mathematics Education.

Bernstein, B. (2000) *Pedagogy, symbolic control and identity: theory, research, critique*. Revised edn. Lanham, Maryland: Rowman & Littlefield Publishers.

Black, L., Mendick, H. & Solomon, Y. (2009) Mathematical relationships in education: Identities and participation. New York: Routledge.

Boaler, J. (2008) Promoting 'relational equity' and high mathematics achievement through an innovative mixed-ability approach. *British Educational Research Journal*, 34(2), 167-194.

Bourdieu, P. & Passeron, J.-C. (1990) *Reproduction in education, society and culture*. 2nd edn. London: Sage.

Ernest, P. (1991) *The philosophy of mathematics education*. London: Falmer Press.

Ernest, P. (2004) Postmodernity and social research in mathematics education. In Valero, P. & Zevenbergen, R. (Eds.) *Researching the socio-political dimensions of mathematics education* (pp. 65-84) Dordrecht, Netherlands: Kluwer Academic Publishers.

Gibson, W.J. & Brown, A. (2009) *Working with qualitative data*. London: Sage.

Gutstein, E. (2003) Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education*, 34(1), 37-73.

Gutstein, E. (2006) *Reading and writing the world with mathematics: Towards a pedagogy for social justice*. New York: Routledge.

Jackson, A.Y. & Mazzei, L.A. (2012) *Thinking with theory in qualitative research: viewing data across multiple perspectives*. Abingdon: Routledge.

Kvale, S. & Brinkmann, S. (2009) *Interviews: learning the craft of qualitative research interviewing*. London: Sage Publications.

Ladkin, D. (2005.) 'The enigma of subjectivity': How might phenomenology help action researchers negotiate the relationship between 'self', 'other' and 'truth'?. *Action Research*, 3(1), 108-126.

Nardi, E. & Steward, S. (2003) Is mathematics T.I.R.E.D.? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal*, 29(3), 345-367.

Noyes, A. (2007) *Rethinking school mathematics*. London: Sage.

Ofsted (2012) *Mathematics: made to measure*, Manchester: Office for Standards in Education.

Planas, N. & Civil, M. (2009) Working with mathematics teachers and immigrant students: An empowerment perspective. *Journal of Mathematics Teacher Education*, 12(6), 391-409.

Reason, P. (1994) Co-operative inquiry, participatory action research and action inquiry: Three approaches to participative inquiry. In Denzin, N.K. & Lincoln, Y.S. (Eds.) *Handbook of qualitative research* (pp. 324-339) Thousand Oaks, CA: Sage.

Skovsmose, O. (2011) *An invitation to critical mathematics education*. Rotterdam: Sense Publishers.

Skovsmose, O. & Borba, M. (2004) Research methodology and critical mathematics education. In Valero, P. & Zevenbergen, R. (Eds.) *Researching the socio-political dimensions of mathematics education* (pp. 207-226) Dordrecht, Netherlands: Kluwer Academic Publishers.

Torrance, H. (2004) Using action research to generate knowledge about educational practice. In Thomas, G. & Pring, R. (Eds.) *Evidence-based practice in education* (pp. 187-200) Maidenhead, UK: Open University Press.