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How teaching mathematics for social justice can support inclusive practices in the elementary mathematics classroom

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The paper describes a project that took place in two elementary schools in London, U.K. By focusing on developing approaches to Teaching Mathematics for Social Justice (TMSJ), we identified opportunities and challenges for teaching and learning activities that promote inclusive practices and critical awareness amongst both teachers and students. By moving away from more traditional classroom practices and creating activities that were genuinely meaningful and engaging, teachers were able to engage their more 'reluctant' mathematics learners and students themselves became more focused and positive about themselves as mathematicians. TMSJ enabled teachers to realise the power of mathematics and to see themselves and their students as agents of change. This critical awareness provided opportunities for greater inclusion and participation.

Keywords: Inclusion, mathematics, participation, problem-solving, social justice.

Introduction

Over the last 40 years in many countries in the West, we have seen a persistent and strong correlation between students' socio-economic backgrounds and their participation and attainment in school mathematics (Boaler et al., 2011). In order to break this tradition, it is useful to explore alternative perspectives on mathematics teaching and learning. Here, we consider critical mathematics education, and adopt the approach of teaching mathematics for social justice. Within the critical mathematics education paradigm, mathematics is not considered to be neutral; instead mathematics education should empower students to develop a critical understanding of the world around them and to see themselves as agents of change (Ernest & Sriraman, 2016). Moreover, Skovsmose (2011, p. 9) argues that the status quo prepares young people for "participating in work processes where a careful following of step by step instructions without any question is essential". Gutstein (2006, p. 10) takes this further by suggesting that many mathematics curricula reflect an economic desire for "an ever-growing army of low-skilled, compliant, docile, pleasant, obedient service workers".

In addressing this context, teaching mathematics for social justice (TMSJ) can employ pedagogies associated with social justice, as well as goals that are mathematics-specific. Gutstein (2003, p.44), identified three Goals of Teaching for Social Justice (Develop Sociopolitical Consciousness, Develop Sense of Agency, Develop Positive Social/Cultural Identities) and three Specific Mathematics-Related Objectives (Read the World Using Mathematics, Develop Mathematical Power, Change Dispositions Toward Mathematics). A curriculum such as this, that focuses on reasoning, communication and problem-solving can empower students and enable them to develop the confidence needed to apply their knowledge to solve genuine real life problems (Boaler, 2009; Gutstein, 2006). By working on activities that are both relevant and meaningful, students begin to

engage with mathematics in new ways that develop greater awareness of the power of mathematics to better understand the world and argue for change (Skovsmose, 1994).

How does TMSJ relate to issues of inclusion? Firstly, the notion of inclusion is non-trivial. It can be taken to focus on aspects of equality and diversity in schools or on ways in which the needs of children with special educational needs and disabilities are met (Ainscow et al., 2006). Within the literature (Roos, 2019), a distinction is often drawn between definitions of “inclusion” that focus on inclusion within society and inclusion within a mainstream classroom. Roos (2019, p.32) has identified two discourses in relation to the mathematics classroom: the “discourse of participation” (where participation includes success) and the “discourse of inclusion in relation to exclusion”. Inclusion then is not just about the learning space, but also the learning experience. In this regard, the choice of activities becomes central to notions of both equity and participation (Moschkovich, 2013). The notion of inclusion that we will be drawing on here, involves active participation and engagement in whole class activities. By focusing on TMSJ, we wanted to develop activities that would engage all members of the class and so careful consideration was given to the nature of the activities.

The purpose of the project was to explore ways that elementary school teachers are able to develop activities involving teaching mathematics for social justice (TMSJ) with children aged between 5 and 11 years. We used participatory action research (PAR), in order to ensure that teachers had ownership of their role within the project. We wanted to explore ways of developing students’ critical mathematical understanding as well as collective agency. With the rise of social media, students of all ages are very aware of global issues. By supporting students to engage critically with this information, we hope that we are supporting a move towards a more humanistic school curriculum (OECD, 2018; UNESCO, 2015). However, as we started to analyse our data, we began to identify significant changes in the TRs’ practice and in the way that the students were engaging with the TRs, their peers and the lesson content.

Methods

We began with a very broad research question: How can primary school teachers maintain and build upon their initial interest in addressing social justice issues through their teaching of mathematics? We used an approach based on participatory action research (PAR). The intention was to provide a genuine collaboration between the six teacher researchers (TRs) and the three academic researchers (ARs) involved in the project. We wanted to bring together the teachers’ in-depth knowledge of the curriculum and their students with the research expertise of the academics. This provided a systematic approach to critically exploring and developing classroom practice. Following an introductory meeting, there were two PAR cycles. Each PAR cycle began with planning meetings where TRs worked together with their paired AR, to discuss ideas for possible activities. All final decisions on the form of the activities and how they would be implemented were made by the TRs. The TRs worked in pairs, to complete their lesson plans and share ideas. The final research design was arrived at collaboratively, with the ARs facilitating discussions and providing an academic framework.

There were five research team meetings, which were recorded and transcribed by two of the ARs. In addition, the TRs were interviewed at the beginning and towards the end of the project. For

consistency, the interviews were undertaken by the AR with whom they had been partnered. These meetings were also recorded and transcribed by the same two ARs.

The TRs taught the research lessons to their own classes. The classes were Year 1 (Emma and Kate's classes), Year 2 (David and Aidan's classes), Year 5 (Rose's class) and Year 6 (Layla's class). All names have been replaced by pseudonyms that were chosen by the TRs themselves. All the TRs, apart from Aidan, were early career teachers with three years or less of teaching experience.

In developing this project, we adapted a model used in a previous research project in a high school. The framework draws on critical perspectives on mathematics teaching and learning provided by Gutstein (2006) and Skovsmose (2011). Gutstein (2003) argues that students need to be supported to use mathematics to identify and reflect upon the injustices in the world and to see themselves as potential agents of change. This involves using mathematics to develop a better understanding of issues relating to power and inequality, and the impact of these on students' own lives as well as society more broadly. Skovsmose (2011) argues that critical mathematics education includes providing opportunities to reflect 'through' mathematics, 'with' mathematics and 'on' mathematics. This led to a framework for teaching mathematics for social justice based on five components:

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 2017, p.520).

In both schools, the teachers used commercial schemes to support the teaching of mathematics. Within the English school system, most elementary schools teach mathematics for about one hour a day. State maintained schools are also required to follow the National Curriculum (DfE, 2014), which stipulates which aspects of mathematics should be covered within each school year. Consequently, finding time to develop approaches that did not fit with the expectations of a "typical" lesson was the first challenge. Additionally, the tensions that exist between the discourses of accountability, inclusion and notions of "ability" in English schools, create challenges for teachers that can inhibit curriculum development and hinder progress (Alderton & Gifford, 2018).

In both schools, all students were taught as a whole class. As the schools were non-selective state-maintained schools, this provided an ideal opportunity to explore whether TMSJ could support the development of inclusive classrooms.

We explored TRs' experiences of TMSJ, in relation to student engagement and participation and how these relate to approaches and decisions with regard to teaching and learning. We also explored changes in attitudes in both the TRs and the students when engaging in activities involving TMSJ.

When reading the transcripts, it is important to note that the year groups in English elementary schools are organised so that children aged 5-6 years are in Year one, children aged 6-7 years are in Year two and so on, until Year six, after which children usually move up to high school.

Data analysis

Thematic analysis was carried out using the six phases outlined by Braun and Clark (2022), using Nvivo software to apply a combination of deductive codes and inductive codes:

1. Familiarisation with the data (through transcribing, reading and re-reading the data)
2. Coding (using a combination of deductive coding and inductive coding)
3. Generating initial themes (examining codes to identify potential themes, i.e. significant and broad patterns of meaning that emerge, and collating relevant data for each potential theme)
4. Developing and reviewing themes
5. Refining, defining and naming themes (analysing, working out scope and focus and naming each theme)
6. Writing up (weaving together themes in analytic narrative in relation to research literature).

Findings and discussion

For this paper, we focus on the aspects of our findings that relate to inclusion and participation. The project report (Wright et al., 2023) provides more detail on the research lessons and on all aspects of our findings.

In the discussion of our findings, we have chosen to focus on three of the themes that came out of our thematic analysis: How teacher researchers engaged critically with TMSJ; Challenges; Identifying “meaningful” problems and activities. These help to give a flavour of our findings, in relation to exploring ways that TRs were able to implement TMSJ and to what extent it supported inclusive practices.

How teacher researchers engaged critically with TMSJ

We found that TRs showed a willingness to challenge students' mindsets by emphasising that mistakes were part of the learning process and not to be feared, as proposed by Boaler (2009). This is highlighted below:

Aidan: ... and for teaching that mindset, of you knowing: “how can I achieve my goal? Yes, I will make mistakes, but I have these resources to help me achieve the goal that I have set or the task that's in front of me.” (Interview 1)

As Gutstein (2003) suggested, the TRs were beginning to challenge students' views about mathematics by demonstrating how learning mathematics can be more meaningful and purposeful. This was shown by two of the TRs. As shown below:

Aidan: ... quite a lot of the children had that assumption, you know, that maths was just for answering questions in school. And I've tried to reiterate in every lesson ... where the benefits of this type of learning will help in the real world, and just almost overemphasise them so that they don't say that again. (Meeting 3)

Kate: I think in year one, maths is very much ... it's in the classroom, it's in the maths lesson. They're quite specific about that. And they were starting to see, actually, how we can use maths, how we can use numbers in different ways. (Meeting 3)

As Boaler (2009) found, the TRs described how students began to adopt a more positive attitude to mathematics when it was presented in a way that made more sense to them. This is demonstrated below by examples from two of the TRs:

Rose: Again, speaking about those children who have those maths anxieties, who have those quite negative views, I don't think I've fully been able to overcome them. But, I think, by presenting maths in a different way, I've had less of a "I don't want to do this, this is boring" reaction, and then seeing "actually, this is maths used in a different context". (Interview 2)

Emma: Because they found something that made sense to them, we've got more out of the children in comparison to maths scenarios that have no sense to them. (Meeting 5)

TRs described how students' confidence in mathematics was boosted as they experienced success in tackling problems in which they could see how mathematics could be applied to meaningful situations (Boaler, 2009):

Kate: And then, for your children, potentially, who think ... "I'm rubbish at maths", actually, they can see that they're not. And they're using what they've learned in maths in a subject that, potentially, they might be more interested in. So, it can then boost children's confidence ... and reframe how they view themselves as 'alone with maths'.

Aidan: And the children just saw maths as a maths lesson, whereas in comparison to now, when we've maybe had more of those conversations that, you know, there's scope for so much more.

TRs began to rethink strategies and approaches to teaching mathematics. The TRs showed an interest in their own professional development and welcomed the opportunity to reflect on their teaching practice. It was already common practice amongst TRs to adapt their teaching to meet the needs of their students by providing tasks at three different levels of difficulty (often with the higher attaining students being given problems that required higher-order thinking skills). However, some of the TRs were beginning to question some of the assumptions on which this approach was based:

David: And maths is definitely one of those subjects where you kind of make assumptions that some people will get something, and some people might struggle. And then sometimes it completely surprises you ... you realize a child, who you thought would just fly with this task, is struggling ... one that you thought would struggle is doing really well. (Interview 1)

Kate: I don't know if the tasks that I've generated catered for everyone's, kind of, level. I think it was really hard to find an activity that ... stretched everyone ... whilst making sure that those who are at 'greater depth' are pushed enough. (Interview 2)

The TRs reflected critically on other aspects of their practice and began to consider different approaches to teaching mathematics that they saw as being more inclusive. For instance, small group discussions were seen as providing opportunities for quieter students to participate more:

Kate: In a small group in a quieter environment, particularly for our children who ... they don't need help all the time and they're not one of the 'high flyers' ... I hate this phrase, but 'invisible children' ... they just don't want to talk ... if they're in a small group they can get involved in these investigations ... it allows them to think and get their voice heard and say what they want to say. (Interview 1)

Rose: They were able to select a spokesperson to speak on behalf of the group. That actually included one child who was happy to speak, who isn't so confident in maths, and does find things challenging. (Meeting 5)

The TRs reported that the problem-solving approaches adopted when making links between mathematics and real-life contexts, also enabled wider participation of students who previously were more likely to avoid speaking out in class:

Kate: It's made me look at my planning a little bit differently and see what we can bring into it ... seeing, actually, how more practical aspects benefit different children, it's helped to sort of identify that and bring it into the teaching. (Interview 2)

Rose: I'm a big pusher of girls being involved in STEM, so I would love for more girls to feel like "Look, I can do this, I can ... maths is actually interesting, it's an issue that I want to get into". And they see that maths is just more than just calculating things, it actually has a wider impact. (Interview 1)

Emma: ... when we gave some of the children who aren't keen on maths, or children who aren't keen on giving opinions, ... more physical tasks ..., they were more confident to express an opinion or ideas in that sort of environment. (Meeting 5)

Challenges

TRs began to find ways to navigate the constraints of the curriculum (Alderton & Gifford, 2018). They reported that, whilst these schemes were supposed to encourage students to go into more depth and apply mathematics to solve real life problems, in reality more time would be required to do this given the pressure on teachers to cover a very large and demanding mathematics curriculum:

David: ... we do a maths mastery program which is just jam packed in terms of the amount that we have to get through.

Aidan: And I think constraints of the actual curriculum is probably the major one really. Like if you reduce the amount that children need to know at certain age groups, you can not only learn the maths in depth ... but you could relate ... the mathematical topics to real life scenarios. And without any change now, I think it's very difficult to ... because you just don't have the time to have these conversations every day, as great as they are. (Interview 2)

Emma: I think, because you've only got a certain amount of time to teach maybe a subject idea or a concept, you don't get the time to, kind of, in depth, explain how this references them [real life scenarios] ... And I think there's not always enough time to teach, in depth, everything. I think it's a 'pick and choose' sort of idea. (Interview 2)

The TRs often struggled to deal with the challenge of having to get through the national curriculum. This they felt restricted the amount of time that was available for TMSJ. This highlights the tension that teachers often felt concerning decisions about which goals to focus on – should they focus on the mathematics (curriculum) goals or the social justice goals? (Bartell, 2013). This was a particular issue for Year 6 in the lead-up to the statutory tests in Year 6 (SATs):

Layla: And again, like [Rose], I mean, every year group is a busy place, but Year 6 is now crazy, like I said, with the ramp up to SATs. And the focus very much on that as well as, you know, everything else that we do in Year 6 ... So, it's about making sure that it fits in. (Interview 1)

Identifying “meaningful” problems and activities

Despite the pressures of curriculum time, the TRs did find ways to incorporate new ideas based on identifying genuine links between mathematics and social justice. They pointed out that a key feature

of the lessons had to be that the links were genuine and not just tokenistic (Boaler, 2009; Gutstein, 2003). For example, one of the activities focused on discussions about the use of part of the playground space and how to make this “fair”. The solutions proposed by the class were taken to the senior management of the school, for consideration. This made a difference to the way that the students engaged with the activity, because they were aware that their input could have a positive impact. Another activity explored different ways of voting and the impact this can have on outcomes. The examples below highlight the nature of the teachers’ growing awareness of how to make the activities genuinely meaningful for the students:

David: ... there does need to be a very clear link and purpose to social justice, and it not be tenuous. And that can sometimes, obviously, be the case. And we talked about that as one of the big challenges when we started the project. (Meeting 5)

At the same time TRs recognised the benefits of spending time developing new approaches, but that there needs to be a commitment from the teachers concerned:

Rose: I would say that you just need to make sure that they [teachers] can see there are opportunities to really exploit these issues in the curriculum. And I think it probably has to come from a bit of, like, drive and motivation. (Meeting 5)

The TRs came to view mathematics and mathematics education in a new light. PAR enabled the creation of a safe space to explore TMSJ and change happened within a relatively short space of time, due to the commitment and hard work of the TRs. The teachers talked about how much they enjoyed their teaching and especially engaging in new ways with some of their reluctant learners.

Conclusion

The research model based on PAR provided an opportunity for TRs and ARs to collaborate in a mutually respectful and productive way. Roles were clearly defined and TRs had full control over what happened in their classrooms. While there were no in-class observations, the bond of trust resulted in teachers feeling comfortable to open up and offer critiques of their own practice about the aspects of the project that worked well and those that continued to be challenges. Teacher researchers reported how engaging in TMSJ resulted in more inclusive classrooms and provided opportunities for teachers to learn new ways of approaching learning and teaching in order to widen participation. By encouraging collaborative working and activities that were more accessible and engaging, students who are more often reluctant to participate felt able to participate more fully. The key element was often around the provision of meaningful activities that the children felt more invested in. This level of engagement supported children to see the value of mathematics within their own lives and experiences, and moved them away from experiences of mathematics that otherwise may have engendered feelings of fear and anxiety.

As we move forward, we would like to explore the possibility of using this approach across the whole school and sustaining the progress made so far.

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