

# Towards an empowering mathematics curriculum: A focus on learner and teacher agency

Pete Wright shares the rationale for the formation of the Teaching Maths for Social Justice Network (TMSJN).

**T**he current (2014) National Curriculum in England includes a claim that “a high-quality mathematics education ... provides a foundation for understanding the world”. The previous (2007) version went further in claiming that “mathematics equips pupils with uniquely powerful ways to describe, analyse and change the world”. Sadly, neither statement is reflected in most learners’ experiences of school mathematics in England, or elsewhere for that matter. With notable exceptions (including the practice of many readers of this journal), too many mathematics classrooms emphasise the acquisition of disparate skills through teachers modelling a solution to a closed problem and students practising the same methods by answering a series of almost identical questions. Implicit messages about mathematics success being attainable only for a gifted minority, together with the value placed on obtaining as many correct answers as possible in the minimum amount of time, lead to many students becoming alienated from mathematics by the time they leave school. It is hardly surprising that most people never use much of the mathematics they learn at school in making sense of situations they come across in their future lives, let alone solving problems they encounter.

In this article, I propose an alternative curriculum that has the potential to empower learners to use mathematics as a means of better understanding their own situations, making sense of the world around them, and advocating for positive change. The importance of such a curriculum is becoming increasingly apparent, given the need to equip today’s learners with the knowledge they will need in future to tackle the environmental, economic and social challenges facing society. I argue that student agency and teacher agency, which are all-too-commonly neglected in current educational policy, need to be foregrounded in school mathematics. Helen Williams and Mike Ollerton, in the closing plenary session at the 2021 ATM conference, highlighted the need to look back in order to move forwards. Therefore, I draw on my 35 years of experience in mathematics education (as a teacher, head of department, curriculum developer, local authority consultant, teacher educator and academic researcher) in explaining the rationale behind the Teaching Maths for Social Justice Network ([www.mathsocialjustice.org](http://www.mathsocialjustice.org)), which was established in April 2021, to advance

some of these ideas. For those wishing to read more about the theoretical ideas and research evidence underlying my argument, I include references to two recently published open-access articles (Wright, 2020; Wright, Fejzo & Carvalho, 2021) at the end of this article.

## Developing the agency of mathematics learners

I spend much of my time as a PGCE Mathematics tutor drawing student teachers’ attention to the research evidence highlighting how teacher-centred pedagogies, focused on ‘answer-getting’ rather than ‘sense-making’, often lead to lower levels of student engagement with mathematics and higher levels of anxiety towards the subject. By contrast, teaching approaches that embrace problem-solving, meaningful contexts, collaborative learning and discussion (promoted by many of the excellent resources published by ATM) tend to elicit greater enjoyment amongst students, more positive attitudes towards learning mathematics and, consequently, higher levels of achievement. I am struck by how similar the messages were that were given to me by my tutors when I was a PGCE Mathematics student 35 years ago. And yet, contrary to what the research evidence has consistently told us about good practice over this period, teacher-centred pedagogies still predominate in many mathematics classrooms. Indeed, approaches such as ‘direct instruction’, in which teachers present concepts to students in a highly structured and unambiguous way, in order to avoid cognitive overload, are enjoying something of a resurgence. Most worryingly, these approaches are often advocated for use with lower-attaining students, thus resulting in a more restricted curriculum than that experienced by their higher-attaining peers. Clearly, new mathematical ideas need to be presented to students at some point and practice may be useful in building students’ confidence and fluency in using mathematical procedures. However, the danger is that, if these approaches are relied on exclusively, students become over-reliant on their teachers as ‘providers of knowledge’.

Proponents of such teacher-centred approaches often justify their use by appealing to the notion of ‘powerful knowledge’, or abstract and formalised knowledge, that enables learners to think ‘the unthinkable’ and the ‘not-yet-thought’. However, this view of powerful knowledge overlooks the importance of appreciating

connections between different mathematical concepts and how new mathematical knowledge is generated. Employing strategies that mathematicians use when generating new knowledge, such as working collaboratively, posing questions, justifying and explaining findings to others, and considering alternative solutions, is important for developing a sense of how mathematics can be used to solve real-life problems. Crucially, the idea that knowledge can only be powerful if the 'knower' is in a position to use it, in other words powerful knowledge is dependent on the agency of the learner, is often ignored. 'Learner agency' involves learners having a feeling of control over their own learning and being able to exercise that control by making decisions and taking actions. In mathematics classrooms, learners will only acquire agency if they are provided with open-ended tasks that involve making decisions about the direction of their learning.

There are various ways of developing learner agency, such as through engaging with context-free investigations. An example is exploring what happens when you find the difference between the products of opposite corners of a 2 by 2 square drawn on a 10 by 10 number grid. Try it for yourself and see what happens. Students should be encouraged to consider and reflect on decisions that need to be taken, such as which squares to try, how to work systematically, how to record their results to make it easier to see patterns, how to describe what they notice, how to justify their results using algebra, and how to extend the problem. Learner agency can also be developed by exposing students to challenging problems for which the method of solving is not immediately obvious, and/or for which they need to choose between different methods that might be applied. It can be relatively straightforward to convert a series of closed tasks into richer and more challenging problems. For instance, instead of providing a series of data sets, and asking students to calculate the mean, median and mode for each set, you could pose questions such as: "Six numbers have a mean of 7, a median of 8 and a mode of 9 – what could the numbers be?" Again, try it for yourself. Another way of developing learner agency is through considering real-life problems that require decisions to be taken before a suitable mathematical model can be employed to solve them. An example is calculating the probability of winning a game where the aim is to flip a 1p coin so that it lands without touching any lines on a 4cm square grid. Consider what simplifying assumptions need to be made before you can model this problem and the implications of these assumptions for the solution you come up with.

Learner agency must be a central concern in developing an empowering mathematics curriculum.

Paolo Freire, in his vision of 'education for liberation', argued that real learning only takes place when the acquisition of knowledge is accompanied by the learner's increased awareness of, and control over, their own situation. Eric Gutstein built on Freire's ideas, by developing the notion of 'reading and writing the world with mathematics', through conducting a series of real-world projects with his (predominantly Latinx) students in a school in a deprived area of Chicago (in the US). An example was a project in which he encouraged his students to measure and quantify the amount of space per student in their school and to compare this with the space available (significantly more) in a nearby school in a more affluent area. This resulted in students taking action by writing letters to the local school board asking for an extension to their school to be built. A similar approach to developing learners' collective agency was taken by the teacher researchers I collaborated with on the Teaching Maths for Social Justice (TMSJ) research project, which was conducted in four comprehensive secondary schools in relatively deprived areas of London (Wright, 2020). During the 'Making a Change' project, groups of students were encouraged to choose an issue of interest to them, use mathematics to develop their awareness of the issue and present an argument for a change they would like to be made. The project had a noticeably positive impact on the motivation of students towards learning mathematics, particularly on some of those who had been previously disengaged from the subject. The students appeared to relish the opportunity, which they had not experienced before, to explore links between mathematics and real-life issues that they felt strongly about. These included discrimination against those with disabilities, the illegal downloading of music, and favouritism exhibited by teachers towards some students. Note the 'Making a Change' project is one of seven projects included in the 'Teaching mathematics for social justice' book published by the ATM.

#### Fairtrade Chocolate

The distribution of revenue from chocolate bars in the late 1980s is displayed:



Display the distribution of revenue from chocolate bars in 2012 in a similar way.

## Developing the agency of mathematics teachers

I return now to the question of why teacher-centred pedagogies still predominate in mathematics classrooms despite continued calls from teacher educators and educational researchers for the adoption of alternative approaches that embrace learner agency. Teachers themselves are often blamed for being inherently resistant to change and for not taking on board research-based evidence. This often leads to school managers compelling teachers to incorporate research findings into their own practice through the setting of targets as part of performance management processes. However, reluctance on the part of teachers to implement changes dictated from above can be better explained by a well-founded distrust and cynicism about the over-abundance of new policy initiatives. These often appear to be incoherent and contradictory and to reflect the political ideology of the current government far more than the needs of mathematics learners. Over the past 40 years, the influence of politicians in determining educational policy has grown significantly. This means that changes in government are increasingly likely to be accompanied by changes, and sometimes complete reversals, in educational policy. This helps to explain the ‘cherry picking’ that is commonplace in setting new policy agendas, such as promoting the adoption of prescriptive and teacher-led pedagogies employed in Shanghai and Singapore (which outperform the UK in mathematics attainment), whilst ignoring the alienation, anxiety and dependency that such pedagogies can produce.

It should come as no surprise that the interests of policy makers and teachers are often in conflict. After all, those in positions of power are more likely to favour educational reforms that encourage learners to become compliant citizens rather than future activists campaigning for change. In contrast, many new teachers come into the profession because they want to make a positive impact on young children’s lives, particularly those from less privileged backgrounds, and do what they can to make the world a better place. Developing teacher agency is therefore essential in creating an empowering mathematics curriculum as change is more likely to come about through ‘bottom-up’ approaches (led by teachers) than through ‘top-down’ reforms (introduced by policy makers). Participatory Action Research (PAR) offers a methodology that can foster teacher agency in bringing about change. It involves genuine collaboration between teacher researchers, drawing on their detailed knowledge of the classroom situation, and academic researchers, drawing on their research expertise. Much conventional research, such as the cognitive science that is used to justify

‘direct instruction’, is based on artificial laboratory-type scenarios that bear little resemblance to the realities of the classroom. In contrast, PAR is conducted in typical classroom situations and therefore engages directly with the constraints that teachers face in developing their practice. This means that the findings of PAR have greater relevance to other practitioners and are more transferable to other classroom situations.

As a teacher educator, I have managed to devote some time over the past 10 years, in between the demands of a full teaching workload, to carry out PAR projects with teachers. The findings of the TMSJ project (mentioned earlier) highlighted the potential for PAR to develop teacher agency (Wright, 2020). The mutual support provided by other teacher researchers helped to overcome constraints and to take risks in trying out new ideas. The involvement of me as an academic researcher was essential in helping teachers to engage with relevant research literature and reflect critically on existing practice. The teacher researchers in the project described how engaging with social justice issues in the mathematics classroom was initially seen to conflict with their aim of helping students (particularly those from less privileged backgrounds) attain the highest possible GCSE grades, crucial for providing future opportunities they might not otherwise have. However, over the course of the project, as they witnessed the positive impact that engaging with meaningful contexts had on students’ general attitudes towards learning mathematics, they began to realise that these two aims were not necessarily in conflict. A significant finding from the project was the interest it generated amongst the teacher researchers’ colleagues (not involved in the project) when they heard about the positive impact it had on students’ motivation and achievement. This suggests that, by demonstrating how the aims of teaching mathematics for social justice and raising mathematical attainment are not contradictory, more teachers can be encouraged to participate in such projects.

The Visible Maths Pedagogy (VMP) project was another PAR study, which I carried out together with two teacher researchers, Alba Fejzo and Tiago Carvalho, from Stoke Newington School in London (Wright, Fejzo & Carvalho, 2021). The focus was on developing strategies for sharing and discussing the teacher’s rationale for adopting ‘progressive’ teaching approaches, for example, by asking students (following a ‘think-pair-share’ activity): “Why do you think I asked you to explain your partner’s thinking and not your own?” Note that ‘progressive’ here refers to collaborative, discursive and open-ended problem-solving teaching approaches. The project’s findings

demonstrated how these strategies enhanced students' appreciation of the teacher's pedagogic rationale and consequently enabled more students to engage successfully with the (often less structured) 'progressive' pedagogies they experienced. The strategies also encouraged the teacher researchers to reflect in greater depth on their rationale for using progressive pedagogies.

Whilst PAR offers the potential to embrace teacher agency in bringing about widescale changes in classroom practice, I have encountered significant barriers in advancing its use in seeking a more empowering mathematics curriculum. There is a reluctance amongst some academics and policymakers to accept that collaborative research with teachers can be a systematic and rigorous method for generating new knowledge. Funding for educational research tends to be channelled into conventional approaches such as randomised control trials and those (described above) that exclude teachers and ignore the realities and constraints of the classroom. I have wasted a considerable amount of time in formulating and submitting several unsuccessful applications for research funding. I am beginning to appreciate that what little time I have available might be more effectively spent in working collaboratively with teachers in developing ideas and carrying out unfunded research around teaching mathematics for social justice. This means accepting that there will inevitably be limited time for me to carry out this research (since funding is used to 'buy out' academics' time to conduct research) and limited resources for buying equipment or for providing cover to release teachers to participate. However, on the positive side, findings from unfunded research are more likely to be transferable to other schools (where lack of resources is not uncommon) and freely available technology can allow valuable work to be carried out on a limited budget. It is within this context that, in April 2021, I decided to team up with colleagues to launch the Teaching Maths for Social Justice Network (TMSJN).

### The Teaching Maths for Social Justice Network

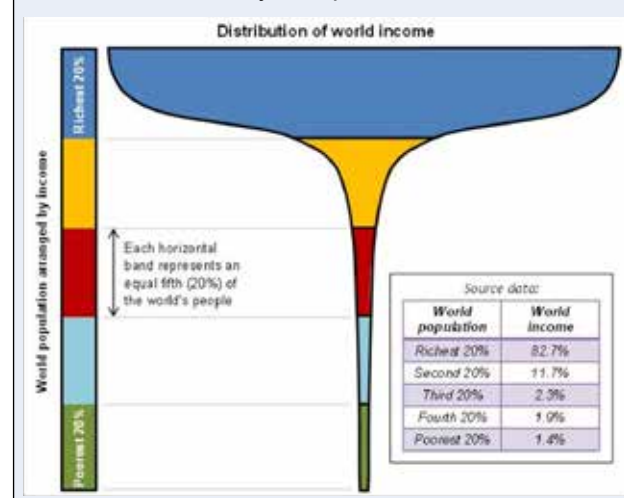
The TMSJN is a network for teachers of mathematics in all school phases, supported by teacher educators, committed to addressing issues of equity and social justice in the classroom. In the first six months since its launch in April 2021, it has grown to over 185 members and the introductory event in June 2021 was attended by 60 members. The principal aim of the TMSJN is to share teaching strategies, resources, and practices with each other, and to provide mutual support and encouragement in trying out new ideas. We plan to organise a programme of seminars, meetings and workshops with presentations from outside speakers and discussions. 'Reading group' meetings will focus

on engaging with research literature relating to TMSJ and discussing its relevance to classroom practice. We will hold 'writing group' meetings to identify and develop TMSJ ideas and activities that can be trialled by other TMSJN members in their schools, with the ultimate aim of producing resources and publishing them on the TMSJN website so that they can be shared freely with others.

### Measuring Inequality

Because of its shape, this diagram was referred to as the 'champagne glass'.

- What would the champagne glass diagram look like for other years?
- How else could you represent this data?



Some TMSJN meetings will be held online and others will be face-to-face, initially in London, but hopefully (if we can secure financial support) to include regional events in future. The TMSJN also provides a valuable forum for fostering, supporting and disseminating collaborative research projects in schools. It has already given rise to one new PAR project that will involve teacher researchers from a group of neighbouring primary schools in London. You can find out more information about the TMSJN and register your interest at [www.mathsocialjustice.org](http://www.mathsocialjustice.org)

### References

- Wright, P. (2020). Transforming mathematics classroom practice through participatory action research. *Journal of Mathematics Teacher Education*. <https://doi.org/10.1007/s10857-019-09452-1>
- Wright, P., Fejzo, A. and Carvalho, T. (2021). Progressive pedagogies made visible: Implications for equitable mathematics teaching. *The Curriculum Journal*. <https://doi.org/10.1002/curj.122>

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