

Mathematics teachers and social justice: A systematic review of empirical studies

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Abstract

The issue of *social justice* has been regularly addressed in many published papers in mathematics education research, particularly after 2000, when the discipline took a more explicit socio-political turn. However, there does not appear to be a consensus as to what the term designates and includes. This paper is a systematic review of the empirical studies published from 2000 until the middle of 2019 that explicitly address social justice from the perspective of practising mathematics teachers and/or teaching. More specifically, we examine (a) how social justice is conceptualised in the identified studies, (b) what specific issues are investigated and methodological approaches employed to do so, and (c) the main key points that arise from their empirical findings. Implications and suggestions of how the field can move forward are discussed at the end.

Keywords: Mathematics education, social justice, systematic review, teachers, teaching

Introduction

The research field of mathematics education is often described as the child of two academic disciplines, mathematics and psychology, given birth around the first half of the 20th century (Andrews & Rowland, 2014; Kilpatrick, 2014). Its conceptual and methodological approaches were significantly influenced by psychology until the '80s, with research interests focused mainly on understanding children's mathematical thinking, through the employment of quantitative approaches, psychometric methods, and statistical techniques. It was only after the '90s that the field took a *social turn* (Lerman, 2000) by putting issues of a sociocultural nature (i.e. influences of culture on teaching and learning mathematics, teacher-learners' relationships and dynamics) under the microscope. Since the beginning of the new millennium, mathematics education made another important shift, towards examining *socio-political* issues (Gutiérrez, 2013a). Various researchers began employing socio-political theories and concepts (i.e. authority, power relations, identity, the social construction of success/failure) to understand and discuss the dynamics between mathematics curricula, policy, politics, and teaching and learning. From this perspective, mathematics education appears to have distanced itself from its parent disciplines and become more associated with political discussions existing in other fields (Sriraman & Steinhorsdottir, 2007), seeking to address questions like "who decides what is taught in K-12 mathematics, and how these political forces connect to the implementation of socially just curricula and pedagogy" (Appelbaum & Davila, 2007, p. 1).

A widely used term in recent texts is *social justice*, a term typically built on the ideological pillars of fairness (Rawls, 1985). Its use, however, neither implies nor confirms uniformity in the ways social justice is conceptualised and operationalised, as what is fair/just to one person or in certain contexts is not necessarily fair/just to another or given a different context (Bartell, 2013; Gates & Jorgensen, 2009; Gutiérrez, 2009a; Strutchens et al., 2012). With these concerns in mind, and through the methodological approach of a systematic review, this paper aims at providing answers to the following research questions:

1. How is social justice conceptualised in empirical studies involving in-service mathematics teachers, published between 2000 and 2019?

2. What are the main issues examined in these studies and what methodological approaches are employed?
3. What do these studies inform us about social justice and mathematics teachers/teaching?

Putting *practising* teachers into the centre of our review happens for three main reasons. First, we acknowledge that “mathematics education in practice is, and always should be, mediated by human teachers” (Bishop, 1988, p. 189). Teachers stand between intended curricula/policies and actual learning outcomes (Stein & Kaufman, 2010), mediating mathematics learning through particular knowledge, beliefs, ideologies, identities, experiences, and instructional practices (Xenofontos, 2016; Gutiérrez, 2013b). Second, as research informs us (i.e. Campbell, 1996; Meschede, Fiebranz, Möller, & Steffensky, 2017), practising teachers typically have a more developed and refined professional identity, teacher self-efficacy, and pedagogical content knowledge than pre-service teachers, mainly due to experience. Third, our initial, pre-systematic, overview of the relevant literature on mathematics and social justice indicated significantly fewer studies on practising teachers than there are on pre-service teachers and initial teacher education. This latter point raises further questions as to why there is a lack of research concerned with practising teachers, who are more involved with mathematics learning on a daily basis than any other group.

Our goal is to provide researchers and policymakers with a comprehensive and up-to-date review of the relevant published research. Examining how current empirical studies position practising mathematics teachers in relation to social justice is crucial for understanding how mathematics education in this area has hitherto developed and how it might move forward effectively. To start, we briefly turn our attention to the ways social justice is approached in mathematics education in general. Following this overview, we present three questions addressed in the studies identified in relation to in-service teachers. In closing, we discuss implications and suggestions for future directions of the field.

Social justice in mathematics education

Talking about *social justice* and its relation to mathematics education is not a straightforward endeavour. In many published papers the term is used interchangeably with *equity* (see for example, Jackson & Jong, 2017; Meyer, 1989), while in other written accounts, the two appear to be distinct; nonetheless, the links between them are explicitly presented and discussed (i.e. Healy & Powell, 2013; Secada, 1989). We decided to pursue this review from an initial viewpoint that equity and social justice represent two closely related, yet different concepts, corresponding to Gutiérrez’s (2009) *learning to play the game* and *learning to change the game*, respectively. The extent to which this has proved to be useful is discussed towards the end of the paper.

In our initial conceptualisation, equity (learning to play the game) was concerned with supporting all learners develop what Gutstein (2007) refers to as classical mathematical knowledge (that is, the mathematics typically taught in schools). Equity, according to Gutiérrez (2002, p. 153), is achieved when those in power are no longer in the position “to predict students’ mathematics achievement and participation based solely on characteristics such as race, class, ethnicity, sex, beliefs and creeds, and proficiency in the dominant language”. Instead, all learners are given opportunities to develop *access* (i.e. to resources available to engage with quality mathematics), *achievement* (i.e. standardised test scores, participation rates), *identity* (maintaining cultural, linguistic, familial connections), and *power* (the ability to mobilise resources to affect change in school or society) (Gutiérrez, 2008). This is echoed by

Boaler (2006, 2008), who suggests that learners also need to develop what she terms *relational equity*. This concept moves the focus away from school outcomes and achievement in tests; instead, it draws attention to the ways in which children learn to treat peers and the respect they learn to have for people from different circumstances to their own. The shift is from getting the answers right to understanding the thinking and learning that move the child closer to a deeper understanding.

Social justice (learning to change the game) presupposes and includes equity, but goes further by explicitly developing and promoting critical awareness regarding the roots of marginalisation, structures of inequalities, practices of injustices, and the urgency to tackle these in order to get closer to a fairer world. The relationship of mathematics education and social justice can be described in terms of what Frankenstein (1983, 1989) and Skovsmose (1994) call *critical mathematics education*. Frankenstein drew on the work of Paulo Freire (1970) and his idea of *conscientização* (conscientisation or critical consciousness), the process of developing a critical awareness of one's social reality through reflection and action. Skovsmose, in turn, drew on the work of critical scholars associated with the Frankfurt School, their development of critical theory and the popularisation of the dialectical method of learning by interrogating the contradictions of society. Simply put, social justice in mathematics education (or critical mathematics education) aims to help learners understand political structures of inequalities, practices of injustices, and mechanisms of oppression, while at the same time, providing them with the necessary mathematical tools and skills to act towards changing the world (Erchick & Tyson, 2013; Stinson, Bidwell, & Powell, 2012). As “both the content and the method of education matter” (Sharma, 2008, p. 10), it is particularly challenging for teachers to negotiate a balance between mathematical content and goals for social justice (Nolan, 2009).

Despite our initial understanding of equity and social justice as two distinct, yet strongly related concepts, we acknowledged the fact that the lines between the two are not easily distinguishable and that colleagues' conceptualisations might differ to ours. For example, Gates and Jorgensen (2009) discuss three types of social justice in mathematics education, which could be placed on a spectrum. On the left side of the spectrum, these authors locate *moderate forms of social justice*, which are the easiest to address, since they provide support to different marginalised learners, but do not explicitly associate marginalisation with structural inequalities in society. This type corresponds to Wager's (2008) teaching mathematics *with* social justice (pedagogical practices promoting a classroom culture to encourage opportunities for equal participation and status), Gutiérrez's (2009) *learning to play the game*, and our understanding of equity as a provision of support to all learners, according to individual needs. In the middle of Gates's and Jorgensen's (2009) spectrum are *liberal forms of social justice*, which recognise structural inequalities, and consider the mathematics classroom a space that can become more just within the existing structures. Finally, on the right side of the spectrum, Gates and Jorgensen (2009) place *radical forms of social justice*, which attribute inequalities to social structures and intend to amend the ways in which inequality is built into existing practices. This type corresponds to Wager's (2008) teaching mathematics *for* social justice (using school mathematics to challenge injustices of the status quo), Gutiérrez's (2009) *learning to change the game*, and our understanding of social justice mathematics as synonymous with critical mathematics education (Frankenstein 1983, 1989; Skovsmose, 1994).

Methodology

A systematic review adheres “closely to a set of scientific methods that explicitly aim to limit systematic error (bias), mainly by attempting to identify, appraise and synthesize all relevant studies (of whatever design) in order to answer a particular question (or set of questions)” (Petticrew & Roberts, 2006, p. 9). Even though often underappreciated in academia, good systematic reviews are significant in identifying and analysing research, enabling evidence-based decision-making, and bridging the gap between research and practice (Gera, 2012). Recently, Harper (2019) examined 35 qualitative reports of social justice mathematics enactments in diverse classroom contexts. However, our work differs from hers in that: (a) we explore the range of different conceptualisations of social justice whereas Harper focused on a specific definition of *teaching mathematics for social justice*; (b) we do not restrict our search to qualitative studies; (c) we do not focus on issues related to people of colour; and (d) we had different inclusion/exclusion criteria, as presented below.

Inclusion/exclusion criteria

To set the boundaries of our review we developed a set of inclusion/exclusion criteria (Petticrew & Roberts, 2006; Thunder & Berry, 2016). The team authors agreed that the following criteria should apply: Firstly, the included papers were published between January 2000 and July 2019 (July being the last month in which the search for papers took place). The year 2000 reflected Gutiérrez’s (2013a) evaluation that mathematics education explicitly took a socio-political turn then. Secondly, we searched for papers that included the terms “social justice” and “mathematics” in their title, abstract, and/or keywords. Thirdly, the studies explicitly focused on mathematics teachers (both primary and secondary) and/or teaching. Fourthly, we only included papers published in peer-reviewed journals, excluding book chapters and in-conference proceedings, which do not always undergo a peer-review process. Including only peer-reviewed journal papers served as an indirect measure of the “quality” of the work selected. Even though issues of quality and its measurement are quite controversial in academia (Pontille & Torny, 2010), the process of peer-reviewing acts as a mechanism of assessing and preserving the trustworthiness of reporting scientific findings (De Silva & Vance, 2010). Finally, we focused on papers published in English so they would be comprehensible to all team authors.

Identification of papers

Identification of studies took place in June/July 2019 by the first two authors, working independently using four electronic databases: ERIC, MathEduc, Scopus, and Web of Science. Each database has slightly different search criteria, and with keywords “social justice” AND “mathematics”, different resources were provided, with many overlaps. Searching resulted in 1395 documents in ERIC, 1103 in MathEduc, 193 in Scopus, and 926 in Web of Science. The two authors examined each document, eliminating those not meeting all inclusion criteria. They subsequently shared the papers identified and discussed several controversial cases, and agreed on 23 documents, included in the reference list at the end of this paper and marked with an asterisk (*). Of those, one paper (Brantlinger, 2013) did not include the term *social justice* in its title, abstract, or keywords. However, it referred to critical mathematics, which we identified as synonymous with teaching mathematics for social justice. Because of the extensive use of social justice in its main text, this paper was included. Conversely, we decided not to include papers like Johnson’s (2016), which, while referring to *critical mathematics education* in its title and abstract, and to *equity* in its keywords, did not use the term *social justice* in the title, abstract, keywords, or main text. Also, two papers were written by the same author, referring to the same project, and presenting findings regarding the same dataset; only one was kept for the purposes of this review (that is, Wright 2016). Furthermore, Gutstein was the author of many papers related to the same projects; yet in this report we included two (Gutstein, 2003,

2016), as these explicitly focused on his experiences as a teacher and his teaching, while other papers related more to learners.

Analysis

The analysis of the studies – or their *critical appraisal*, as Petticrew and Roberts (2006) call the analysis process in the context of systematic reviews – was conducted by the first author, with critical input and feedback from the other three authors. It was decided from the beginning not to employ any predetermined coding scheme, as our work here is more of an exploratory nature. We generated codes by treating the research articles as qualitative data, in a combination of theory- and data-driven thematic analysis (Miles & Huberman, 1994). Specifically, the three research questions served as themes; each article was critically appraised against those themes, codes were identified, and later, combined into categories. Such an approach appears to be common among systematic reviews (see, for example, Aikens, McKenzie, & Vaughter, 2016; Bano, Zowghi, Kearney, Schuck, & Aubusson, 2018). Table 1 summarises the emerged categories (sub-themes) and the codes employed for the critical appraisal of the papers. For the first and second sub-themes, the numbers of studies are presented. Nevertheless, we chose not to do so for the third theme, since what we present as main conclusions largely relies on our understandings. These conclusions are discussed by the majority of the papers. Soon after the first author developed the coding scheme, all authors met and discussed its appropriateness and the extent to which it covered all major points. Consequently, amendments were made.

Theme	Categories (sub-themes)	Codes
Conceptualisations of social justice	Social justice as equity (n = 5)	Improving mathematical outputs of specific groups of learners (i.e. ethnic minorities, gender, social class)
		Empowering pupils as learners
	Social justice as critical mathematics (n = 18)	Development of socio-political awareness
		Social justice as extension of equity
Issues examined, and methodological approaches employed	Understanding teachers' current beliefs and/or practices (n = 10)	Single case-study approach (individual teachers as cases)
		Vignettes
		Thematic analysis with interview data
	Continuous professional development (n = 9)	Partnerships between schools and universities

	Practitioner/action research (n = 4)	Programmes for teachers
		Researcher as participant
		Reflection on one's practices
Main conclusions	Teachers feel tensions and dilemmas	How to put socio-political intuitions into practice?
		Balance between social justice and mathematical content
		Impact of external factors (i.e. school administration, parents etc)
	The importance of continuous professional programmes	Length of programme
		Balance between theory and practice

Table 1: The emerged coding scheme

Below, we present the findings of this review, organised in themes corresponding to the three questions.

Findings

RQ1: Conceptualisations of social justice

An apparent polarisation, regarding the conceptualisations of social justice, was observed in the studies. In one cluster, comprising five papers, social justice was associated with **equity**, aligned with Gutiérrez's (2009) idea of *learning to play the game*. Interestingly, these five studies cover a wide range of different issues traditionally related to marginalisation and underperformance (see Xenofontos, 2019a), as for example, gender (Halai, 2011), social class and poverty (Mhlolo & Schäfer, 2012; Ndlovu, 2011), ethnicity and culture (Meaney et al., 2009), immigration and learning mathematics in a second language (Planas & Civil, 2009). The studies in this cluster are concerned with supporting learners to develop their competence in classical mathematical knowledge (Gutstein, 2007) and/or their identities as learners of mathematics, by adopting empowerment perspectives (Gutiérrez, 2008).

The majority of the studies (n = 18), however, formed the second cluster, approaching social justice in mathematics from the perspective of **critical pedagogy**, in a similar manner to Gutiérrez's (2009) notion of *learning to change the game*. The work of Gutstein (2003), also included in this cluster, is often cited in the other papers, as a seminal point of reference in the field. In later work, Gutstein (2016) moves from the notion of *teaching mathematics for social*

justice to reading and writing the world with mathematics, a conceptual framework that explicitly highlights the importance of learning to play the game before being in a position to change it. Similarly, most studies in this cluster perceive social justice as an extension of, or complementary to, equity. Specifically, many of the papers present detailed frameworks that demonstrate links between the two concepts: Aguirre's and Zavala's (2013) framework on culturally responsive mathematics teaching, Esmonde's and Casewell's (2010) adaptation of a previous framework regarding the principles of teaching for social justice in general, and Bartell's (2013) bilateral understanding of teaching mathematics for social justice as the pedagogy that addresses the issues of provision of mathematical instruction for success in the current system *and* of opportunities to use mathematics to expose and confront social inequalities.

RQ2: Issues examined and methodological approaches employed

The studies in this review cover a range of topics examined and methodological approaches employed. Overall, they can be grouped in three broad categories. In the first category, several papers (n = 10) aim at **understanding teachers' current beliefs and/or practices**. The studies in this category can generally be described in three types. Some studies, for example, follow a *single case-study approach*, examining the beliefs and practices of individual teachers (see Felton-Koestler, 2019, and Gregson, 2013). These papers typically focus on the journey of the participant teachers in negotiating dilemmas related to social justice and mathematics, and how they eventually "get to know", shift their beliefs, and reconsider their practices. A second type presents and discusses *vignettes* from teachers' professional lives (i.e. Mamolo & Pinto, 2015; Mhlolo & Schäfer, 2012), identifying internal and external factors that may facilitate or prohibit the implementation of social justice pedagogies. A third type is based on qualitative interviews with teachers (see Povey, 2002; Paygoza 2016; Turkkan & Karakus, 2018). Typically employing *thematic analysis* techniques, these studies identify patterns in teachers' beliefs and cluster them into broader themes.

The second category of studies – appears equally popular – reports **continuous professional development**, in the form of programmes and activities (n = 9). The majority of papers discuss partnerships between university researchers and teachers, working together as a community of practice to support the latter develop theoretical knowledge and practical tools for their mathematics teaching (see Aguirre & Zavala, 2013; Bartell, 2013; Meaney et al., 2009, Ndlovu, 2011; Planas & Civil, 2009; Wright, 2016). Typically, the reported programmes last for several weeks, and are usually designed in two phases: first, engagement with social justice through mathematics readings and group discussions, and then, design, implementation, and evaluation of the effectiveness of lessons, with input from co-participants.

Finally, a small number of studies (n = 4) follows a **practitioner/action research** approach with individual researchers in the additional role of classroom teacher. For example, through a two-year examination of his own practices, Gutstein (2003) discusses how his approach of teaching mathematics for social justice helped high-school children in an urban Latino school learn to use mathematics to analyse socio-political issues (i.e. racism) and understand power relations and unequal resource allocation in society. In later work, Gutstein (2016) was part of the design team that created the plan for a new high-school which valued social justice throughout all curriculum subjects. During the school's third year, Gutstein taught mathematics to a 12th grade, putting his framework for *reading and writing the world with mathematics* into action. In the same spirit, Brantlinger (2013) and Harrison (2015) discuss their experiences as

university researchers and teacher educators taking up the role of classroom teachers, and bring social issues and mathematical content together in their teaching.

RQ3: How these studies inform us

In this section, we summarise what we consider to be key, evidence-based, points from the findings of the 23 reviewed studies. A first important point is that **teachers feel tensions and dilemmas** in adopting social justice perspectives in their mathematics teaching. Regardless of whether social justice is associated with equity or critical pedagogy, it requires teachers to move away from beliefs like “*I’m just one of those math for math’s sake people*”, which “implicitly legitimates an entire set of social practices associated with school mathematics, and thereby serves to reproduce the power relations enacted therein” (de Freitas & Zolkower, 2009, p. 190). Many teachers have social and political intuitions; they sense the interplay between school mathematics and political issues, but do not always know how to put these intuitions into practice in ways that help their pupils (Apple, 2008; Xenofontos, 2019a; Gutiérrez, 2013b). One of the biggest tensions and dilemmas indicated by the studies, even for teachers in favour of critical approaches, is to negotiate and find a balance in teaching between goals of social justice and mathematics (see, for example, Bartell, 2013; Brantlinger, 2013; Gutstein, 2003; Gregson, 2013; Harrison, 2015). Teachers’ tensions and dilemmas may be influenced positively or negatively by various external factors, for example the participation of their students in high-stakes examinations, school climate, the views of school administration on the links between mathematics and social justice, and parents’ expectations (Gregson, 2013; Mamolo & Pinto, 2015; Turkkan & Karakus, 2018).

The provision of opportunities for teachers to participate in **continuous professional development** examining links between social justice and mathematics is crucial. It enables teachers to manage their tensions and dilemmas, and to understand, formalise, and put into action their political intuitions. Contrary to many educational authorities’ requirements for quick evidence of *what works* (Ndlovu, 2011), this review provides evidence that successful programmes rely upon several factors. First, they require teacher commitment to social justice and a willingness to move from classical mathematical knowledge to critical approaches and to the development of learners’ critical awareness of how to understand, analyse, and change social injustices through mathematics (Gutstein, 2003, 2016; Freire 1970). Simply put, teachers need to attend related programmes with an open mind and a positive predisposition towards tackling the sources of marginalisation (Bartell, 2013; Esmonde & Caswell, 2010; Meaney et al., 2009; Raygoza, 2016; Wright, 2016). Secondly, professional development programmes should provide a safe space for teachers to raise and share concerns with researchers and colleagues, and receive appropriate feedback/support from the group, which needs to work as a community of practice, sharing common visions (Gonzalez, 2009; Nicol et al., 2019; Planas & Civil, 2009). Another important issue raised by almost all studies reporting a professional development programme is the necessity for a balance between theory and practice (see Aguirre & Zavala, 2013). As discussed, a typical structure of effective programmes comprises two parts, corresponding to: (a) examination of theoretical issues; and (b) implementation of social justice ideas in the mathematics classroom, followed by reflection. Finally, length is an important factor determining the relative effectiveness of programmes (Felton- Koestler, 2019). Teachers need time to digest new ideas, implement them, reflect and revise them. In the studies identified, the length ranged from one week (i.e. Meaney et al., 2009) to three years (i.e. Ndlovu, 2011), with most studies falling in the middle (i.e. Bartell, 2013; Planas & Civil, 2009).

Discussion and conclusions

Rethinking the relationship between social justice and mathematics teaching

As mentioned, we commenced this review asserting that equity and social justice are closely related, yet different concepts. We perceived equity as associated with the development of classical mathematical knowledge (Gutstein, 2007), with special attendance to each individual learner's background, learning needs and particularities. For us, social justice is linked to critical mathematics education and Freire's (1970) idea of *conscientização* through mathematics. Nevertheless, despite our initial understanding, we decided not to impose our views on the analysis process. As our first research question indicates, we wanted to identify different conceptualisations of social justice employed in empirical studies from teachers' perspectives. In doing so, we have come to the realisation that our initial perception of the relationship between equity and social justice requires amendments.

It is important to clarify that our approach to social justice is concerned with teachers and teaching. We, therefore, return to the ideas of Wager (2008) about teaching mathematics *with* and *for* social justice, Gates's and Jorgensen's (2009) three forms of social justice (moderate, liberal, and radical), and Gutiérrez's (2009) learning to play and to change the game. Considering what these authors have written and the findings of our review, we would like to introduce the term *teaching mathematics as social justice*, which we consider to be more appropriate for capturing the variety of related concepts. We would like to bring equity more explicitly into the equation.

Teaching mathematics as social justice has two sides that must be developed simultaneously. The first is equity, the elimination of the ability to predict learners' participation and performance based solely on race and ethnicity, home language, gender, sexuality, and social class (Gutiérrez, 2002). To achieve equity, children need to develop competence in classical mathematical knowledge, as well as agency to do so. The second is critical mathematics, the development of critical awareness of the world, the use of classical mathematical knowledge to understand and change social injustices, and the use of social phenomena to understand and develop deep conceptual understanding of mathematics (Gutstein, 2007; Frankenstein, 1983, 1989; Skovsmose, 1994). One way to describe this uses Gutstein's (2016) perspective of both *reading* and *writing the world with mathematics*. Table 2 summarises the two sides of teaching mathematics as social justice (equity and critical mathematics) and their components.

Teaching mathematics as social justice	
Equity	Critical mathematics
<ul style="list-style-type: none"> • <i>Access</i> to resources available to engage with quality mathematics • <i>Achievement</i> - standardised test scores, participation rates • <i>Identity</i> - maintaining cultural, linguistic, familial connections • <i>Power</i> - agency to affect change in school or society <p style="text-align: right;">Gutiérrez (2002)</p> <ul style="list-style-type: none"> • <i>Relational equity</i> (the ways children learn to treat peers and the respect they learn to have for people from different circumstances to their own) <p style="text-align: right;">Boaler (2006, 2008)</p>	<ul style="list-style-type: none"> • <i>Reading the world with mathematics</i> (use of mathematics to understand relations of power, resource inequities, disparate opportunities between different social groups, and to understand explicit discrimination based on race, class, gender, language, etc.) • <i>Writing the world with mathematics</i> (development of social and individual agency to use mathematics to change the world) <p style="text-align: right;">Gutstein (2016)</p>

Table 2: Teaching mathematics as social justice

As far as promoting equity is concerned, Bartell, Wager, Edwards, Battey, Foote, and Spencer (2017) summarise nine research-informed practices that can be applied by mathematics teachers, namely: draw on pupils' funds of knowledge; establish classroom norms for participation; position pupils as capable; monitor how pupils position each other; attend explicitly to race and culture; recognise multiple forms of discourse and language as a resource; press for academic success; attend to pupils' mathematical thinking; and support development of a socio-political disposition. More details about each teaching practice can be found in the article of Bartell et al. (2017). Similarly, Boaler (2006, 2008) identifies seven practices that promote relational equity, namely: multidimensionality; assigning roles; assigning competence; teaching pupils to be responsible for each other's learning; high expectations; effort over ability; and learning practices (for a full description, see Boaler, 2006, 2008). Regarding the promotion of critical mathematical knowledge – socio-political conditions of one's immediate and broader existence (Gutstein, 2007) – several activities and classroom projects are documented in the literature. Socio-political issues in mathematics classrooms can be addressed at all school levels, from early years (i.e. Murphy, 2009), to primary (i.e. Esmonde & Caswell, 2010), secondary (i.e. Gutstein & Peterson, 2004), and tertiary education (i.e. Winter, 2007). Teachers need, however, to carefully select topics that draw on learners' personal experiences and community knowledge, so that the development of both classical and critical mathematical knowledge can take place more effectively (Gutstein, 2016).

The originality of our framework lies in bringing well-rehearsed ideas from the relevant literature together and presenting them in a coherent manner. In her work, Gutiérrez (2008, 2009a, 2013a) talks about two axes of equity: the dominant (including access and achievement) and the critical (including identity and power). Gutiérrez's intention was apparently to make an explicit distinction between these axes, by associating the former with issues of equity, *learning to play the game*, and teaching mathematics *with* social justice, and the latter with critical mathematics, *learning to change the game*, and teaching mathematics *for* social justice. Nevertheless, while for Gutiérrez identity and power are concerned, *inter alia*, with

empowering learners to develop critical consciousness and providing them with tools to change the game, other mathematics education researchers do not share this perception. They understand the concept of empowerment as related to learning mathematical content, and not about reading the world and changing the game. Indeed, in acknowledging the breadth of different (often contrasting) understandings of concepts like equity, social justice, and other associated terms, Gutiérrez (2018) has recently taken a new direction, by talking about *rehumanizing mathematics*. While, we agree with how Gutiérrez moved in that direction, we believe our proposed framework reveals her initial intentions regarding equity, making them less inclined to misinterpretation.

Our framework, *teaching mathematics as social justice*, captures different conceptualisations of social justice in the studies reviewed on mathematics teachers and/or teaching, whether these are concerned with issues of equity (i.e. Mhlolo & Schäfer, 2012; Meaney et al., 2009; Planas & Civil, 2009) or critical mathematics pedagogy (i.e. Aguirre & Zavala, 2013; Esmonde & Casewell, 2010; Raygoza, 2016). It may also explain why in the literature, social justice is often used interchangeably with equity or critical mathematics. Bringing equity and critical mathematics together responds well to Biesta's (2010) three functions of education. According to Biesta, one function of education is *qualification*, the provision of knowledge, skills, understandings, and dispositions to "do". This *doing* "can range from the very specific (as in the case of training for a particular job or profession, or the training of a particular skill or technique) to the much more general (i.e., an introduction to modern culture, or the teaching of life skills, etcetera)" (Biesta, 2010, p. 19). A second function of education is *socialisation*, concerned with the mechanisms through which we learn to become members of particular social, cultural, and political "orders". "Through its socializing function education inserts individuals into existing ways of doing and being. In this way, education plays an important role in the continuation of culture and tradition – both with regard to its desirable and its undesirable aspects" (ibid). Finally, a third function of education is *subjectification*, often seen as the opposite of socialisation; it concerns the development of critical capacities to "become" a unique individual who can influence the world. As Biesta (2010, p. 21) states, subjectification is "precisely *not* about the insertion of 'newcomers' into existing orders, but about ways of being that hint at independence from such orders". Gutiérrez's (2002) dimensions of *access* and *achievement*, along with Gutstein's (2016) *reading the world with mathematics*, correspond to Biesta's (2010) qualification function. They are concerned with the development of classical mathematical knowledge and skills in ways that learners can function effectively in existing social structures. Boaler's (2006, 2008) idea of *relational equity* can be described as a socialisation function, as it positions mathematics learners in relation to their peers and promotes three important outlooks: (1) respect for other people's ideas, leading to positive intellectual relations, (2) commitment to the learning of others, and (3) learned methods of communication and support. Finally, the development of *identity* and *power* (Gutiérrez, 2002) and the capacity to *write the world with mathematics* (Gutstein, 2016) can be described as acts of subjectification. Not only do learners develop classical mathematical knowledge and skills, but they are in a position to use these to impact their lives and communities in positive and critical manners.

The importance of continuous professional development – moving forward

Given the complexities of pursuing systematic changes in education at the macro-level of policies and intended curricula (Apple, 2008; Xenofontos 2019b; Freire, 1970), our review of the literature points to the fundamental necessity of addressing *teaching mathematics as social justice* in professional learning and continuous critical development for teachers. Drew,

Priestley, and Michael (2016) summarise challenges and tensions in professional development programmes, related to the purpose of an enquiry undertaken, questions of who has power and control in the professional learning process, limitations in space and time, and teachers' knowledge of and experiences with educational research processes. To address these, future programmes could consider the following. Firstly, programmes need to bring equity and critical mathematics to the fore. As discussed previously, in some of the related papers of our review, researchers focus either on issues of equity or critical mathematics. In cases where both equity and critical mathematics are addressed, only the latter is explicitly associated with social justice. Secondly, teachers need to embrace the principles of a programme and associate those principles with their everyday classroom needs (Handal & Herrington, 2003). The components of equity and critical mathematics should not be presented to teachers merely as theoretical concepts. On the contrary, Gutiérrez's (2002) ideas of access, achievement, identity, and power, Boaler's (2006, 2008) concept of relational equity, and Gutstein's (2016) reading and writing the world with mathematics should be explored in relation to teachers' contextual conditions and needs, with a balance between theory and practice (Aguirre & Zavala, 2013). Thirdly, it needs to be made clear to teachers, researchers and policy-makers that there are no quick, ready-to-apply formulas of best practice (Ndlovu, 2011). Professional development programmes need to be undertaken over a substantial period (Drew et al., 2016), during which researchers and teachers co-investigate, imagine, design, implement, and reflect.

Another issue that appears absent from the gamut of studies is an explicit focus on how the overall educational context (i.e. national curricula and policies) influences teachers' beliefs and knowledge, their enactments of social justice, and the implementations of continuous professional development programmes. In some educational contexts, teachers are allowed the 'discretionary space' to approach curriculum as a social practice and implement new ideas, while elsewhere teachers do not have significant space to 'deviate' from the prescribed agenda, despite policy rhetoric about autonomy (Priestley & Xenofontos, 2020). Future research could examine how the ideas of teaching mathematics as social justice are included in intended policies and the extent to which teachers are given the discretionary space to participate in related programmes of professional development and to implement these ideas in classrooms.

Limitations of this study

In closing, we want to acknowledge two limitations of our work, which derive from our inclusion/exclusion criteria and can be addressed in future studies. Firstly, in this paper we focused on studies concerned with in-service teachers and their teaching. There is extensive literature approaching issues of social justice and mathematics education in relation to prospective teachers and initial teacher education programmes (i.e. Bateiha, & Reeder, 2014; Boylan, 2009; Nolan, 2009). Such studies were not included in this review. Colleagues might be interested in replicating our methodology with papers on prospective teachers. This approach would be particularly important in confirming or providing suggestions for amendment of our proposed framework, *teaching mathematics as social justice*, which we consider tentative and prone to further development. Secondly, central to our work is *social justice*, so we excluded studies that did not incorporate it or used related terms (e.g., Johnson's 2016 paper). Unsurprisingly, *equity* and *critical mathematics* emerged from our analysis, as many authors used these terms synonymously with social justice. To examine the trustworthiness of our framework, future reviews could originate from the concepts of equity and/or critical mathematics and investigate the extent to which these fit the *teaching mathematics as social justice* framework.

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