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Navigating through Social Justice in Mathematics Education: Prospects, Priorities, Processes, and Problems

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ABSTRACT Social justice in mathematics education remains a critical concern. Despite growing awareness, progress has been insufficient. Mathematics education plays a pivotal role in fostering social justice through creativity, critical thinking, innovation, and collaborative problem-solving. However, existing curriculum, teaching practices, and assessments reveal significant shortcomings. This review-based argument highlights four critical areas—prospects, priorities, processes, and problems—aimed at creating a socially just environment with equitable access to high-quality mathematics for all students. The authors emphasize the interrelatedness of social justice within these criteria to promote equity, access, and empowerment in mathematics education.

KEYWORDS *Social justice, prospect of social justice, priority of social justice, process of social justice, problems of social justice*

Introduction

Justice in mathematics education is a critical concern. It encompasses fairness, equity, equality, and equal access to learning opportunities inside and outside mathematics classrooms (Esmonde & Caswell, 2010). Mawarti and Nurlaelah (2020) describe that mathematics education holds immense potential to enhance social justice through student participation in learning and development. According to them, this potential can be materialized through membership based on equality while using resources in and for education and through cognitive and affective impact on the development of humanity, fostering a just and peaceful world. To achieve this, we must integrate mathematics and social justice by aligning contents with the contexts (Nolan, 2009). Transforming mathematics education into participatory democracy is essential for sustainable futures with social justice (Nolan, 2009) in a way that ensures justice, equity, and fairness for all students in the schools and classrooms (Gutstein, 2006). For this transformation, teachers and students should critically challenge the social and political structures to combat injustice and unfairness (Cotton & Hardy, 2004). Socially just educational pedagogy such as dramatic, interactive, and experiential teaching and learning can develop personal and group participation, exemplify reflection, and engage teachers and students in critical issues through dialogue (Boylan, 2009). Disciplinary boundaries no longer exist in socially just pedagogy to ensure equitable learning opportunities (Moje, 2007).

Paulo Freire's (1970) critical pedagogy acknowledges the existence of oppressed and oppressors in the social, cultural, historical, and political context of educational practices, and it further links opportunities and justice in education (AydÕn et al., 2010). From this view, socially just pedagogy embodies a vision of equality across race, class, ability, and gender in any classroom (Lynch & Baker, 2000). Consequently, teachers and institutions may shape what to teach, how to teach, and why

to teach a subject matter or content in the mathematics curriculum (Buell & Shulman, 2019). Despite mathematics education being a powerful and essential tool for maintaining social justice (Gutstein, 2003), most teachers may not teach for social justice due to the pressure to prepare students for mandated assessments. They may have difficulty planning lessons integrating social justice with mathematics subject matter (Register et al., 2022). If considered and applied correctly, social justice pedagogy in mathematics can make students confident and creative with a broader public mission to prepare them to be responsible citizens (Colby & Erlich, 2000). Social justice pedagogy in mathematics classrooms may engage, empower, and motivate students to solve social problems through mathematics as a tool (Bond & Chernoff, 2015). Integrating social justice issues into mathematics classes may help teachers seek a broader social, cultural, and political connection between classroom practices and the community through lesson modeling and reflection (Garii & Rule, 2009).

Social justice in mathematics education is complex and multifaceted. Achieving clarity in its planning and implementation is essential, and this goes beyond transforming beliefs, dispositions, and knowledge with self-awareness and self-reflexivity in mathematics teaching and learning (Boylan & Woolsey, 2015). The issue is pervasive across various educational contexts (Panthi & Belbase, 2017; Panthi et al., 2021) and affects social dynamics in teaching mathematics (Wright, 2016). Mathematics teachers often find themselves in the role of advocates, needing to counsel and persuade not just students but also other stakeholders of the value of social justice in the classroom (Panthi et al., 2018a, 2018b). Yet, they face obstacles, such as cultural diversity, disconnected curricula, traditional teaching methods, seating arrangements, and large class sizes (Panthi & Belbase, 2017; Panthi et al., 2021), all of which can impede the integration of social justice into mathematics education.

This paper seeks to establish a consistent approach to social justice within mathematics education, recognizing that mere advocacy may not suffice to affect change in classroom practices. It examines four critical dimensions: the potential benefits (prospects), the areas of greatest need (priorities), the method of implementation (processes), and the challenges faced (problems) in integrating social justice into mathematics education. The central question is: "What are the prospects, priorities, processes, and problems associated with social justice in mathematics education?" This inquiry aims to contribute to the evolving understanding of how social justice can be effectively woven into the fabric of mathematics teaching and learning.

Method of Study

This study conducts a comprehensive literature review to explore the four key dimensions of social justice in mathematics education: prospects, priorities, processes, and problems. The methodology of this study is document collection, review, and analysis to understand and address these critical aspects effectively.

Document Collection

Our literature review encompassed a diverse range of sources, including peer-reviewed articles, books, book chapters, theses, dissertations, and website content. Initiated in January 2021, the collection process involved gathering relevant documents from various online platforms and libraries, focusing on four primary types of materials to inform our study on social justice in mathematics education.

A comprehensive search was conducted using Google and the Education Resources and Information Center (ERIC), utilizing a variety of keywords including 'justice', 'social justice', 'socially just pedagogy', 'culturally relevant pedagogy', 'culturally responsive assessment', 'mathematics and social justice', 'reconstruction of mathematics', 'transformative learning', 'critical pedagogy', 'social justice in mathematics teaching', 'social justice in mathematics', equity in mathematics education', 'critical mathematics education', 'prospects of social justice', 'priorities of social justice', 'processes of social justice', and 'problems of social justice'. This search yielded a multitude of websites and online resources pertaining to social justice in mathematics education.

Our search synthesized a wealth of literature on social justice in mathematics education, drawing from a variety of sources: Primary information came from educational websites, while journal articles and conference papers provided in-depth analyses on topics like equity pedagogy and critical mathematics education. Influential texts such as D'Ambrosio's (2012) exploration of social justice, Koestler's (2012) insights on equitable teaching, and Freire's (1970/1999) seminal work on oppressed pedagogy formed the backbone of our theoretical framework. Other works, such as critical pedagogy (Darder et al., 2003), pedagogy for social justice (Gutstein, 2006), and curriculum and evaluation standards (National Council of Teachers of Mathematics, 1989 & 2000), were additional resources used to conceptualize social justice in mathematics education.

Additionally, theses and dissertations (e.g., Bialick, 2021; Colquitt, 2014; Kari, 2017; Seegmiller, 2020; Wonnacott, 2011; & Wright, 2015) offered fresh perspectives on the subject, and institutional content further enriched our understanding of the practical applications of social justice in educational settings.

Document Analysis

We employed document analysis as a method for synthesizing key codes, concepts, and categories from the different sources outlined above (Bowen, 2009; Morgan, 2021). Through meticulous review and analysis, we extracted key concepts, which were then coded to unearth potential categories and themes following Morgan's (2021) and Bowen's (2009) detailed approach to document analysis. In this process, we reviewed and identified key concepts related to prospects, priorities, processes, and problems of social justice in mathematics education and noted them down in a table forming a matrix of codes, concepts, and relevant sources (see Tables 1-4). This open coding and conceptualizing of key ideas from different sources in an open exploration continued until the conceptual matrix was saturated enough to cover key ideas related to the four critical dimensions of social justice in mathematics education. This iterative process of reading and coding key concepts from the documents allowed us to distill the essence of social justice in mathematics education into distinct codes. Once we accumulated enough codes, we grouped them into categories that formed the subthemes of our conceptual matrix (refer to Tables 1-4). Our analytical framework was further refined by adopting categorical thinking, as suggested by Freeman (2017), and grounded theory coding, suggested by Bryant (2017), to systematically organize these insights into four overarching themes of social justice in mathematics education.

There were three sub-themes under the prospect of social justice in mathematics education: social justice movement, sustainability and democracy, and critical pedagogy (Figure 1). In the second theme, priorities, we generated two sub-themes: curriculum reform and pedagogical reform. We generated three sub-themes for the third theme, process: a curriculum process, a pedagogical process, and an assessment process. The last theme was problems associated with social justice in mathematics education, which included the two subthemes: the difficulty of social justice in mathematics education and the challenges of social justice in mathematics education. Figure 1 shows the schematic of these four dimensions in our study.

Thematic Results and Discussion

We organized the codes into conceptual groups, which are grouped under prospects, priorities, processes, and problems. Figure 1 presents each theme and its categories, and each theme and its categories are discussed separately.

Prospects for Social Justice in Mathematics Education

The prospect of social justice in mathematics education is related to the possibility of integrating social justice with mathematics. The prospects are summarized in the following codes and categories in Table 1 with three distinct sub-themes—social justice movement, sustainability and democracy, and critical pedagogy. Each subtheme has been explored under separate subheadings.

The Social Justice Movement In Mathematics Education

There has been a call to restructure mathematics education that includes reform in teaching and learning mathematics for social justice (Grazino, 2017), acknowledging students' background, family values, race, class, language, or culture (Acharya et al., 2021). Social justice

Figure 1

Conceptual framework of prospects, priorities, and problems of social justice in mathematics education

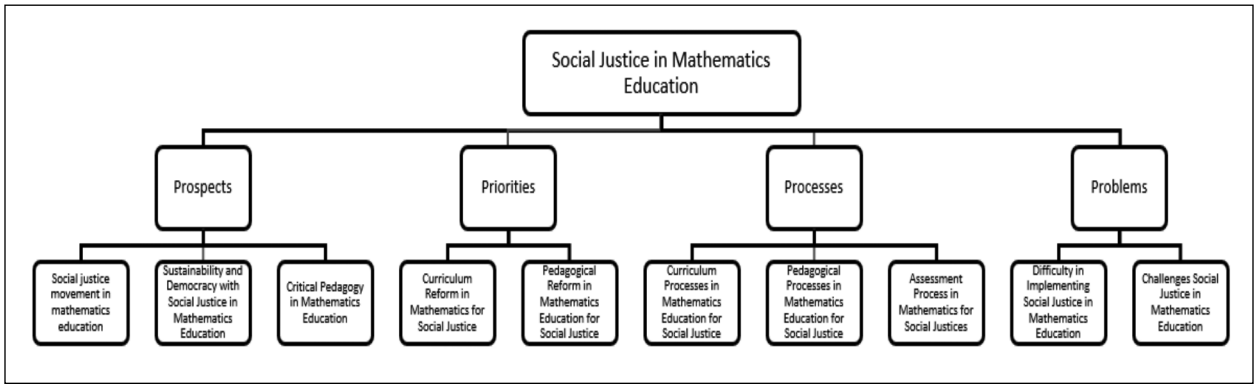

Table 1

Prospects of social justice in mathematics education

Primary Codes	Categories	Relevant Literature
M1. Reform teaching and learning. M2. Realistic mathematics M3. Developing equitable pedagogy M4. Differentiation in teaching M5. Equity principle M6. Landless movement pedagogy M7. Habitus in classroom M8. Critical mathematics M9. Re-imagining social justice in mathematics. M10. Democracy in mathematics classroom	Movement	Grazino (2017), Mawarti & Nurlaelah (2020), Bartell (2013), Wager (2008), NCTM (2000), Knijnik & Wanderer (2015), Fletcher (2012), Skovsmose (2011), Le Roux (2016), Ball & Bass (2008)
SD1. Sustainable development SD2. Mathematics for sustainability SD3. Participation in decisions SD4. Social justice and sustainability SD5. Numeracy and sustainability SD6. Quantitative and qualitative interpretation SD7. A fair share of resources SD8. Taking a stand for justice SD9. Discrimination and unfair treatment SD10. Sustainable development goals SD11. Mathematics for sustainability	Sustainability and Democracy	Campbell (2013), Fraser (2013), Mawarti & Nurlaelah (2020), Miller (2002), Norton (2003), Dryzek (2010), NCTM (2014),Mawarti & Nurlaelah (2020), OECD (2015), Roe et al. (2018)
CP1. Empowering students CP2. Functional math CP3. Democratic community CP4. Students' critical eye CP5. Dialogical pedagogy CP6. Banking model of education CP7. Professional development for critical thinking CP8. Inclusive and responsive teaching CP9. Connection to real-world issues CP10. Culture and context-bound	Critical pedagogy	Ernest (2016), Jorgensen (2016), Andersson & Valero (2016), Tutak et al. (2011), Uenrostro (2016), Freire (1970), Shapira-Lishchinsky (2016), Mumu et al. (2017), Selvianiresa & Prabawanto (2017), Skovsmose (2011)

in mathematics education has two related components: mathematics literacy and realistic mathematics (Mawarti & Nurlaelah, 2020). The first component emphasizes mathematics literacy as a civil rights or social justice issue that incorporates lessons and activities to apply knowledge in a socially responsible way. The second component includes understanding social justice issues through a mathematical framework to address social problems (Mawarti & Nurlaelah, 2020). In this sense, social justice in mathematics education has been realized as a new movement for developing equitable mathematics pedagogy considering cultural and social justice (Bartell, 2013). There is a renewed interest in teaching for and about social justice by differentiating between teaching about, with, and for social justice (Wager, 2008). The National Council of Teachers of Mathematics (NCTM, 1989) initiated social justice as a framework for inclusive mathematics education through the equity principle that further continued in NCTM (2000) its commitment to social justice with a strong emphasis on helping all students learn mathematics despite their background and ability groups. The social justice movement in mathematics education has been growing in different parts of the world. For example, projects such as active school programs and landless movement pedagogy in Brazil (Knijnik & Wanderer, 2015), habitus (an internalized pattern of behavior, action, and disposition) created by mathematics teachers and students in the classrooms in Ghana (Fletcher, 2012), critical mathematics education in Denmark (Skovsmose, 2011 & 2012), and re-imagining the possibility of equity and social justice through mathematics education in a South African university (Le Roux, 2016), are a few initiatives in social justice movements in different places.

The restructuring of mathematics education has been proposed to include a focus on teaching and learning

that promotes social justice. This reform, as suggested by Graziano (2017), involves recognizing and valuing students' diverse backgrounds, family values, races, classes, languages, and cultures. Social justice within the context of mathematics education encompasses two interconnected components: mathematics literacy and realistic mathematics education, as identified by Mawarti and Nurlaelah (2020). The former views mathematical literacy as an issue of civil rights and social justice, integrating lessons and activities that encourage the application of knowledge for societal benefit. The latter seeks to comprehend social justice concerns using mathematical concepts to tackle societal issues.

This approach to social justice has sparked a new movement aimed at developing an equitable mathematics pedagogy that takes into account cultural and social justice considerations, as discussed by Bartell (2013). Moreover, a growing interest is in differentiating the teaching methods for, with, and about social justice, as outlined by Wagner (2008). The National Council of Teachers of Mathematics (NCTM) laid the groundwork for this approach in 1989 by introducing social justice as a framework for inclusive mathematics education, which was reinforced in 2000 with a strong commitment to ensuring all students have access to mathematics education, regardless of their background or abilities.

Sustainability and Democracy with Social Justice in Mathematics Education

The interplay between equity, justice, and sustainability forms a crucial axis in mathematics education. Campbell (2013) posits that these elements are integral to sustainable development, yet social justice alone cannot fully realize this goal. When social justice and equity principles are woven into the fabric of mathematics education, they can profoundly shape students' attitudes, values, and competencies, such as numeracy. This integration enables students to connect mathematical concepts with societal challenges, fostering sustainable development.

From the vantage point of social justice, mathematics education catalyzes heightened awareness of societal values, encourages active citizen participation in decision-making processes, and advocates for equitable resource allocation and distribution (Fraser, 2013). Mawarti and Nurlaelah (2020) and Roe et al. (2018) further affirm that embedding social justice within mathematics education is a step toward achieving sustainable development.

Sustainability encompasses not only environmental stewardship but also economic and educational equity, fairness, and the democratization of resources and the opportunity to access these resources with a fair share and utilization (Roe et al., 2018). Renert (2011) emphasizes that natural capital, a shared inheritance of humanity, should be equitably distributed across current and future generations, irrespective of background. This equitable distribution is facilitated by linking educational pursuits, particularly mathematics, with ecological sustainability.

The ideal learning environment marries mathematical thinking and quantitative reasoning with real-world applications, fostering a culture of informed decision-making and risk-taking (Roe et al., 2018). Such an environment is predicated on citizens' numeracy and quantitative skills (Volchok, 2019), complemented by qualitative insights into their social, cultural, historical, and political identities (Miller, 2002; Norton, 2002).

Sustainability is also deeply entwined with democratic ideals, where equitable resource sharing, opportunity access, and balanced power dynamics are not merely the privileges of voters but the rights of all critically thinking, informed, and mathematically literate individuals (Dryzek, 2010). The National Council of Teachers of Mathematics (NCTM, 2014) advocates for mathematics education that champions equity, justice, and democratic values, challenging discrimination and promoting fairness.

Various global initiatives exemplify the commitment to teaching mathematics through the lens of sustainability and democracy. In the United States, equity pedagogy (Cabana et al., 2014; Jackson, 2013), democratic practices in South African mathematics classrooms (Christiansen, 2007; Vithal, 1999 & 2012), and educational reforms in Denmark (Valero, 2002) all contribute to this movement. The OECD's Sustainable Development Goal Four underscores the importance of equitable, inclusive, and quality education, including mathematics, as a foundation for sustainable development (OECD, 2015). In conclusion, mathematics education is poised to play a pivotal role in instilling democratic principles and values within classroom teaching and extending these concepts into daily life, thereby shaping a sustainable present and future (Ball & Bass, 2008).

Critical Pedagogy in Mathematics Education

Critical mathematics education is designed to endow students with the functional knowledge and skills of mathematics and the critical consciousness necessary for fostering democratic communities committed to social justice, both within and beyond the school environment. This educational approach, championed by Ernest (2016), Jorgensen (2016), and Andersson and Valero (2016), encourages educators to adopt democratic principles such as justice, equity, and culturally

responsive pedagogy, nurturing students to engage with social justice issues in their surroundings critically.

The practice of mathematics education involves a reflective critique of conventional norms and the application of theories that promote a socially just pedagogy characterized by equity, access, and fairness (Tutak et al., 2011). Teachers are encouraged to engage in meaningful dialogue with students, embracing inclusive practices that reflect thoughtfulness and consideration for all learners (Jorgensen, 2016).

Critical pedagogy, as advocated by Uenrostro (2016), supports dialogic teaching methods that facilitate social agency and societal transformation by questioning established societal norms. This pedagogical stance, as outlined by Freire (1999), rejects the traditional 'banking' model of education, where teachers passively deposit information into students, who are seen as mere receptacles. Instead, it calls for an educational paradigm shift towards a more interactive and caring approach to teaching that emphasizes social justice.

Therefore, professional development programs for teachers should focus on fostering a pedagogy of social justice that encompasses equity, access, fairness, and care, as Shapira-Lishchinsky (2016) suggested. Critical pedagogical practices can address and rectify students' misconceptions about mathematics by promoting an inclusive and responsive teaching environment.

Moreover, critical pedagogy enables students to connect mathematical concepts to real-world situations and their life experiences, empowering them to challenge the traditional notions of objectivity and truth (Mumu et al., 2017). This approach reveals the culturally and contextually bound nature of mathematical knowledge, allowing for subjective interpretations and a broader understanding of mathematics as a discipline intertwined with the real world (Skovsmose, 2011; Selvianiresa & Prabawanto, 2017).

The prospects for mathematics education, as discussed above, extend across various disciplines, social and cultural contexts, and educational systems globally. These prospects have paved the way for social justice to become a priority in mathematics education, promoting values such as peace, harmony, tolerance, and resilience, transcending the confines of strict disciplinary knowledge and skills.

Priorities for Social Justice in Mathematics Education

Mathematics, as a universal body of knowledge, belongs to all of humanity and should be imparted through a pedagogy steeped in social justice and equity. Such as pedagogy would transcend the barriers of race, class, and gender within any educational setting, as advocated by Buell and Shulman (2019). In light of this, mathematics teachers and educators must place social justice at the forefront of mathematics education. This initiative entails a commitment to reforms in curriculum, teaching methods, and assessment practices, all aimed at fostering an environment where learning and teaching mathematics is a socially just experience. The following discussion elaborates on these priorities, further delineating with specific codes and categories in Table 2.

Curriculum Reform in Mathematics Education for Social Justice

Mathematics curriculum reform is a multifaceted process with deep historical, social, and political roots. It encompasses various movements and initiatives across the globe, such as the 'new math', 'back to basics', and 'standards movement' in the US (NCTM, 2000), 'realistic mathematics education' (RME) in the Netherlands (van Zanten & de Heuvel-Panhuizen, 2021), and a series of reform efforts in the UK, including the National Numeracy Strategy (1999), Primary National Strategy (2003), Every Child Matters (2004), and Every Child Counts (2004) (Vollaard et al., 2008). These ongoing reforms raise the question of how social justice has been integrated into the mathematics curriculum.

In the US, curriculum reforms have aimed to address equity, access, and fairness in mathematics education (NCTM, 2000 & 2014). The RME approach has shown potential for promoting social justice within mathematics classrooms, as evidenced by various studies (Gutstein, 2006; Kathotia et al., 2021; Solomon et al., 2021; Stephan et al., 2014). However, these reforms have often been entangled in discourses of inclusion that, paradoxically, may lead to marginalization or require assimilation into the prevailing mathematics education culture, thus maintaining its core characteristics (Sojoyner, 2017). Notably, past reforms, particularly in the US, have not always been inclusive of all groups, especially black learners who have historically faced racism, white supremacy, and legalized segregation (Berry et al., 2014). Despite efforts towards equity and inclusion, many black learners in the US still encounter oppressive educational practices (Martin, 2019).

The Ontario Secondary Mathematics Curriculum in Canada emphasizes the importance of students actively constructing new knowledge based on their prior experiences, preparing them for societal roles (Ontario Ministry of Education, 2005). This approach aligns with the transformative nature of the curriculum that

Table 2

Priorities of social justice in mathematics education

Primary Codes	Categories	Relevant Literature
CR1. Standards movement CR2. Realist mathematics education (RME) CR3. National numeracy strategy CR4. Every child matters. CR5. Discourse on inclusion. CR6. Legalized segregation CR7. Enclosure and containment CR8. Transformative curriculum CR9. In and out of classroom math CR10. Critical stance CR11. Inquiry-based curriculum	Curriculum reform	NCTM (2000), van Zanten & de Heuvel-Panhuizen (2021), Vollaard et al. (2008), Martin et al. (2010), Berry et al. (2014), Sojoyner (2017), Lam (2012), Mitescu et al. (2011), Chapman et al. (2016), McHugh (2015)
PR1. Daily life and social context PR2. Constructing and reconstructing math PR3. Scrutinizing student and teacher roles PR4. Pedagogical reform PR5. Reformative motion PR6. Personal empowerment PR7. Transformative learning PR8. Critical reflection PR9. Understanding social issues PR10. Engaging in community issues in math PR11. Day-to-day life math PR12. Specific circumstances	Pedagogical reform	Skovsmose (2011), Wedege (2016), Alderton (2020), Boaler (2008), Colquitt (2014), Jackson (2013), Hassi & Laursen (2015), Mezirow (1991), Evans & Davies (1993), Hendrickson (2015), Bartell (2013), Cochran-Smith, (1999)

refines learners' experiences (Lam, 2012). Reform-oriented teaching practices that are grounded in social justice principles advocate for higher-level thinking, deep content knowledge, and a cooperative learning environment where students respect and learn from one another, thereby creating rich and meaningful learning opportunities both inside and outside the classroom (Mitescu et al., 2011). Furthermore, these practices promote a critical examination of mathematical content within a democratic context that addresses broader structural and societal issues (Chapman et al., 2016). An inquiry-based curriculum that explores societal inequities through mathematics enables students to engage with and interpret the world mathematically (Gutstein, 2006; McHugh, 2015).

Pedagogical Reform in Mathematics Education for Social Justice

The integration of mathematics education with daily life and societal contexts is a critical aspect of learning and teaching, as it involves the construction and reconstruction of mathematical knowledge within the context of students' backgrounds and aspirations (Skovsmose, 2011, 2013; Wedge, 2016)"). This process also entails a critical examination of the roles of students and teachers, focusing on their actions and potential growth (Alderton, 2020). Central to this is the concept of social justice in mathematics education, which necessitates pedagogical reforms that transform the identities of students and teachers through dynamic relationships and context-sensitive discourse (Alderton, 2020; Boaler, 2008).

Such transformation provides opportunities for student empowerment, enabling them to engage with mathematics through inquiry, collaboration, and communication (Colquitt, 2014). Equity pedagogy plays a vital role in facilitating these transformative learning experiences, which require teachers to have a profound understanding of their students' learning processes (Hassi & Laursen, 2015; Jackson, 2013).

Transformative learning is characterized by self-reflection and agency, shifting the interpretation of experiences through critical awareness and reflection (Mezirow, 1991). It promotes autonomy and self-directed learning, often achieved through collaborative group work (Hassi & Laursen, 2015). In a socially just educational environment, transformative learning leads to significant shifts in how students derive meaning from their experiences, a hallmark of this educational approach (Mezirow, 1991, 1997). Empowerment in this context is not just about the learning process but

also the outcomes, particularly in college mathematics (Hassi & Laursen, 2015).

By recognizing the value of mathematics as a tool for understanding and addressing social issues, students can balance social justice with mathematical learning, engaging in community-centered activities within the classroom (Evans & Davies, 1993; Hendrickson, 2015). This approach enhances students' awareness of social realities by connecting mathematical concepts to everyday life and adapting to their unique circumstances (Bartell, 2013; Cochran-Smith, 1999; Skovsmose, 1994).

To advance socially just mathematics education, curriculum and pedagogical reforms must be prioritized, requiring ongoing efforts to uphold social justice through clear visions, plans, and actions within classrooms, schools, and educational policies. These priorities should extend to pedagogical and assessment practices that emphasize equity, access, and a high-quality learning environment, thereby fostering a more equitable and just educational landscape.

The Processes of Social Justice in Mathematics Education

The pursuit of social justice within mathematics education is a complex and nuanced endeavor. It involves navigating through contentious debates that revolve around the potential negative or positive effects such initiatives may have on students' opportunities, access to resources, and equitable educational outcomes (Wright, 2017). To better understand and organize these intricate processes, we have delineated them into three distinct sub-themes: curriculum processes, pedagogical processes, and assessment processes. Each of these plays a pivotal role in the advancement of social justice in mathematics education. The specific categories within these sub-themes, along with their corresponding codes, are systematically outlined in Table 3.

Curricular Processes in Mathematics Education for Social Justice

The curriculum serves as a comprehensive guide that addresses the multifaceted questions of what, when, why, whom, and how to teach, as well as the assessment of students' mathematical understanding. It is shaped by diverse philosophical and theoretical perspectives, as depicted by various education scholars and practitioners (Belbase et al., 2022). Within the broad social, cultural, historical, and political contexts, a curriculum that strives for social justice must actively engage with these dimensions rather than remaining silent or neutral (Ndimande, 2010).

A spectrum of interest groups influences the development and ongoing refinement of mathematics curriculum, each viewing social justice through unique lenses, including mathematics teachers, educators, and stakeholders (German, 2021; Kumashiro, 2009). A socially just curricular process in mathematics education embodies high expectations for learning outcomes, ensures equitable access to rigorous and relevant mathematics for all students, and fosters a positive learning environment conducive to high achievement (National Council of Supervisors of Mathematics & TODOS, 2016).

To uphold the intrinsic value of mathematics for learners, the curriculum should cultivate positive beliefs and identities (Aguirre et al., 2013), demand high cognitive and affective engagement, and encourage creative mathematical thinking rooted in learners' knowledge and experiences (Bright et al., 2015; Turner et al., 2012). It should integrate content and assessment activities that promote civic engagement (Gutstein & Peterson, 2013; Martin et al., 2010) and facilitate participatory learning through open discourse and interaction (Horn, 2012).

Achieving such a curriculum requires a collaborative and inclusive approach to planning. This involves creating a shared platform where curriculum experts, mathematics teachers, educators, mathematicians, and supervisors can collectively contribute their beliefs, values, conceptions, and theories to shape the curriculum's aims and learning outcomes (Walker, 1970). The Walker model of curriculum planning, though classical, offers a more organic approach than the Tyler and Taba models. By incorporating social justice considerations into the evolving context of mathematics curriculum design, the Walker model can be adapted to develop and implement equity-based, inclusive standards and frameworks for school mathematics (Walker, 1971). In this process, teachers' insights and perceptions become instrumental in dynamically shaping the curriculum in action (Panthi et al., 2018a & 2018b).

Pedagogical Processes in Mathematics Education for Social Justice

In the realm of mathematics education, pedagogical processes are often categorized into traditional and constructivist frameworks, reflecting the distinct roles of teachers and students (von Glasersfeld, 1995). However, this binary classification may not fully capture the diverse array of teaching and learning practices found in mathematics classrooms (Bas & Kivilcim, 2021; Wood et al., 2001). A multitude of pedagogical approaches has been proposed to enhance students' mathematical learning, including

Table 3

Priorities of social justice in mathematics education

Primary Codes	Categories	Relevant Literature
CPr1. Curriculum images CPr2. Silent and neutral curriculum CPr3. Interest groups CPr4. Rigorous and relevant CPr5. Enduring value CPr6. Funds of knowledge CPr7. Civic engagement in math learning CPr8. Discourse and open interaction CPr9. Curriculum platform CPr10. Curriculum deliberation	Curricular process	Belbase et al. (2022), Ndimande (2010), German (2021), National Council of Supervisors of Mathematics and TODOS (2016), Aguirre et al. (2013), Bright et al.2(015), Gutstein & Peterson (2013), Horn (2012), Walker (1970)
PP1. Constructivist teaching and learning PP2. Varieties of teaching methods PP3. Community of practice PP4. Discourse-based teaching PP5. Realistic mathematics teaching PP6. Constructivist teaching PP7. Equity-based teaching PP8. Transformative teaching PP9. Culturally specific pedagogy PP10. Empowering marginalized PP11. Participation of students PP12. Opportunity of learning PP13. Empowering low achievers PP14. Teacher and student commitment PP15. Restrictions of race, class, and gender PP16. Students' needs PP17. Inclusive practices PP18. Social and environmental justice PP19. Build identities	Pedagogical process	Von Glasersfeld (1995), Bas & Kivilcim (2021), Carpenter et al. (2001), Franke & Kazemi (2001), Andersson & Valero (2016), Alro & Johnsen-Hoines (2016), Richardson (2001), Gutstein, (2006), Seda (2008), Sriraman (2008), Leonard (2019), Hytten & Buttez (2011), Hytten & Buttez (2011), Keddie (2012), Allsup & Shieh (2012), Sanjakdar et al. (2022), Buell & Shulman (2019), John (2020), Wright (2020), Aguirre et al. (2019), Fabrega (2019)
AP1. Effect of assessment AP2. Positive and negative sides of assessment AP3. Normative and formative assessment AP4. Assessment for learning AP5. Flexibility and fairness AP6. Developing creativity AP7. Project-based learning and assessment AP8. Inclusive assessment AP9. Transformative agency AP10. High-quality instructions and assessments AP11. Equity-based assessment AP12. Assessment for achieved curriculum	Assessment process	Wonnacott (2011), Autin et al. (2015), Bennett (2011), Mawarti & Nurlaelah (2020),McArthur (2015), Roman et al. (2021), McHugh (2015), Gutstein (2006), Turner & Font Strawhun (2013), National Governing Association Center for Best Practices & Council of Chief State School Officers (2010), NCTM (2000), Wager & Stinson (2012)

teaching for understanding (Carpenter et al., 2001), a community of practice learning (Franke & Kazemi, 2001), discourse-based and dialogic teaching (Andersson & Valero, 2016; Vithal, 2003), realistic mathematics teaching (Alro & Johnsen-Hoines, 2016; McNeal, 2001), facilitative teaching (Nelson, 2001; Richardson, 2001), constructivist teaching (Ernest, 2016; Richardson, 2001), equity-based teaching (Gutstein, 2006; Seda, 2008), transformative teaching (Sriraman, 2008), and culturally specific pedagogy (Leonard, 2019). These pedagogical strategies are linked to a socially just pedagogy, which encompasses a call for social change, a participatory vision of education, multicultural practices, empowerment of marginalized students, full participation of all students (Hytten & Buttez, 2011), and equal educational opportunities regardless of race, gender, or socioeconomic status (Keddie, 2012).

Equity-based pedagogy is particularly crucial for empowering marginalized and low-achieving students (Allsup & Shieh, 2012), as it aims to narrow the achievement gap by fostering an equitable environment, access, and participation in the classroom (Sanjakdar et al., 2022). This approach is shaped by institutional requirements, accreditation standards, and personal philosophies, leading to a curriculum and methodology that transcends the confines of race, class, and gender (Buell & Shulman, 2019) and challenges power dynamics, racism, and classism (Cochran-Smith, 1999).

To implement these changes, professional development for teachers is essential, focusing on promoting equity and the role of mathematicians in a democratic society (Buell & Shulman, 2019). Teachers who adopt a socially just pedagogy can tailor their teaching to meet students' needs through collaborative, discursive, and inquiry-based methods, establishing inclusive practices (John, 2020; Wright, 2020). They should design mathematical tasks that are cognitively stimulating, socially engaging, and methodologically varied, addressing key social and environmental justice issues (Aguirre et al., 2019; Freire, 1970; Gutstein, 2006). Ultimately, mathematics teaching should be child-centered, contextual, meaningful, and interactive, enabling students to construct knowledge, examine biases, and develop their identities within a culturally responsive educational framework (Panthi et al., 2018a & 2018b; Fabrega, 2019; Gay, 2002).

The Assessment Processes in Mathematics Education for Social Justice

Assessment practices in mathematics education are pivotal in shaping students' educational experiences and their development as citizens. These practices can have varied impacts based on students' race, gender, ability group, culture, and socioeconomic status, potentially influencing their opportunities and fair share of educational outcomes (Wonnacott, 2011). The assessment process can be viewed through two lenses—normative and formative. Normative assessments may segregate students by merit, adversely affecting those underperforming, while formative assessments offer a more interactive and reflective approach to learning, promoting social and economic well-being (Autin et al., 2015; Bennett, 2011).

Formative assessments, characterized by contextual tasks and activities, serve as tools for social justice by providing flexibility and fairness in the evaluation process, thereby enhancing students' mathematical learning (Mawarti & Nurlaelah, 2020; McArthur, 2015; Widjaja, 2013). Project work, for instance, can foster in-depth learning, mutual respect, and creativity among students (Roman et al., 2021). Project-based learning (PBL) bridges classroom learning with real-world applications, supporting inclusive pedagogy and empowering students with transformative agency (Gutstein, 2006; McHugh, 2015; Turner & Font Strawhun, 2013).

The curriculum manifests in three forms: intended, implemented, and achieved (Phaeton & Stears, 2017). The intended curriculum outlines a vision for incorporating social justice into teaching, learning, and assessment practices (UNESCO International Bureau of Education, 2022). The Common Core State Standards for Mathematics (CCSSM) emphasize problem-solving, perseverance, abstract reasoning, and logical argumentation (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), serving as guidelines for high-quality mathematics instruction and assessment.

The National Council of Teachers of Mathematics (NCTM) articulates a vision for social justice in mathematics curriculum standards, advocating for inclusion, equity, and high-quality support for all students (NCTM, 2000). Interest in social justice within mathematics education is increasing, though variations exist between the intended curriculum and its implementation and the achieved outcomes (Wager & Stinson, 2012).

The journey towards a socially just mathematics education is complex and challenging. Discrepancies between the visions of curriculum authorities and the practical understanding and implementation by mathematics teachers can create obstacles. Exam directives and priorities may exacerbate these challenges, leading to high-stakes outcomes that undermine the essence of process-based learning and raise concerns regarding social justice in mathematics education.

Problems of Social Justice in Mathematics Education

The integration of social justice into mathematics education, despite increasing interest and dedication, faces complex challenges in the reform and execution of classroom plans, policies, and actions. The process of aligning social justice principles with mathematics content and pedagogy presents several obstacles. To better understand these issues, they have been organized into two main categories:

Difficulties in Implementing Social Justice in Mathematics Education:

This category explores the practical hurdles educators face when attempting to incorporate social justice into their teaching practices.

Table 4

Problems of social justice in mathematics education

Primary Codes	Categories	Relevant Literature
DI1. Equity and fairness DI2. Critiques of social justice DI3. Political biases and provocation DI4. Implementing social justice DI5. Low performance DI6. Disadvantaged students DI7. Mainstream benefits DI8. Inclusion of racial minorities DI9. Tools and resources DI10. White middle class DI11. Issues developing countries DI12. Critical mathematical literacy DI13. No quick guide for equity pedagogy DI14. Student diversity	Difficulty in implementation	Alfrey & O'Connor (2020), Gewertz (2020), Harrison (2015), McName (2013), Seegmiller (2020), Turner, Gutierrez, Gutierrez (2012), Secada et al. (2003), Frankenstein (1997), Hodge (2006)
CT1. Teacher readiness CT2. Diversity and multicultural classes CT3. Different interests CT4. Different SES CT5. Lack of social justice in teacher education CT6. Decontextualized mathematics curriculum and textbooks CT7. Demands teacher dedication CT7. Mandated standardized tests CT7. Difficulty in maintaining balance in curriculum and context CT8. Daunting tasks for teachers CT9. Balancing math content with real-world application CT10. Complexity of social justice and equity in implementation	Challenge of teaching	Secada et al. (2003), LaDuke (2009), Acharya et al. (2021), Esmonde & Caswell (2010), Vomvoridi-Ivanovic & McLeman (2015), Luitel (2009), Luitel & Taylor (2005), Belbase et al. (2008), Bond & Chernoff (2015), Gregson (2013), Pennell (2019), Felton et al. (2016)

Challenges of Social Justice in Mathematics Education:

This category examines the broader challenges that impact the effectiveness of social justice initiatives within the educational system.

These categories, along with their associated codes, are detailed in Table 4, providing a structured overview of the complexities involved in realizing social justice within the context of mathematics education.

Difficulty in Implementing Social Justice in Mathematics Education

Social justice in mathematics education, defined as equity, fairness, and equality (Alfrey & O'Connor, 2020), is a multifaceted concept that hinges on the effective use of resources by teachers to ensure equitable student engagement. Achieving high levels of learning for all students while addressing social justice is challenging, with concerns that it may shift focus from cognitive to non-cognitive issues due to the politics of power, culture, and diversity (Gewertz, 2020). The integration of personal and political beliefs into mathematics teaching is fraught with the risk of political bias and controversy (Gewertz, 2020).

Teachers' understanding and skills regarding race, gender, and socioeconomic status are crucial in implementing social justice in mathematics education, as these factors influence the social constructs of equity, equality, and fairness within teaching (Harrison, 2015). Teacher education programs often promote a non-critical stance, yet social justice efforts tend to support marginalized groups, aiming to elevate disadvantaged students to equal educational standing (Harrison, 2015).

Curricula designed with social justice in mind must navigate the complexities of incorporating social, cultural, and political issues, which is a significant challenge

(McName, 2013). Many schools lack the necessary tools and resources for quality social justice teaching (Seegmiller, 2020). Additionally, teachers, particularly those from the majority class, may be ill-equipped to teach mathematics through a multicultural, equitable lens, complicating the implementation of social justice pedagogy (Turner et al., 2012). This difficulty is prevalent in developing countries, where introducing social justice into mathematics classes is problematic (Secada et al., 2003), possibly due to lack of resources, unfair distribution of available resources, and decontextualized mathematics teaching and learning.

Beyond teacher knowledge, other factors impede the realization of social justice in mathematics education. Even with adequate technology, resources, and culturally competent teachers, achieving true equity remains elusive (Colquitt, 2014). Classrooms must be equitable to foster critical thinking about mathematics from a social justice perspective (Colquitt, 2014). Critical mathematics literacy involves using mathematics to analyze and challenge injustices, and advocating for change (Frankenstein, 1997). However, there is a need for a comprehensive guide to equity pedagogy (Frankenstein, 1997). The distinction between equality and fairness is also highlighted, as students' diverse abilities, values, and motivations necessitate responsive teaching (Gutiérrez, 1999; Hodge, 2006; Rousseau & Tate, 2003), adding another layer of complexity to social justice in mathematics education.

Challenges of Teaching for Social Justice in Mathematics Education

In the current landscape of standards-based educational reform, intellectuals are finding it increasingly difficult to integrate a social justice agenda. The emphasis on high-stakes testing and standardized assessments tends to marginalize content that is not tested, stifling the creativity of both teachers and students (Um, 2019). The challenges of upholding social justice in mathematics education are manifold and include:

- Teacher Readiness: Educators must be prepared to apply socially critical pedagogies, a commitment that requires ongoing dedication (Bond & Chernoff, 2015; Secada et al., 2003).
- Student Diversity: Multicultural classrooms present unique challenges in aligning mathematics content with the varied personal and family interests of students (LaDuke, 2009; Acharya et al., 2021).
- Socioeconomic Factors: Students' socioeconomic backgrounds influence their access to mathematics education (Esmonde & Caswell, 2010).
- Teacher Education: Training programs need to equip teachers with the skills to address social justice issues within their teaching (Vomvoridi-Ivanovic & McLeman, 2015).
- Curriculum and Pedagogy: The content and methods of teaching must be contextualized to reflect social justice principles (Belbase et al., 2008; Luitel, 2009; Taylor & Luitel, 2005).

The pressure to prepare students for mandated tests complicates the implementation of teaching for social justice (Gregson, 2013). Teachers struggle to find mathematics content that aligns with social issues and often require more time to prepare equity-based lessons. Additionally, the transient nature of student populations in schools adds to the complexity of maintaining a consistent approach to social justice education.

Implementing an equity pedagogy, critical pedagogy, and social justice pedagogy in mathematics requires flexibility to adapt plans and activities to the evolving dialogues and debates in the classroom, which can be challenging for teachers (Pennell, 2019). Equity pedagogy in mathematics can be fairness in classroom participation, engagement, and assessment, and equitable access to school resources for all students. Critical pedagogy in mathematics education can be a method of teaching and learning mathematics that enables and empowers students to question unfairness and injustice in society through mathematical discourse. Likewise, social justice pedagogy can be an approach to mathematics teaching and learning promoting fairness, equity, equality, and justice. In this context, mathematics teachers who believe in the value of incorporating diverse cultures and experiences into their lessons are more likely to integrate considerations of race, class, gender, disabilities, and critical social issues into their teaching. However, fostering such beliefs is a challenge, necessitating teacher development programs and professional development activities that provide real-world context and examples (Evans, 2013).

Reflection, Implication, and Conclusion

In our reflection on the four paradigmatic themes of social justice in mathematics education, we delved into the implications and synthesized our perspectives. We have dissected the concept into four key areas: prospects, priorities, processes, and problems. Social justice as a movement within mathematics education is deeply rooted in historical social and political movements advocating for educational reform. This movement encompasses the standards movement, realist mathematics,

and ethnomathematics, which have significantly influenced teacher awareness but have had a limited impact on actual teaching practices and student outcomes, particularly for marginalized groups. To foster equitable pedagogy, mathematics teachers must employ innovative teaching methods, integrating technology and other resources to ensure fairness, equality, and equity.

Curricular and pedagogical reforms are central to social justice in mathematics education. Efforts across various countries have led to changes in content alignment and distribution across grade levels. However, these reforms have inadvertently perpetuated segregation and performance-based student division, failing to bridge gaps across race, gender, and economic status. Despite the transformative intentions of these reforms, their full potential has yet to be realized in classroom pedagogy. The processes supporting social justice in mathematics education are underpinned by curricular, pedagogical, and assessment practices. The curriculum, often viewed by teachers as a neutral document, outlines content without considering the broader social context. A robust and relevant curriculum should facilitate high-quality mathematics learning, drawing from students' backgrounds and knowledge. Teachers should engage students in civic responsibilities, encouraging them to address community issues through mathematics. Collaborative platforms are essential for stakeholders to share beliefs and priorities, shaping a curriculum that responds to job market needs, scientific advancements, and societal challenges.

Implementing social justice in mathematics education is fraught with challenges, including teacher readiness, student diversity, socioeconomic factors, and the nature of teacher education programs. High-stakes testing and standardized assessments further complicate the landscape, limiting teachers' ability to foster creativity and critical thinking. Pedagogical practices must empower students, providing equitable learning opportunities and dismantling barriers related to race, class, gender, and ability. Assessment practices should be reformed to evaluate students holistically, reflecting their capabilities and potential rather than conforming to a uniform standard.

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