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Integrative projects and mathematics for social justice

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ABSTRACT

Background: In the context of the Brazilian High School Reform, the National Textbook and Teaching Material Program (PNLD) began distributing integrative project (IP) textbooks as part of the materials allocated to general education. **Objectives:** This study investigates how these books support the development of students' abilities to read and write the world with mathematics, that is, to interpret and transform it, as proposed in Gutstein's mathematics for social justice, inspired by the ideas of FSreire and Skovsmose. **Design:** This is a qualitative, document-based study that analyses the two IP textbooks with the highest circulation in the 2021 PNLD, the first call for submissions aligned with the Reform. Together, these books account for approximately 46% of the total distributed copies. **Setting and Participants:** The textbooks are treated as the objects of study, with their content serving as the corpus for analysis. **Data Collection and Analysis:** The study followed the three phases of the Teorema System: planning, material exploration, and data processing, focusing on both the teacher's guide and the student's edition. **Results:** Most IPs show potential to engage students, but avoid deeper exploration of social issues. Mathematics is only marginally integrated into the contexts and does not significantly contribute to understanding them or supporting decision-making. **Conclusions:** The analysed books show weaknesses in supporting the reading of the world with mathematics and almost entirely disregard the writing of the world with mathematics. Furthermore, the study emphasises that the current context of PNLD development hinders the construction of PIs guided by the principles of mathematics for social justice.

Keywords: Mathematics for social justice; Integrative projects; Critical mathematics education; PNLD; New High School.

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RESUMO

Contexto: No contexto da Reforma do Ensino Médio, o Programa Nacional do Livro e do Material Didático (PNLD) passou a distribuir livros didáticos de projetos integradores (PI) como parte do material destinado à formação geral básica. **Objetivos**: Este estudo investiga como esses livros favorecem o desenvolvimento das habilidades de ler e escrever (interpretar e transformar) o mundo com matemática pelos estudantes, conforme a abordagem pedagógica de matemática para a justiça social proposta por Gutstein, inspirada nas ideias de Freire e Skovsmose. **Design**: Trata-se de uma pesquisa qualitativa, de caráter documental, que analisa os dois livros didáticos de PI com maior tiragem no PNLD 2021, o primeiro edital a considerar a Reforma. Juntos, esses livros representam cerca de 46% dos exemplares distribuídos. **Ambiente e participantes**: Os livros são tratados como objetos de estudo, assumindo-se seus conteúdos como corpus de análise. **Produção e análise de dados**: O estudo seguiu as três fases do sistema Teorema: planejamento, exploração do material e tratamento dos dados, com foco tanto no livro do professor quanto na versão do estudante. **Resultados**: A maioria dos PI possui potencial para engajar os estudantes, mas evita aprofundar questões sociais. A matemática aparece pouco integrada aos contextos e não contribui significativamente para a compreensão nem para a tomada de decisões. **Conclusões**: Os livros analisados apresentam fragilidades na leitura do mundo com matemática e ignoram, quase por completo, a escrita do mundo com matemática. Salientamos, ainda, que o contexto atual de desenvolvimento do PNLD dificulta a construção de PI orientados pela matemática para a justiça social.

Palavras-chave: Matemática para a justiça social; Projetos integradores; Educação matemática crítica; PNLD; Novo Ensino Médio.

INTRODUCTION

The enactment of the High School Reform in Brazil, established by Law N. 13.415/2017 (Brasil, 2017), redefined the curriculum organisation of the final stage of basic education (K-1 through K-12). This new configuration began to be structured around two main axes: Basic General Education and Formative Itineraries. The Basic General Education corresponds to the common and mandatory part of the curriculum, aimed at guaranteeing the knowledge defined by the National Common Curriculum Base (BNCC). The Formative Itineraries, in turn, comprise flexible and elective components that allow for the deepening or expansion of learning in specific areas or in technical and professional training.

Among the changes introduced is the requirement that school units must guarantee actions that promote curriculum integration (Brasil, 2018). Official documents do not define this term, but in a recent analysis, Simas et al.

(manuscript under analysis) discuss this concept by comparing specialised scientific literature with the government's proposal for curriculum integration. To contribute to the implementation of this guideline, starting in 2021, the Ministry of Education, through the National Book and Teaching Material Program (PNLD), began distributing books on integrative projects (IPs) for Brazilian secondary education to be used in the basic general education rather than during formative itineraries (Brasil, 2019).

As determined by the 2021 PNLD notice, the IP textbooks for mathematics and its technologies are made up of six projects covering the BNCC skills chosen by the authors, addressing "integrating themes" and general BNCC competencies pre-defined in the notice for each IP (see Brasil, 2019; Simas et al., 2025). This scenario is conducive to discussions about the challenges involved in promoting learning that dialogues with students' realities and effectively contributes to their critical, civic, and democratic development.

The proposal for a mathematics for social justice, as formulated in Gutstein (2006), articulates the foundations of Paulo Freire's liberating pedagogy and Ole Skovsmose's critical mathematical education, arguing that students learn to read and write the world with mathematics. This implies recognising mathematical knowledge as a language capable of revealing power relations, social inequalities, and oppressive structures, in addition to being a tool for transforming reality. This perspective gains special relevance in an educational scenario marked by tensions, as observed in the production of teaching materials offered to public schools, since, as Amaral et al. (2022, p. 30) observe, the textbook "is not produced in a neutral way, there is an ideology that supports it, as well as being a means of disseminating values and beliefs of a given culture, situated in a certain historical period."

Recent studies have expanded the understanding of mathematics teaching with a focus on social justice. Gonzalez (2024) observes that, for a long time, mathematics was considered a neutral discipline and its teaching was seen as apolitical. However, it highlights that it is a powerful tool for understanding social life and its inequalities and that, as a language, it can be used to defend a more just society. Furthermore, he adds that the mathematics curriculum can strengthen democracy and move society towards social justice. The author proposes that mathematics can be used to engage students in critical debates on issues affecting society and to actively advocate for change.

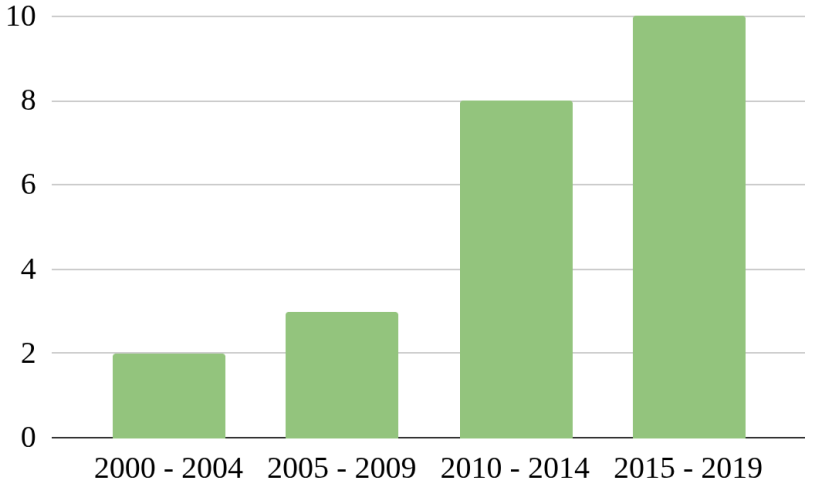
As part of research involving this topic in Brazil, Taveira (2024) carried out a systematic review of the academic literature on curriculum justice and found the absence of this debate in privileged spaces in the field of mathematics

education, especially in the recent thematic dossiers of Working Group 3 of the Brazilian Society of Mathematics Education (GT3 of SBEM), which deals with curriculum. From this gap, the author proposes a political manifesto that articulates the need to critically think about school curricula in order to meet the interests of historically disadvantaged groups.

At the international level, Xenofontos et al. (2020) analysed scientific publications produced between 2000 and 2019, through a systematic review of empirical studies involving mathematics for social justice. The data indicate growth in these studies over the 20 years considered (Figure 1). According to the authors, although the notion of social justice has gained ground in recent literature in the field, there is still little consensus on its forms of implementation, which reinforces the importance of research that contributes to this agenda.

Figure 1

Evolution of empirical studies involving mathematics for social justice. (Based on data from Xenofontos et al., 2020)



Recent studies have been investigating possibilities for linking mathematics and social justice in specific school contexts. Nicol et al. (2019) analyse their own experiences involving participants from five countries, including primary and higher education teachers. Educators sought to learn how to teach and create STEM (science, technology, engineering, and mathematics) activities

aimed at different educational segments, focusing on mathematics and social justice issues such as climate change and homelessness. The authors highlight that this co-authorship process strengthens engagement with social issues. Furthermore, they report various challenges, both in the preparation and implementation of the activities developed. Similarly, recent proposals in the field of mathematics education within the STEM approach have advocated for articulating school content with students' concrete actions, valuing local contexts as a starting point for analysing global problems, such as sustainability, biodiversity, and human rights (Anderson, 2024).

In another study, Nock et al. (2025) investigated the effects of including social justice themes in a doctoral engineering course on learning technical content. The authors state that, although the students showed a slight decline in technical performance in the first assessment, their learning matched that of the control group throughout the course, along with a greater ability to reflect critically on the social implications of technical decisions.

Despite the theoretical defences and reported experiences, significant barriers to the implementation of mathematics for social justice in everyday school life persist. In the study by Gonzalez (2025), seven high school mathematics teachers in New York participated in a continuing education course offered on this proposal. At the end of the course, everyone declared that they agreed with the principles of the approach and recognised its potential. Even so, they indicated that they would be unlikely to implement it regularly in their classes. Teachers expressed concerns about the lack of alignment between this proposal and official curricula, potential resistance from managers and those responsible, and fears of heated classroom discussions that they do not feel prepared to handle. They also reported fears that students would feel powerless in the face of the injustices discussed. According to the author, a central point identified in the teachers' statements concerns their beliefs about the place of mathematics for social justice in pedagogical practice: it is often perceived as an addition, something to be done when there is time available or as a specific motivational strategy, preferably in extracurricular spaces such as elective courses or clubs. Furthermore, many believe that students need to learn mathematical content in a traditional way before applying it in social justice contexts, which reveals a view that mathematical learning cannot emerge from the social situations analysed. Such beliefs and fears help to understand why, even among committed teachers, this proposal remains marginalised in relation to traditional teaching.

Given this scenario, this article seeks to answer the following research question: whether, and in what way, the PNLD 2021 integrative projects favour the development of the world's reading and writing skills with mathematics, according to the assumptions of mathematics for social justice. The relevance of the research lies in understanding how these materials can support mathematics teaching and contribute to the field of mathematics education. They offer assistance to teachers, authors, and researchers in formulating educational projects guided by the principles of mathematics for social justice. The study analyses the two most widely circulated integrative project books in the PNLD 2021, which, together, represent around 46% of the copies distributed (FNDE, 2021). Although these works do not explicitly reference mathematics for social justice, and only one mentions critical mathematics education (Gay, 2020), some of their projects propose social reflections linked to mathematics, justifying the adoption of this theoretical framework in our analysis. Furthermore, this research report helps reduce the gap identified by Taveira (2024) concerning the scarcity of national productions addressing curriculum justice and mathematics for social justice.

THEORETICAL FRAMEWORK

This study is anchored in the perspective of mathematics for social justice, formulated by Gutstein (2006), which articulates elements of critical mathematics education (Skovsmose, 1994) and, mainly, the notion of liberating education (Freire, 2013b). The author begins with the understanding that mathematics teaching must consider broader objectives and contribute to forming critical subjects capable of understanding power relations and transforming the social conditions in which they live through the use of mathematics. Thus, in addition to students believing in the usefulness of mathematics, we want them to see it as a tool for reading and writing about the world.

Gutstein (2006) presents examples of activities for elementary school students that aim to develop the power of social action (*social agency*), that is, the ability to imagine other possible worlds and to act on reality in an ethical, informed, and transformative way. The author refers to the agency for social transformation rather than individual transformation, such as emotional or psychological issues related to self-efficacy, optimism, and performance. This approach recognises that students can reflect and act collectively, feeling capable of contributing to historical processes.

Gutstein (2006) observes that teaching mathematics for social justice depends on political intentionality and agrees with Freire and Faundez (2013) when they defend the need for teachers to take a stand in the classroom and

allow discussion about their position; and they highlight the challenge of avoiding "disaffirming students" (Freire & Faundez, 2013, p. 39):

> [...] My experience has always been rich, and I find comfort in the fact that, in it, I have never started from the authoritarian conviction that I have a truth to impose—the indisputable truth. On the other hand, I never said or even suggested that the opposite of not having a truth to impose would be not having anything to propose. If we have nothing to propose or if we simply refuse to do so, we have nothing truly to do in educational practice. The question that arises is the pedagogical-democratic understanding of the act of proposing. Educators cannot refuse to propose, nor can they refuse to allow the student to discuss what they propose. Ultimately, this concerns the near mystery surrounding the practice of the educator who embodies democratic substantivity, asserting oneself without, however, disaffirming the students. It is this position, that of radicalism or democratic substantivity, that opposes, on the one hand, authoritarianism and, on the other, spontaneity. (Freire & Faundez, 2013, p. 39)

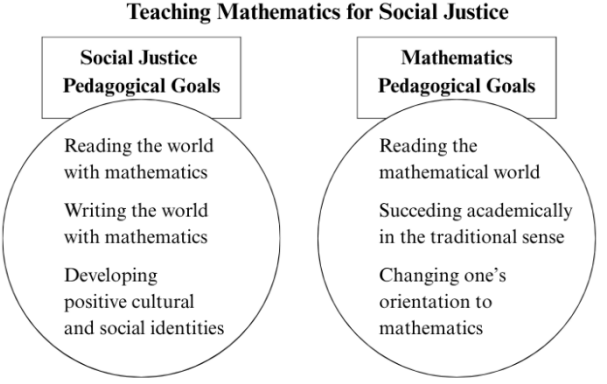
From an educational perspective committed to social transformation, the teachers' role transcends the mere transmission of content. They must take a stand as active agents in shaping critical and participatory subjects. In this sense, Gutstein (2006) considers that teachers from all areas of knowledge must assume the role of "transgressors" (Hooks, 1994, our translation), that is, a stance committed to broader social transformations. [our translation de que lingua para que língua?] They must recognise their role within collective movements and act intentionally to create educational spaces that encourage young people to actively engage in changing society. From this perspective, mathematics teaching must contemplate two sets of pedagogical objectives, as summarised in Figure 2.

Pedagogical objectives for social justice

The three pedagogical objectives indicated below are oriented towards developing a critical vision for social justice through the use of mathematics.

Figure 2

Pedagogical Objectives of Mathematics for Social Justice. (adapted from Gutstein, 2006, p. 23)



Reading the world with mathematics

The notion of *reading the world* was originally proposed by Paulo Freire, who distinguished between *reading the world* and *reading the word* (Freire & Macedo, 1987), arguing that both must occur in an articulated manner. As Freire writes, "Neither the reading of the word alone, nor the reading of the world alone, but the two dialectically supportive." (Freire, 2013a, p. 122). Gutstein (2006) appropriates this Freirean conception and extends it to the field of mathematics, proposing that students learn to read the world with mathematics. This means using mathematical concepts and tools to understand power relations, social injustices, and forms of oppression that affect different social groups. For Gutstein (2003), reading the world with mathematics means:

> Using mathematics to understand power relations, resource inequalities, and unequal opportunities among different social groups, and to understand explicit discrimination based on race, class, gender, language, and other differences. (Gutstein, 2003, p. 45, our translation)

A related concept is that of *critical literacy,* which involves both the construction of specific knowledge, such as concepts, ideas, skills, and facts, as well as a conscious political orientation, aimed at identifying the oppressive dimensions present in society and acting to build a more just world (Macedo, 1994). Thus, in this model, the curriculum is linked to the ability to understand

the complexity of the world and to confront the structures that sustain oppression. Thus, what defines whether a curriculum promotes critical literacy is not its technical quality or some isolated evaluative criterion, but rather the way it responds to the educational and sociopolitical structures and demands of society. It is, therefore, a matter of recognising that the curriculum carries intentions and can contribute both to the maintenance of the current order and to its transformation (Gutstein, 2006).

An emblematic example transforms a piece of data, initially abstract, into something concrete and politically significant.

> When the students realised that one B-2 bomber was equivalent to the cost of providing four-year college scholarships to every student in the following 79 classes at their school, they began to read the world through a mathematical lens. (Gutstein, 2006, p. 26, our translation)

This critical reading promotes the development of sociopolitical awareness, which is expressed in the ability to relate numerical data to one's own life and the functioning of society.

Writing the world with mathematics

This objective is linked to Freire's notion of *praxis* (*i.e.,* reflective and transformative action on reality), emphasising the articulation between reflection and action. As Severino (2022) highlights, in the preface to the work *A importância do ato de ler* [The importance of reading], by Paulo Freire:

> […] the reading of the word is always preceded by the reading of the world. And learning to read, to write, to become literate is, above all, learning to read the world, to understand its context, not through a mechanical manipulation of words, but through a dynamic relationship that links language and reality. Furthermore, learning to read and literacy are acts of education, and education is a fundamentally political act. (Severino, 2022, preface)

Thus, *writing the world with mathematics* means using mathematical knowledge as a tool for social transformation. Gutstein (2006) highlights that, although young people can intervene in society with mathematics, it is essential to develop a sense of social action (sense of social agency) so that, little by little, students begin to feel involved with the social challenges studied. In short,

"writing the world with mathematics means to use mathematics to change the world" (Gutstein, 2006, p. 27, our translation).

One example is Tate's (1995) work, in which elementary school students use data to argue to the city council against the excessive concentration of liquor stores in their neighbourhood. This concrete action represents a writing of the world with mathematics.

Develop positive cultural and social identities

This objective emphasises the recognition and appreciation of students' cultures, histories, and languages. The proposal is that they maintain their cultural integrity while critically appropriating the dominant culture taught in the school context.

Authors such as Ladson-Billings (1995) and Murrell (1997) argue that developing positive identities involves rooting oneself in one's own culture and, simultaneously, building tools to navigate and transform the social world.

> Positive cultural identities mean that students are strongly rooted in their home languages, cultures, and communities, but at the same time can appropriate what they need to survive and thrive in the dominant culture. (Gutstein, 2006, p. 28)

In addition to cultural identities, the author highlights the importance of social identity, which involves the confidence, perseverance, and courage necessary to act politically in the world, even if contextualised to the possibilities and limitations of youth.

The pedagogical objectives of mathematics

These three objectives are more directly linked to learning mathematics, although the author emphasises that both sets of objectives are "dialectically related" (Gutstein, 2006, p. 29).

Reading the word mathematics

Reading the word mathematics involves mastering mathematical concepts and procedures, which Gutstein (2006) refers to as mathematical power. This power is considered essential for students to critically understand reality, achieve academic success, and transform society: "If the student has difficulty reading the word mathematics, they may have difficulty reading the world with mathematics" (Gutstein, 2006, p. 29-30, our translation).

Furthermore, the critical appropriation of mathematics is seen as a matter of *educational justice,* especially for students from historically marginalised groups.

To be academically successful in the traditional sense

This objective refers to performance in exams, access to advanced mathematics courses, entry into higher education, and the opportunity to choose careers in the field, if desired. Gutstein (2006) emphasises that traditional success is *necessary, but not sufficient.* The goal is not just to get more students from oppressed groups into traditional pathways, but to transform those structures along with access: "I disagree with the position that advocates increasing access to opportunities in mathematics, but which simultaneously does not question the structures that created the injustices" (Gutstein, 2006, p. 30, our translation).

Changing the way one relates to mathematics

Finally, the third objective is for students to stop seeing mathematics as a set of decontextualised rules and start seeing it as a *powerful and relevant language,* capable of explaining and transforming the world. This shift in orientation is central to building a meaningful relationship with mathematical knowledge: "The shift in orientation I propose is not just that students believe that mathematics is useful, but also see it as a tool for reading the world" (Gutstein, 2006, p. 31).

The author argues that these learnings should be anchored in the students' life experiences, recognising their knowings and identities as a legitimate starting point for the educational process. According to him, "If we want students to become social actors, we need to start with what they know and what they value" (Gutstein, 2006, p. 40). This perspective dialogues with the proposal of *curriculum integration* (see Simas et al., in analysis), in which the experiences of school communities are integrated into pedagogical practices. Gutstein (2006) also highlights the challenge of the theoretical approach of mathematics for social justice materialising in pedagogical proposals in the classroom and describes practices already used with students in the school context.

Furthermore, Gutstein (2006) draws attention to the need for schools to be a safe space for students, especially those who belong to historically marginalised groups. He argues that discussions on sensitive topics, such as racism, poverty, exclusion, or police violence, should be welcomed and addressed as part of students' critical education.

This teaching perspective implies reviewing the roles of the school, mathematics and the teacher, shifting the focus from the mere transmission of content to the formation of critical and engaged subjects. Mathematics, therefore, ceases to be a decontextualised language and becomes part of collective projects of reading and rewriting the world.

METHODOLOGY

The methodology adopted in this research is based on a qualitative approach. As Bogdan and Biklen (1994, p. 209) state, studies of this nature "should reveal greater concern for the process and meaning rather than for their causes and effects". In this context, the focus of this research is to understand whether, and in what way, the PNLD 2021 integrative projects favour the development of the world's reading and writing skills with mathematics, according to the assumptions of mathematics for social justice by Gutstein (2006). Analysing the opportunities given to students through these materials is a natural concern in line with qualitative research, according to Denzin and Lincoln (2000) and Vidich and Lyman (2000).

It is important to clarify that the theoretical framework we assume was developed from experiences in everyday classroom mathematics teaching. Agreeing with Gonzalez (2024, p. 455), we understand that teaching materials may (or may not) create space for us to use mathematics as "a tool for democratic participation in society and, ultimately, for social justice [...] the curriculum must be reviewed, to value the use of mathematics as an essential tool for understanding our social world and advocating for changes that lead to its improvement" and looking critically at textbooks with Gutstein's (2006) theoretical perspective allows us to identify these possible changes and/or opportunities. Gonzalez's (2024, p. 459) research, for example, led her to observe that "existing textbooks and curricula [in her country] value the experiences and stories of some students over others [and that] the majority [...] prioritise a white, middle-class vision."

In this context, the perspective of mathematics for social justice was constituted by an analytical framework for textbooks in our study. Thus, we traced the methodological path adopting the theorem system (Amaral et al., 2022), summarised in Figure 3. The three central aspects of this system are: planning, material exploration, and data processing.

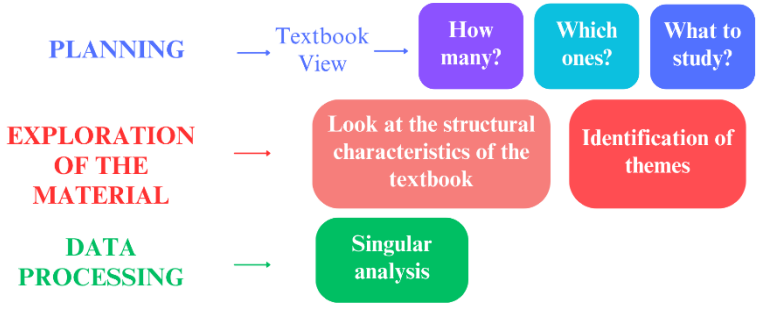
In planning the research, we adopted the perspective of the "textbook view," in which the object of study is the book as instructional material. We seek to understand the mathematics IP and its technologies approved in the

2021 PNLD, the first aimed at the New High School. This notice selected 14 IP works, but two of them accounted for around 46% of the distribution. According to data from FNDE (2021), one of these works accounts for approximately 38% of the total circulation, while the other accounts for 8%. Thus, we decided to analyse the books *Mais Ação na Escola e na Comunidade* [More Action at School and in the Community] (Bueno, 2020) by Editora FTD and *Práticas na Escola* [Practices at School] (Gay, 2020), by Editora Moderna. The analysis considered the teacher's manual, which already includes the student's book, totalling 615 pages of material.

The exploration of the material began with observing the structural characteristics of the textbooks, which contributed to adjustments in the planning. This led to reading the 2021 PNLD Notice to understand the requirements directed at publishers and authors. This approach aligns with the notion of *emerging design*, by Lincoln and Guba (1985), which Araújo and Borba (2019) translate as being the plan and strategies that are (re)constructed as the research develops. Even while exploring the material, we noted that the IP did not prioritise the construction of a sense of power of social action in students. This particular aspect of the research guided the choice of mathematics for social justice (Gutstein, 2006) as a theoretical lens for analysis.

Figure 3

Teorema System Methodology



The data processing stage involved analysing individual textbooks in the context of mathematics for social justice. Both works are considered in their entirety as objects of study, unlike stratified analysis, where only certain sections of the material are considered. In this process, the authors met weekly to discuss the book *Reading and writing the world with mathematics* [Ler e escrever o mundo com matemática] (Gutstein, 2006) and other readings related

to the theoretical framework, share their perceptions about the 12 IP, discuss the approaches of the books globally, and systematise the results of this material based on the theoretical lens chosen. In each meeting, reflections were recorded, such as a "research diary," which also makes up the data set considered in this article.

RESULTS AND DISCUSSIONS

We divided our reflections into two moments: "sense of power of social action" and "reading and writing the world with mathematics." The first addresses sociopolitical discussions on social justice in the analysed textbooks, which do not consider the use of mathematics. The second deals with aspects more directly linked to mathematics for social justice. First, we make some comparisons between the two books to provide a more comprehensive view of these resources to the reader.

Bueno (2020) and Gay (2020) have thematic similarities, but also significant differences regarding the nature of the final products, the degree of mediation required by teachers and the way in which sociopolitical issues are constructed and addressed. Both books, for example, include projects that address the scarcity of drinking water, the development of cooperative games for conflict mediation, and financial planning.

Five of Gay's (2020) six final products can be developed almost entirely using computers, even when they involve actions outside the school or home environment. They include: the creation of blogs, mobile apps, a digital magazine, an information panel and a cultural centre project. The exception is Project 1 (see Table 2), which proposes the creation of a physical packaging prototype, which presupposes access to a FabLab or similar structure. In Bueno (2020), for example, Project 1 (see Table 1) involves the final product depending on the construction or design and prototype of a cistern at the school; Project 3 includes a newscast recording; and Project 6 involves building a vegetable garden. It is worth noting that, if Projects 1 and 6 are carried out by more than one class, whether in the same school year or in different years, it may not make sense to propose repeated construction of cisterns or vegetable gardens in the same school.

Table 1

Description of Bueno's (2020) IP

Editora FTD	Project title	Brief description
Proj. 1	Water: How to reuse this resource?	It discusses inequality in access to drinking water, conscious consumption and the reuse of rainwater. Final product: construction of a cistern at the school.
Proj. 2	Budget: How to take care of our money?	It covers household debt, consumerism, and concepts of credit, investment, and financial planning. Final product: creation of an information panel on financial planning.
Proj. 3	Research results: How are they obtained and disseminated?	It introduces concepts of statistics, opinion research, and different forms of communication. Final product: production of a newscast with the results of research carried out by students.
Proj. 4	Games: Can they help solve conflicts?	It explores the diversity of games and their relationship to empathy, rules, and conflict resolution. Final product: creation of a games club with games produced in the classroom.
Proj. 5	Architecture: How to build sustainably?	It studies architecture, sustainability, and the conscious use of natural resources. Final product: development of a sustainable architectural project for the school using the software Tinkercad.
Proj. 6	Healthy eating: How to grow what you eat?	It deals with food, nutritional education, and urban agriculture. Final product: implementation of a school garden.

Table 2

Description of Gay's (2020) IP

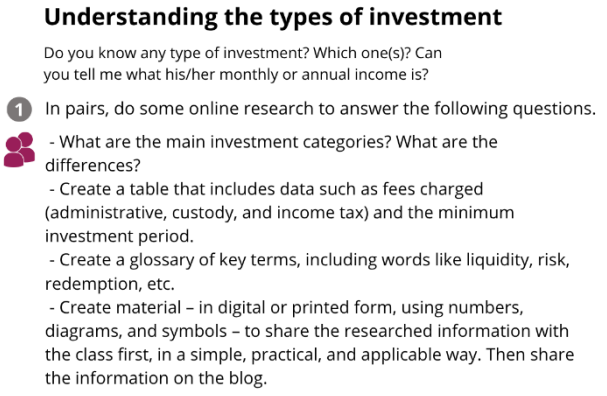
Editora Moderna	Project Title	Brief description
Proj. 1	What is the best packaging?	It deals with sustainability, resource conservation, and design innovation. Final product: creation of economical and sustainable food packaging.
Proj. 2	A space that reflects our culture	It explores youth cultures and local sociocultural identity. Final product: project for a community cultural space.
Proj. 3	Water shortage, what can I do?	It addresses conscious water consumption, unequal access, and environmental impact. Final product: creation of an app to implement habit changes and conscious consumption.
Proj. 4	Establishing a culture of peace	It discusses types of conflicts and forms of mediation in the school environment. Final product: creation of a game about conflict mediation.
Proj. 5	Financial planning	It works on financial mathematics, budget organisation, and conscious consumption. Final product: creation of an informative blog.
Proj. 6	Depression in adolescence: what can be done to combat it?	It reflects on mental health, support networks, and depression prevention. Final product: production of a digital magazine for communication and dissemination of information about combating depression.

The teaching mediation required in the projects varies significantly between the two collections analysed, depending on the depth of the proposed discussions. In Gay (2020), tasks often require the teacher to master specialised knowledge on the topics covered. An example is Project 5, whose objective is to present the different types of investment (Figure 4). Students are invited to research administration fees, taxes, minimum investment time, concepts such as liquidity and redemption, and are also required to develop glossaries and explanatory materials. However, the teacher's manual does not provide a link

or material to support the technical aspects of investments, requiring dynamism and willingness from the teacher to handle possible unknown terms.

Figure 4

Task that requires in-depth knowledge from the teacher. (Gay, 2020, p. 133)



Understanding the types of investment

Do you know any type of investment? Which one(s)? Can you tell me what his/her monthly or annual income is?

1 In pairs, do some online research to answer the following questions.

- What are the main investment categories? What are the differences?
- Create a table that includes data such as fees charged (administrative, custody, and income tax) and the minimum investment period.
- Create a glossary of key terms, including words like liquidity, risk, redemption, etc.
- Create material – in digital or printed form, using numbers, diagrams, and symbols – to share the researched information with the class first, in a simple, practical, and applicable way. Then share the information on the blog.

In Bueno (2020), the themes are more accessible, and the activities present less conceptual complexity. This reduces the requirement for prior preparation on the part of the teacher, but can also limit the depth of discussions. To break with this superficiality, the teacher must develop new questions and conduct interventions that encourage students to critically read the world.

The sense of power of social action

For Gutstein (2006), developing a sense of power of social action in students means creating conditions for them to see themselves as capable of acting politically in the world, based on a critical reading of reality, understanding power relations and structural inequalities. This is distinct from individual transformation—such as effort, self-confidence, or resilience—because it involves collectively imagining other possible worlds and acting ethically and informedly to transform the concrete conditions in which we live. An example of this sense in the analysed IPs is Gay's Project 2 (2020). In it, students are invited to investigate the cultural demands of the community, write a project for the construction of a cultural space and present it to the competent authorities, which implies recognising themselves as a collective subject capable of intervening in reality. This IP represents an exception. As a rule, the projects in the two textbooks analysed propose solutions centred on changes in individual

or small group behaviour—such as cultivating empathy, improving family financial planning, or saving water—without connecting with the historical or social processes that produce the issues under discussion. This localised approach shifts the focus from transforming reality through collective action to personal adaptation, limiting students' possibilities for developing a sense of power for social action, as conceived within the framework of mathematics for social justice.

Although individual or small group actions are relevant in responding to sociopolitical issues, it is essential to recognise that critical and conscious decisions depend on understanding the individual as part of a social network marked by tensions, asymmetries, and shared responsibilities (Gutstein, 2006). In the IP of the books analysed, this more complex reading of society proves to be very limited. The authors tend to adopt a stance of apparent neutrality, which distances them from relevant and necessary sociopolitical debates.

The sense of power in social action also presupposes an appropriate understanding of the relevant facts related to the project's context, including consideration of power relations and other sociopolitical elements involved (Gutstein, 2006). Let us look at some examples: the two IPs that address the scarcity of drinking water—one in each book analysed—do not support this reading. Both discuss the concept of a consumer item's water footprint, understood as the total volume of fresh water used, directly or indirectly, throughout the entire production chain of a product, generally expressed in litres of water per kilogram of the product. Even though they mention beef as a product with a high water footprint, the emphasis given to this information does not match its relevance to the issue of drinking water scarcity. Furthermore, IPs do not address the role of agribusiness sectors (FAO, 2020), often unrelated to food production, and the industry that, together, consume more than 90% of drinking water availablein Brazil (ANA, 2017), nor do they mention the role of public authorities, climate change or the importance of preserving riparian forests and other aspects related to the water cycle. On the other hand, both have activities for students to reflect on their individual and family water consumption (e.g., Bueno, 2020, p. 20; Gay, 2020, p. 74).

The same type of limitation appears in Bueno's (2020) Project 6, which deals with healthy eating. Although it highlights the importance of non-processed foods and their physical and financial accessibility (Figure 5), it does not mention ultra-processed items—which are often more affordable and cheaper than food *in natura* (Brasil, 2014)—in shaping the population's eating

habits. By disregarding essential factors on the topics under discussion, IPs offer a negligent reading of the world and, therefore, limit the power of social action, highlighted by Gutstein (2006), which could be fostered in students.

Figure 5.

Critical omission – ultra-processed foods. (Bueno, 2020, p. 174, our emphasis)

A healthy diet should be:

Varied: which includes several food groups to provide different nutrients (for example: cereals, fruits, vegetables, meats, dairy products, and beans).
Balanced: respecting the adequate consumption of each type of food (example: you should eat more fruit than fats).

Enough: in quantities that meet and respect the needs of each person.

Accessible: non-processed foods, produced and marketed regionally (physical accessibility), which are cheaper than processed foods (financial accessibility).

Writing the world with mathematics

Gutstein (2006) also highlights the importance of reading the world with mathematics, i.e., the use of mathematical concepts and tools to analyse power relations, social injustices, and forms of oppression that affect different social groups. However, both books—Bueno's (2020) and Gay's (2020)—present a significant gap in this aspect, which is precisely one of the fundamental principles highlighted by Gutstein (2006) for the promotion of social justice.

Most IPs address social problems with the potential to offer landscapes for relevant analyses using mathematics. However, often authors do not take advantage of these opportunities to use mathematics to read the world. The rule is that quite elementary mathematics, such as calculating the arithmetic mean or converting percentages into absolute values, is covered in high school. These concepts are used to answer questions that, although related to the topic, are self-contained and do not contribute to the understanding of the situation.

An example of this can be found in Gay's (2020) Project 6. The text contains data from a survey carried out in Covilhã, Portugal, with 59 young people aged 11 to 17, 31 boys and 28 girls. The study investigated depressive symptoms and life satisfaction among children and adolescents living with their

families (30) and those in residential care institutions (29), such as orphanages (see Figure 6).

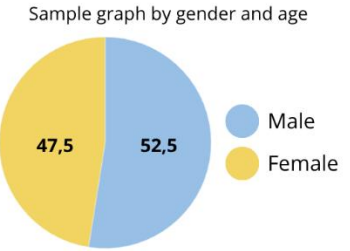
Figure 6

Activity on mean and standard deviation. (Gay, 2020, p. 156)

Table 1 Descriptive statistics of the sample of all young people, according to gender and age

	Age			
Gender	Mean	Standard deviation	Min. Max.	%
Male	14.06	1.692	11-17	52.5
Female	14.68	2.091	11-17	47.5
Total	14.36	1.901	11-17	100

Source: Martins (2012, p. 18).



1. In general, which group is older: boys or girls?
   That of girls, which can be evidenced by the average age, which is higher than that of boys.
2. Which group is more homogeneous, with ages closer to the average: boys or girls? Why?
   Boys, because the standard deviation is smaller.
3. In what situation would the standard deviation have resulted in zero?
   In the case where all the young people in that group were the same age. For example, all girls are 15 years old.
4. Considering the arithmetic means presented, would it be possible to have zero standard deviation?
   No. For the standard deviation to be zero, the ages would have to be the same; therefore, the arithmetic mean would be an exact number (unlike the cases cited, in which the means were 14.68 and 14.06).
5. If the arithmetic mean of the group of girls was 14, would it be possible to say that the standard deviation is zero? Why? Use examples to justify.

The activity aims to work with statistical concepts and ignores any critical discussion. The context in which the data is entered is not relevant to the solution of the exercise. Conversely, the analysis performed using mathematics in the exercise does not contribute to advances in understanding the topic being discussed.

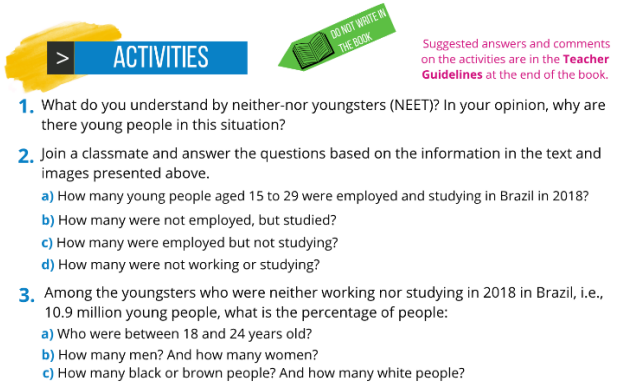
Figure 7

Bueno's Project 3 Task. Charts (2020, p. 81-2)

A similar example occurs in Bueno's (2020) Project 3. One of the activities is entitled "In Brazil, around 11 million young people neither study nor work." It presents four paragraphs discussing the term "neither-nor," two tables with quantitative data and a set of activities proposed to students (Figure 7). In this case, there is clear space for discussion of inequalities and power relations, including those involving gender and race (item 3 in Figure 8). In this sense, the textbook just asks: "In your opinion, why are there young people in this situation?" (item 1 in Figure 8). Here, mathematics is used to convert percentages into absolute values and vice versa. This would not be a problem if the information obtained from mathematics returned to the sociopolitical discussion in context; however, this is not what happens. The activity does not help the student to read the world with mathematics.

Figure 8

Mathematics task that does not dialogue with the context. (Bueno, 2020, p. 82)



> ACTIVITIES

DO NOT WRITE IN THE BOOK

Suggested answers and comments on the activities are in the **Teacher Guidelines** at the end of the book.

1. What do you understand by neither-nor youngsters (NEET)? In your opinion, why are there young people in this situation?
2. Join a classmate and answer the questions based on the information in the text and images presented above.
   a) How many young people aged 15 to 29 were employed and studying in Brazil in 2018?
   b) How many were not employed, but studied?
   c) How many were employed but not studying?
   d) How many were not working or studying?
3. Among the youngsters who were neither working nor studying in 2018 in Brazil, i.e., 10.9 million young people, what is the percentage of people:
   a) Who were between 18 and 24 years old?
   b) How many men? And how many women?
   c) How many black or brown people? And how many white people?

The main examples of using mathematics to read and write about the world in the IPs involve statistical research conducted by the students themselves, aimed at supporting decisions in the final projects. In Bueno's (2020) Project 2, which focused on financial planning, students investigated the investment habits of people they know, creating questionnaires, applying them in small groups and organising a collective report with the data obtained anonymously. Similarly, in Gay's (2020) Project 2, students research to understand the local community's interests in creating a cultural space. Using this information, they must locate a suitable plot of land, prepare architectural, electrical, and plumbing plans, develop a budget, and present the proposal to a public authority to strengthen community support.

These practices illustrate how the world is read through mathematics by using statistical concepts to understand concrete social realities. Furthermore, by proposing well-founded solutions and presenting collective demands through technical documents, students practice writing the world with mathematics, mobilising their knowledge to intervene in reality in an ethical and transformative way.

FINAL CONSIDERATIONS

As seen, Bueno's (2020) and Gay's (2020) IPs present significant limitations that compromise their potential to contribute to the reading and writing of the world with mathematics, as defended in the proposal of mathematics for social justice (Gutstein, 2006). Aspects relevant to a critical and well-founded analysis of the sociopolitical themes addressed are often disregarded in an apparent search for political neutrality. This oversight, in some cases, makes an informed interpretation of reality impossible, even without the support of mathematics. Proposals centred on individual behavioural changes predominate, without articulation with collective transformation processes or public authority actions. Furthermore, mathematics often appears as ancillary content, minimally integrated into the analysis of problems or decision-making, which limits its function as a tool for critically reading reality.

Despite these limitations, we believe that IPs have the potential to enhance the education of high school students, particularly by encouraging engagement with socially relevant issues and collaborative work. Still, the mathematical learning provided is quite limited. The connections between mathematics and other areas of knowledge are generally superficial or poorly explored, which weakens the role of mathematics as a critical and transformative language. For IPs to truly contribute to the development of critical and demo-

cratic citizenship, they must be designed based on principles that value the reading and writing of the world with mathematics, articulating school knowledge with complex social contexts and the active and informed participation of students.

The allocation of IPs in the time assigned to basic general education (Brasil, 2019) tends to hinder their implementation in schools, as it places them in competition with traditional subjects, whose workloads are already quite demanding. CNE/CEB Resolution N. 2 of 2024 (Brasil, 2024), however, established that the new IP books can be used both in basic general education and in formative itineraries, which offer greater curriculum flexibility, openness to interdisciplinarity, and valorisation of students' interests. Furthermore, in the PNLD 2026, IPs were defined as "Integrating Projects in interface with the World of Work" (Brasil, 2025). Apparently, the new books prioritise workforce training, and in this sense, there is an invitation for new research to analyse the possible impacts of this change on the perspective discussed here regarding mathematics for social justice.

However, changes in curriculum allocation, by themselves, do not guarantee the commitment of projects to a critical perspective of mathematics education. It is important to recognise that materials produced by large publishers, even if formally aligned with curriculum guidelines, tend to avoid more incisive approaches in social and political terms. One should not expect that an IP committed to mathematics for social justice will be produced by the corporations that dominate the PNLD or even by the Ministry of Education itself. The Brazilian publishing market allocates a large amount of resources, attracting the participation of multinational organisations and sectors of the financial market (Cassiano, 2005; Zeferino, 2024). These entities are committed to maintaining the current social order, which limits their willingness to foster truly critical approaches. As D'Ambrosio (2019, p. 20) reminds us, "the great political objective in the dominant concept of citizenship calls for conformist and, to a certain extent, standardised behaviour, which allows for the continuity of the social model."

Freire (2013b) warned that problematising pedagogies, the starting point for mathematics for social justice (Gutstein, 2006), do not serve the interests of the oppressors, as they imply a constant "unveiling of reality" (Freire, 2013b, p. 93) and prepare students for a "critical perception of reality" (p. 61). By proposing that living conditions be understood not as something immutable, but as "limit situations" (p. 47) that can be transformed, Freire (2013b) states that an authentic movement is only possible when "the situation they are in does

not seem to them as something fatal and insurmountable, but as a challenging situation, which only limits them" (p. 92). In this sense, problem-posing pedagogy invites students to "start asking: why?" (p. 67), and it is precisely this gesture of questioning that threatens the maintenance of the current social order.

Given the scenario analysed, we consider it necessary to promote alternative ways of constructing IPs, based on open and collaborative processes, and guided by social transformation. Such processes must actively involve teachers, researchers, educational institutions, social movements, and other groups committed to mathematics for social justice, whether in the production of teaching materials, the provision of continuing education, or the conduct of empirical research that deepens understanding of the scope and limits of this perspective in the school context.

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The authors jointly conceived the idea for the study, produced and analysed the data in weekly meetings with everyone's collaboration. Everyone contributed to the writing and general review of the final manuscript.

INFORMATION AVAILABILITY STATEMENT

Data sharing does not apply to this article, as it is a publicly available bibliography search.

REFERENCES

Agência Nacional de Águas [ANA]. (2017). *Água na indústria: uso e coeficientes técnicos*. https://www.snirh.gov.br/portal/centrais-de-conteudos/central-de-publicacoes/f0a7-agua-na-industria-uso-e-coeficientes-tecnicos

Amaral, R. B.; Mazzi, L.C.; Andrade, L.V.; Perovano, A.P. (2022). *Livro didático de matemática: compreensões e reflexões no âmbito da educação matemática*. (v. 19, 1ª ed.) Editora Mercado de Letras.

Anderson, J. (2024). How mathematics in STEM can contribute to responsible citizenship education in schools. In J. Anderson & K. Makar (Eds.), *The*

contribution of mathematics to school STEM education (pp. 243 – 256).Springer. https://doi.org/10.1007/978-981-97-2728-5_14

Araújo, J. de L., & Borba, M. de C. (Eds.). (2019). *Pesquisa qualitativa em educação matemática* (6ª ed.). Autêntica.

Bogdan, R. C., & Biklen, S. K. (1994). *Investigação qualitativa em educação.* Porto Editora.

Brasil. (2017). *Lei nº 13.415, de 16 de fevereiro de 2017*. Altera as Leis nº 9.394, de 20 de dezembro de 1996, e nº 11.494, de 20 de junho de 2007, entre outras providências. Diário Oficial da União.

Brasil. Conselho Nacional de Educação. (2024). *Resolução CNE/CEB nº 2, de 13 de novembro de 2024: Institui as Diretrizes Curriculares Nacionais para o Ensino Médio – DCNEM*. Diário Oficial da União.

Brasil. Conselho Nacional de Educação. (2018). *Resolução CNE/CP nº 3, de 21 de novembro de 2018: Define as Diretrizes Curriculares Nacionais para o Ensino Médio*. Diário Oficial da União.

Brasil. Ministério da Educação. (2025). *Guia do PNLD Ensino Médio 2026–2029*. Fundo Nacional de Desenvolvimento da Educação.

Brasil. Ministério da Educação. (2019). *Edital de convocação para o Programa Nacional do Livro e do Material Didático – PNLD 2021*. MEC/SEB.

Brasil. Ministério da Saúde. (2014). *Guia alimentar para a população brasileira* (2ª ed.). Ministério da Saúde.

Bueno, C. de O. C. (Ed.). (2020). *Mais ação na escola e na comunidade: Projetos integradores – Matemática e suas tecnologias*, *volume único, Ensino Médio*. FTD.

Cassiano, C. C. de F. (2005). Reconfiguração do mercado editorial brasileiro de livros didáticos no início do século XXI: História das principais editoras e suas práticas comerciais. *Em Questão*, *11*(2), 281–312.

D'Ambrosio, U. (2019). Prefácio [Prefácio]. Em J. L. Araújo & M. C. Borba (Orgs.), *Pesquisa qualitativa em educação matemática* (6ª ed., pp. 11-22). Autêntica.

Denzin, N.K. & Lincoln, Y.S. (2000) The discipline and practice of qualitative research, In: Denzin, N.; Lincoln, Y.S. *Handbook of qualitative research*. Second edition. Londres: Sage publications.

Food and Agriculture Organization of the United Nations (FAO). (2020). *The State of Food and Agriculture 2020. Overcoming water challenges in agriculture*. Rome. https://doi.org/10.4060/cb1447en

Fundo Nacional de Desenvolvimento da Educação (FNDE). (2021). *PNLD 2021 – Ensino Médio – Projetos Integradores e Projeto de Vida – Objeto 1: valores por título* [planilha eletrônica]. Fundo Nacional de Desenvolvimento da Educação. https://www.gov.br/fnde/pt-br/acesso-a-informacao/acoes-e-programas/programas/programas-do-livro/pnld/dados-estatisticos-1/PNLD2021EnsinoMdioProjetosIntegradoreseProjetodeVidaobjeto1_valoresporttulo.xlsx

Freire, P. (2013a). *Pedagogia da esperança: Um encontro com a pedagogia do oprimido.* Paz e Terra.

Freire, P. (2013b). *Pedagogia do oprimido*. Paz e Terra.

Freire, P., & Faundez, A. (2013). *Por uma pedagogia da pergunta*. Paz e Terra.

Freire, P., & Macedo, D. (1987). *Literacy: Reading the word and the world.* Westport, CT: Bergin & Garvey.

Gay, M. R. G. (Ed.). (2020). *Práticas na escola: Matemática e suas tecnologias – Projetos Integradores.* Moderna.

Gonzalez, L. (2025). Why I won't teach mathematics for social justice (even though I want to). *The Mathematics Educator, 32*(1). https://doi.org/10.63301/tme.v32i1.2811

Gonzalez, L. (2024). Mathematics curriculum as a vehicle for democracy and social justice. *Curriculum Perspectives*, 44(3), 453–461. https://doi.org/10.1007/s41297-024-00262-x

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

Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education*, 34(1), 37–73. https://doi.org/10.2307/30034699

Hooks, B. (1994). *Teaching to transgress: Education as the practice of freedom.* London: Falmer Press.

Ladson-Billings, G. (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal*, 32(3), 465–491. https://doi.org/10.2307/1163320

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Sage.

Macedo, D. (1994). *Literacies of power: What Americans are not allowed to know*. Boulder, CO: Westview Press.

Murrell, P. C., Jr. (1997). Digging again the family wells: A Freirean literacy framework as emancipatory pedagogy for African-American children. In P. Freire (Ed.), *Mentoring the mentor: A critical dialogue with Paulo Freire* (pp. 19–55). Peter Lang Publishing.

Nicol, C., Bragg, L. A., Radzimski, V., Yaro, K., Chen, A., & Amoah, E. (2019). Learning to teach the M in/for STEM for social justice. *ZDM - Mathematics Education*, 51, 1005–1016. https://doi.org/10.1007/s11858-019-01065-5

Nock, D., Pottmeyer, L., & Cranmer, A. (2025). Investigating how social justice framing for assessments impacts technical learning. *INFORMS Transactions on Education*, 25(2), 136-151. https://doi.org/10.1287/ited.2022.0030

Severino, A. J. (2022). Prefácio. In P. Freire, *A importância do ato de ler: Em três artigos que se completam* (1ª ed.). Cortez.

Simas, F. L. B., Carreta, C. L. A. & Amaral, R. B. (2025). Projetos Integradores no novo ensino médio: caminhos para a cidadania crítica. *Tangram – Revista de Educação Matemática, 8(1).* https://doi.org/10.30612/tangram.v8i1.19580

Simas, F. L. B., Amaral, R. B. & Carreta, C. L. A. (manuscrito submetido para publicação). A Integração Curricular no Novo Ensino Médio: um olhar sobre os livros didáticos.

Skovsmose, O. (1994). *Towards a philosophy of critical mathematics education*. Kluwer Academic Publishers.

Tate, W. F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice*, 34(3), 166–173. https://doi.org/10.1080/00405849509543676

Taveira, F. A. L. (2024). Currículo, justiça curricular e educação matemática: Um manifesto político. *RIPEM - Revista Internacional de Pesquisa em*

Educação Matemática, 14(2), 1-13. https://doi.org/10.37001/ripem.v14i2.3947

Vidich, A. J. & Lyman, S. (2000). Qualitative Methods: Their History in Sociology and Anthropology. In: Denzin, N.K.; Lincoln, I.S. (Org.). *Handbook of Qualitative Research*. 2.ed. London: Sage publications.

Xenofontos, C., Fraser, S., Priestley, A., & Priestley, M. (2020). Mathematics teachers and social justice: a systematic review of empirical studies. *Oxford Review of Education*, 47(2), 135–151. https://doi.org/10.1080/03054985.2020.1807314

Zeferino, W. R., Frossard, M. L., Cassani, J. M., & Santos, W. dos. (2024). Análise das editoras participantes do Plano Nacional do Livro Didático 2004-2019. *Jornal de Políticas Educacionais*, 18, e95739. Epub 15 de janeiro de 2025. https://doi.org/10.5380/jpe.v17i0.95739