Concerns of Critical Mathematics Education and of Ethnomathematics

Preocupações da Eduação Matemática Crítica e da Etnomatemática

Preocupaciones de la educación matemática crítica y de la etnomatemática

Ole Skovsmose* orcid.org/0000-0002-1528-796X

Para citar este artículo: Skovmose, O. (2022). Concerns of Critical Mathematics Education and of Ethnomathematics. *Revista Colombiana de Educación,* (86), 365-382. https://doi.org/10.17227/rce.num86-13713

Recibido: 21/04/2021
Evaluado: 28/05/2021

* Doctor in Education, Royal Danish School of Educational Studies. Aalborg University, Aalborg, Denmark and Universidade Estadual Paulista (Unesp), Rio Claro, Brazil. osk@ikl.aau.dk

Abstract

Critical mathematics education can be characterized by its many concerns. I refer here to four of them connected to social justice and politics, power and mathematics, students' future possibilities, and the socio-political structuring of education, all of which are interrelated and integrated. Those concerns are shared by much work done in ethnomathematics. However, to what extent an ethnomathematical study turns critical must be discussed in every case. I see the concerns of critical mathematics education as an important challenge to ethnomathematics.

Keywords

Critical mathematics education; social justice; power and mathematics; students' future possibilities; socio-political structuring of education; ethnomathematics

Resumo

A educação matemática crítica pode ser caracterizada por suas múltiplas preocupações. Neste artigo, faço quatro delas relacionadas à justiça social e política, o poder e as matemáticas, as possibilidades de futuro dos alunos e estruturação sociopolítica da educação, todos inter-relacionados e integrados. Essas preocupações são compartilhadas por grande parte do trabalho feito em etnomatemática. No entanto, é necessário discutir em cada caso em que medida um estudo etnomatemático se torna crítico. Considero que as preocupações da educação matemática crítica são um importante desafio para a etnomatemática.

Palavras-chave

Educação matemática crítica; justiça social; poder e matemáticas; possibilidades futuras para os alunos; estruturação sociopolítica da educação; etnomatemática

Resumen

La educación matemática crítica puede caracterizarse por sus múltiples preocupaciones. En este artículo, me refiero a cuatro de ellas relacionadas con la justicia social y la política, el poder y las matemáticas, las posibilidades de futuro de los estudiantes y la estructuración sociopolítica de la educación, todas ellas interrelacionadas e integradas. Estas preocupaciones son compartidas por gran parte del trabajo realizado en etnomatemáticas. Sin embargo, hay que discutir en cada caso hasta qué punto un estudio etnomatemático se vuelve crítico. Considero que las preocupaciones de la educación matemática crítica son un reto importante para la etnomatemática.

Palabras clave

Educación matemática crítica; justicia social; poder y matemáticas; posibilidades de futuro de los estudiantes; estructuración sociopolítica de la educación; etnomatemáticas

Introduction

The notion of critical mathematics education can be used in a broad sense, and I do not make any distinction between critical mathematics education and mathematics education for social justice. In fact, one can be involved in critical mathematics education without using the label. The important thing is what concerns one is pursuing through the educational activities.[1]

I usually do not try to characterise critical mathematics education in connection with some theoretical positions or particular classroom methodologies, but in terms of its concerns. In the following, I will outline four such concerns —although more could be added—, namely with respect to *social justice and politics*, *power and mathematics*, *the students' future possibilities*, and *the socio-political structuring of education*, which are all interrelated and integrated.

In the final section, I reflect on what it could mean for *ethnomathematics* to share concerns with critical mathematics education. Ethnomathematics is a broad research programme that has incorporated many perspectives and theoretical positions, and is engaged in a wide range of educational practices. I consider much work done in ethnomathematics as making part of critical mathematics education. However, let us consider the nature of the concerns that might be shared.

Social justice and politics

The notion of *social justice* is important for capturing a critical perspective on education. One might try to clarify what social justice could mean by relating it to other general notions, such as equity and democracy.[2] However, here I will take a different approach. I will try to connect this concept to two publications that have inspired critical education in general and critical mathematics education in particular. From my perspective, these two publications show what concerns about social justice could include and what are the implications of acknowledging that education has a political obligation.

The first one is Paulo Freire's *Pedagogia do Oprimido* (1968), which in 1972 was published in English as *The Pedagogy of the Oppressed*. He wrote the book when he was forced into exile, first in Bolivia then in Chile, down to the brutality of the military dictatorship that governed Brazil from 1964 to 1985.

1 For an outlining of critical mathematics education, see Skovsmose (2011).

2 For a discussion of social justice, see Rawls (1999).

The second publication I have in mind is Theodor Adorno's short article "Erziehung nach Auschwitz" ["Education after Auschwitz"], which appeared in 1966. Its first sentence states: "The premier demand upon all education is that Auschwitz not happen again."

Freire developed a pedagogy in solidarity with the oppressed. According to him, education ought to be a part of a struggle against any form of oppression and its devastating implications. In his pedagogy, Freire starts from a series of injustice issues, for example, water supply in a neighbourhood. Who has access to water? Who has access to clean water? What health problems are related to lack of clean water? Those questions allow exploring the "politics of water supply" as part of an educational project. Likewise, engaging in the "politics of" a range of everyday issues might reveal profound oppressive structures engraved in the socio-economic order of today.

Mathematics educators inspired by Freire have been explicit in their commitments with groups who suffer social injustices. Marilyn Frankenstein (1983; 1989) has worked in community education. She has addressed problems of unemployment, compared budgets for social services with military budgets, and presented statistics that document the levels of sexism at workplaces. Eric Gutstein (2006; 2016; 2018) has worked with Latin American and African American students in a disadvantaged and impoverished neighbourhood in Chicago. He has addressed cases of foreclosure, decay of neighbourhoods, and gentrification. Both Frankenstein and Gutstein have been deeply involved in showing how the "politics of" a range of everyday issues can be explored through mathematics.

Adorno's opening statement can be taken literally, but also metaphorically as claiming that education has to confront any form of injustice. To refer to Auschwitz as an example of social injustice might appear a bewildering understatement. However, Adorno's idea is clear: Education cannot be maintained as an isolated activity; it has to assume its political role in society. Education has to assume its responsibility in confronting any kind of oppression, also in its most barbarous format. Maybe education does not have the power to do so effectively, but it remains an obligation.

Freire's formulation of a pedagogy of the oppressed, and Adorno's reference to an education after Auschwitz signify the emergence of critical education with a profound social engagement. From 1968 and onwards, students' movement worked for a politisation of education. University studies should not any longer be organised according to traditional disciplines. Instead, the starting point should be real-life problems, and the students should have a principal say in what to study and how to study it. Studies should be problem-based and project-organised. These ideas all made part of critical education. The conception of critical mathematics

education was proposed as part of this movement (For more details about the initial formulation of critical mathematics education, see Frankenstein 2012; Skovsmose, 2012; 2020a).

One can observe a difference in the formulation of critical education, depending on whether the inspiration comes from Freire or Adorno. As the title of Freire's book indicates, he wanted to formulate an education together with the oppressed and for the oppressed. With this inspiration, many educational initiatives have focused on students at social risks. Adorno's reference to Auschwitz, however, highlights that critical education concerns all groups of students. If one, through education, should prevent a new Auschwitz from happening again, one needs to confront possible oppressive forces. One needs to address cases of oppression and injustices, also together with privileged groups of students.

I assume this broader perspective on critical education and on critical mathematics education. It is an education not only for students at social risks, but also for students in what I have referred to as comfortable positions. In fact, it is an ambition of critical mathematics education to try to engage every group of students, including those who study mathematics at the university, in discussions of what to consider oppression and exploitation, and what it could mean to work for social justice through mathematics (for further elaboration of this point, see Skovsmose, 2016).

Mathematics and power

Critical mathematics education is concerned about the power that might be exercised through mathematics. Michel Foucault addressed connections between knowledge and power (Foucault, 2000), particularly on issues related to humanities and social sciences such as psychology, psychiatry, and conceptions of madness and sexuality. However, he did not address connections between power and natural sciences nor mathematics.

I have addressed such connections in terms of the *formatting power of mathematics* as well as in terms of *mathematics in action*.[3] By the notion of mathematics in action, I want to highlight that mathematics belongs to many forms of technologies that form our everyday life. Mathematics is integrated in a range of processes of production, thus any kind of automatisation becomes formed through mathematical algorithms. Mathematics is part of modern communication and information processing, whatever we are dealing with civilian or military purposes. Mathematics also is part of modern medicine, where diagnostics and treatments draw on more and

3 See, for instance, Part 4 "Mathematics and Power" in Skovsmose (2014b); and Ravn and Skovsmose (2019). See also my discussion of the "banality of mathematical expertise" (Skovsmose, 2020c).

more advanced technologies. By opening new possibilities for handling huge data material, mathematics provides new possibilities for surveilling and controlling, and therefore also for manipulation and falsification.

In all such examples, one finds cases of mathematics-power interactions. In fact, I find that relationships between knowledge and power become particularly accentuated with reference to mathematics. Such relationships concern the overall formation of our life-worlds. Let me try to point out some elements of this formation by indicating how mathematics can be used in formatting possibilities, arguments, ideologies, and realities.

Formatting possibilities. New technological possibilities can be articulated in any type of language, natural language being one option. However, the language of mathematics includes some particular potentials for formulating technological possibilities. The whole conception of digitalisation and electronic computing builds on mathematics, and the possibility of establishing an internet could not be formulated without it. No natural language would make it possible to conceptualise the nature of such networking. However, we have to be careful when we talk about possibilities. The very notion of "possibility" connotes that we are dealing with some attractive alternatives, but this need not be the case. Mathematics also opens doors towards the most devastating possibilities and makes part of the formation of social risks.[4]

Formatting arguments is a common function of mathematics. For example, a government makes estimations of possible implications of economic initiatives.[5] Any macro-economic model includes a range of parameters connected through equations. By changing the value of some parameters, one can make an *experimental forecasting*. However, we should remember that the selection of parameters and the way they are connected through equations do not provide any direct representation of an economic reality. A mathematical model provides rather a particular interpretation of such a reality. Such an interpretation can include all kind of economic assumptions, political priorities, and ideological positions, which through mathematical formulations turn into integral, but also hidden, part of the model. This way, the experimental forecasting obtains a false appearance of objectivity.[6] This observation applies not only to economic models, but to any kind of mathematical modelling. Beneath the cover of apparently neutral looking symbols and equations, mathematical models format the way arguments become elaborated and perceived.

4 In Skovsmose (2019), I have argued that mathematics makes integral part of the formation of the risk society.

5 In Denmark, the Economic Council has used the Simulation Model of the Economic Council (SMEC) for advising the government, and the Danish government is using the Annual Danish Aggregate Model (ADAM).

6 In Chapter 17 in Skovsmose (2014b) I have discussed SMEC and the neo-liberal assumptions incorporated in the model.

Formatting ideologies. The mathematical shaping of ideologies can be irrational and dangerous. As an example, one can refer to the articulation of the neoliberal economic outlook, according to which the invisible hand of the market will ensure an enduring economic and social progress. This claim is based on a conglomerate of ideological assumptions and mathematical analyses, providing the neoliberal outlook with a mathematical legitimisation. The functioning of the "invisible hand" is a mathematical construct. Governments that are spellbound by the neoliberal outlook try to privatise public companies, public services, and so on. Creating legitimisations for doing so is a general function of mathematical formatting of ideologies, the neoliberal economic outlook being only one example.

Formatting realities refers to the phenomenon that mathematics not only operates as a tool for formatting possibilities, but also comes to make integral part of realities as well. Many discourses with respect to mathematical modelling present it as a detached description of a piece of reality. By talking about mathematics in action, I try to highlight that through mathematics one makes interventions in reality. Through mathematics-based automatisations, companies implement new patterns of production, which can lead to workers' dismissal. One establishes new forms of information processing, which bring about the conditions to fabricate fake news on an industrial scale. By making it possible to handle huge data material, mathematics creates new ways of organising commercials, marketing, propaganda, and for manipulating consumers and public opinion. In all such cases, mathematics does not "describe" the realities in question; it builds them up and comes to make part of them. In the end, mathematics comes to constitute basic features of our life-worlds.

Power becomes exercised through mathematics-based formattings of possibilities, arguments, ideologies, and realities. Such formattings can serve any kind of interests. There are no given positive qualities to be associated with mathematics-based actions due to their nature. As any kind of action, they can have any kind of qualities: risky, presumptions, expensive, misunderstood, cynical, dangerous, benevolent, altruistic, generous, brutal, and so on.

The mathematics implicitly referred to in these observations might be thought of as academic mathematics. However, it is important to acknowledge the plurality of mathematics. One can talk about engineering mathematics, street mathematics, school mathematics, elementary mathematics, advanced mathematics, pure mathematics, applied mathematics, any kind of ethnomathematics. Behind this multitude, there does not exist any "real" mathematics. Mathematics is a plurality. Any kind of mathematics from this plurality can bring about formatting of possibilities, arguments, ideologies, and realities. This observation is crucial for critical mathematics education, no matter what group of students one has in mind.[7]

7 See Skovsmose (2020c) for exploring the ethical dimension of a philosophy of mathematics.

Students' future possibilities

Throughout history, students and learners have been conceptualised in many different ways. They have been considered empty vessels that need to be properly filled through instructions. This conception echoes the classic empirical position as expressed by John Locke (1997) in *An Essay Concerning Human Understanding*, first published in 1689. Locke sees the human mind as initially being a *tabula rasa*, which during time get covered by sense impressions.

Critical education including critical mathematics education also operates with a conception of the students. They are not seen as any empty vessels, but as complex human beings and as potential socio-political actors. They are taken as resources for making social changes. It is through students that an education for social justices might come to make a difference.

In order to see students as potential socio-political actors, one needs to pay attention to their possible motives for engaging in learning processes and for addressing cases of injustices. I talk about motives and not about motivations. The reason is that the notion of motivation has been elaborated within a behaviourist outlook, which sees students as advanced stimulus-response systems.[8]

Motives for action can be formed from the person's background, but also through what I refer to as the person's *foreground*.[9] Foregrounds are constituted by varieties of possibilities as well by absence of possibilities. Economic conditions, cultural belongings, and dominant discourses structure a person's foreground. Simultaneously, it is formed through the person's —implicit or explicit— conceptions of such social structures. It is formed through experiences of possibilities as well as of impossibilities. A foreground is structured by hopes and aspirations, as well as by fears and aversions. Sometimes I prefer talking about foregrounds in plural, as it might not make sense to talk about *the* foreground of a person, as if it were a single well-defined entity. Anybody makes interpretations, changes interpretations, comes to grasp new possibilities, and recognise new obstructions.

I see learning as action, and motives for action as first of all established from the persons' foregrounds. Thus, for understanding students' motives or lack of motives for learning, one needs to consider their foregrounds and the nature of their social structuring.

8 For a clarification of the notion of motivation, see, for instance, Madsen (1974).

9 In Skovsmose (2014a), I make a general presentation of the conception of students' foregrounds, while in Skovsmose (2018) I relate foregrounds and experiences of meaning.

Seeing foregrounds and motives as not only personal, but also social constructions, provides a starting point for interpreting students' performances, also in mathematics. Previously, I have been involved in an educational project in South Africa, supervising a group of PhD students belonging to the first generation of researchers in mathematics education graduated after the Apartheid regime had come to an end. During the Apartheid, one finds much research in mathematics education, also research that apparently documented that black students' performances in mathematics are below white students' performances. In interpreting such observations, I did refer to the notion of foreground. As part of the Apartheid brutality, black people were deprived of many possibilities in life. Doing further education was restricted to few possibilities; becoming an engineer or any other technical professional was prohibited. These restrictions were Apartheid acts with huge implications for the formation of black students' motives for engaging with mathematics. My suggestion was to read black students' apparently weak performances in mathematics mainly as a consequence of the Apartheid brutality. It was the Apartheid regime that provoked those weak performances by amputating their foregrounds and annihilating motives for learning mathematics.

Similar observations apply not only to the Apartheid regime, but to many other situations. Economic inequality and systemic poverty are huge causes for eroding motives for learning. When a certain group of students apparently have a weaker performance in mathematics than other groups, one needs to consider the socio-political formations of their foregrounds and motives for learning. *Obstructions of students' future possibilities in life is a devastating learning obstacle*. By making this remark, I also distance myself from many discussions of learning obstacles, seeing them as routed in students' conceptual misunderstandings.

A principal concern of critical mathematics education is to construct new possibilities for the students, and to do so together with them. It is a concern to add new features to their foregrounds and to broaden their horizons towards the future. In the United States, Bob Moses organised the Algebra Project with the aim of improving the quality of mathematics education in poor communities and to provide better access to further education for black students (Moses & Cobb, 2001). Mathematics exercises a powerful screening function, and Moses wanted to ensure that black students were not obstructed in their career opportunities by low scores in mathematics. In order to overcome such obstructions, it became crucial to engage black students in the existing curriculum. This curriculum establishes a logic of gatekeeping, and the aim of the Algebra Project was to help black students master this logic. The mathematical content of the Algebra Project does not appear innovative, but it is clear in its ambition of adding new elements to the foregrounds of black students.

In his study *Interplay of Citizenship, Education and Mathematics: Formation of Foregrounds of Pakistani Immigrants in Denmark*, Sikunder Ali Baber (2007) makes profound observations with respect to students' foreground, (Baber, 2012; Biotto Filho, 2015) based on in-depth interviews with students and families from Pakistan living in Denmark. For short, I refer to these students as Pakistan students, even though they might have been born in Denmark and speak Danish without any sign of a foreign accent. I refer to students with longer historical roots in Denmark as Danish students. Baber found that students from Pakistan described their future opportunities in Denmark as being principally different from Danish students' ones. They found that they had to perform *far above* average in school, in order to get the same opportunities in Denmark as Danish students. If their performances turn out to be average —not to mention if they were below average—, they were left with no job possibilities in Denmark. The focus of Baber's study was not to try to verify to what extent the Pakistan students' claims were fair, but to identify the nature of their experiences. They felt their future possibilities were diminished. Such experiences can cause a polarisation of motives for learning, some might engage dedicated of their school tasks, while others might turn apathetic.

In "Antes de Dividir Temos que Somar" (Skovsmose *et al*., 2009), we present interviews with students from an indigenous community in Brazil. We wanted to explore what they saw as their future opportunities, how they evaluated them, and how they related them to mathematics. One student wanted to continue his life in the village. He related the mathematics he learnt in school to fieldwork: measuring the size of the fields, quantifying the harvests, and dividing the crops. Another student wanted to leave the village in order to study medicine. He saw the relevance of mathematics as a means for entering the university; he also found that mathematics could be relevant for studying medicine, although at the moment he could not imagine how it could be so. He found it important to study medicine for later returning to the village, as he saw health problems as being serious in indigenous communities. Different prospects in life are formulated by the two students, which establishes different motives for learning mathematics.

One cannot make assumptions about students' preferences, but one can support them in formulating new goals and getting new motives for learning. It is a concern of critical mathematics education to create new possibilities together with the students, and in this way to add new features to their foregrounds.

The socio-political structuring of education

By the socio-political structuring of education, I mean the external factors that influence what takes place in the classroom. Critical mathematics education is concerned about the nature of any such structuring (see, for instances Skovsmose, 2020b).

In the United States and many other countries like Brazil, the extreme right has been in the ascendance. Today, we often associate that current with a neo-liberal economic outlook. This is different from traditionally extreme right-wing movements like Nazism and Fascism, which grabbed the power by grabbing the State and its economic resources. However, current right-wing programmes usually include attempts to privatise everything. A source of inspiration comes from Milton Friedman's economic outlook. The so-called Chicago Boys, a group of Chilean economists that influenced many places in South America and Chile during the Pinochet dictatorship, elaborated this outlook further.

Today, a neoliberal economic experiment is taking place in Brazil, with president Jair Bolsonaro and the minister of finance Paulo Guedes, the eager privatiser. More and more educational institutions get privatised, which establishes new conditions for teaching and learning at all levels. Schools and universities turn into profit-oriented companies with a purposive business model and become submitted to the demand of making profit. Students have to pay, and teachers have to teach for larger and larger groups of students for lower and lower salaries. It has also become common to fire experienced teachers to employ younger teachers with lower salaries.

To an authoritarian regime, it is crucial to control the school system. The regime has to control that the content and format of the teaching is in accordance with the stipulated ideological order. The same applied to education in Germany during the Nazi period, and applies to authoritarian regimes today. Schoolbooks can be censored. Teachers can be controlled. Teachers that address controversial socio-political issues can be denounced. Students can be controlled by tests. All sorts of controlling can be brought in operation in order to dictate what takes place in the classroom.

Should the teaching and learning of mathematics be organised following the school mathematics tradition, it is normally not submitted to any eager authoritarian control mechanisms.[10] The school mathematics tradition appears to combine smoothly with different political outlooks, also of the most dubious nature. Herbert Mehrtens (1993) reveals the intimate relationships that emerged during the 1930s in Germany between, on the one hand, mathematics and mathematics education and, on the other hand, the Nazi

10 For a discussion for the school mathematics tradition, see Skovsmose and Penteado (2016).

ideologies. The adaptability of mathematics and mathematics education is a concern for critical mathematics education. However, a critical mathematics education, which addresses controversial socio-political issues, confronts patterns of oppression, and works for social justice— might face severe difficulties in a situation where the extreme-right plays a dominant political role.

The structuring of mathematics education according to some dominant socio-political order is a quite general phenomenon. Thus, capitalism in general exercises a structuring power. Alexandre Pais has highlighted that mathematics education is structured according to the capitalist order of things (see, for instance, Pais, 2012). Melissa Andrade-Molina (2018) has identified the nature of the "desired child", which refers to the formation of students according to the dominant economic order. She shows how this formation takes place in mathematics education by preparing the students to become part of a workforce, submissively incorporated in the machinery of production. The result is a fabrication of a *homo-economicus*. Those who are not able to fit into this conception will pose a danger for the functioning of the production machinery, therefore, they will be segregated. Alex Montecino (2018) has described the "desired teacher", as the one characterised through a variety of official documents. This "desired teacher" might serve functionally for the fabrication of the "desired child". The studies by Pais, Andrade-Molina, and Montecino tend to unmask the socio-political structuring of mathematics education.

With such considerations in mind, we should ask to what extent it is possible to organise a critical mathematics education that is not submitted to the dominant social order. The situation might well be paradoxical. On the one hand, I find it necessary to establish a critical mathematics education where controversial issues can be addressed, and concerns for social justice can be acted out. On the other hand, such a critical mathematics education might be, if not impossible, then at least very difficult to implement within the given socio-political order. This is a paradox that any form of critical mathematics education needs to face.

Critical concerns in ethnomathematics

I have related the concerns about social justice and politics, power and mathematics, students' future possibilities, and the socio-political structuring of education to critical mathematics education. One can mention more preoccupations of critical mathematics education. However, the four mentioned are sufficient for raising the question to what extent they can be considered concerns of ethnomathematics as well.[11]

11 Both the notions of mathematics education and ethnomathematics include ambiguities. Mathematics education can refer to practices of teaching and learning mathematics,

In the article "State of the Art in Ethnomathematics", Milton Rosa and Daniel Clark Orey (2016) summarise six dimensions of ethnomathematics, one being the political. The recognition of this dimension is crucial for any critical turn of education. This was what Adorno pointed out in 1966, and what Freire (1968) considered and integral part of a pedagogy of the oppressed.

As an illustration of what acknowledging the political dimension of ethnomathematics could mean, I want to refer to Aldo Parra's (2018) study *Curupira's Walk: Prowling Ethnomathematics Theory through Decoloniality*. Parra's starts from a conception of ethnomathematics as a study of relationships. This may be relationships between instances of ethnomathematics and instances of academic mathematics. By making this formulation, Parra moves beyond the traditional conception of ethnomathematics as a study of the mathematics of particular ethnic groups.[12]

Let me illustrate what the emphasis on relationships could mean. Parra worked in a Nasa community, a group of indigenous people living in Colombia. He was interested in coming to understand their conception of space, and how they measured land and distances. However, Parra not only registered techniques that were applied, but he also introduced other mathematical approaches, thus he showed how Google Maps functioned. By doing so, Parra related cultural techniques with other techniques for grasping geometric features of the environment. He did not simply register the ethnomathematics of the Nasa people, but also related it to other forms of mathematics.

Parra engaged himself in the educational programme developed by the Nasa community, and tried to make contributions to it. He was not making studies *of* the Nasa people, but doing studies *together with* them. He did not see himself as first and foremost an *observer*, but as a *participant*. By engaging in the problems and projects of the Nasa people, he acted out an interpretation of the political dimension of ethnomathematics.

In *Exclusão e Resistência: Educação Matemática e Legitimidade Cultural*, Gelsa Knijnik (1996) points out an important notion for the political dimension of ethnomathematics, namely *resistance*. She presents political action in terms of collaborations with groups of people who suffer social injustices. Knijnik (2007) pays special attention to *Movimento dos Trabalhadores Rurais Sem Terra* (*MST*), however, the importance of resistance can refer to any groups of people suffering oppressions. Through participation and resistance, ethnomathematics can come to act out its political dimension.

but also to studies of such practices. Ethnomathematics can refer to cultural embedded ways of doing mathematics, but also to studies of such ways of doing mathematics. Such ambiguities are normally clarified through the context in which the notion is used, and in the following I will switch between the different meanings of ethnomathematics.

12 In making this move, Parra points out that he is inspired by Alangui (2010).

The Amazon contains a wealth of natural resources, and the advancing industrial exploitation of these resources seems a certain way of making money, at least according to the economic outlook of the right-wing government in Brazil. That is a threat to the indigenous people living there. We can easily imagine ethnomathematical studies of these people's cultural traditions and ways of doing mathematics. We can imagine that such studies become conducted according to a descriptive research paradigm. However, considering the current situation, a descriptive approach would appear to be, not any objective and neutral, but rather cynical. For ethnomathematics to be critical, it needs to explore what participation and resistance would mean also in this case. Following Adorno, it is an obligation for education to act against any form of atrocities, even those that the indigenous people in the Amazon are facing.

To critical mathematics education, it is important to engage in the students' future, and to ethnomathematics it is important to commit with the future of the people one is interacting with. I think that ethnomathematics, when formulating educational proposals, first of all has been considering the students' backgrounds, while I suggest to pay particular attention to their foregrounds. Ethnomathematical studies needs not only to address, what is currently taking place in the community, and how people are operating with mathematics, but also to engage with what the people see at their future possibilities. Ethnomathematical studies need to explore how people operate with mathematics at present, but also of how they *might come to operate* with it.

Ethnomathematics, like any mathematics, also becomes brought in action (Skovsmose, 2015). It might provide ways of understanding a particular problem, but also ways for misunderstanding it. It might create ways of acting, as well as ways of misacting. Ethnomathematics, like any mathematics, is in need of critique. Such a critique can, for instance, be facilitated by pointing out relationships to other forms of mathematics, as done by Parra. Providing space for a critique of ethnomathematical practices is an important feature of ethnomathematical studies.

In ethnomathematics, the concern about the socio-political structuring of education makes part of the studies conducted by both Parra and Knijnik. The concern refers to the conditions for the people to implement their own educational programmes, rather than being subjected to programmes imposed on them. The Nasa people has formulated a programme they refer to as "proper education". To maintain and further develop such a programme makes part of the Nasa people's identity and aspirations for the future. Through his participatory approach, Parra contributes to this educational programme. *Movimento dos Trabalhadores Rurais Sem Terra* is also running their own educational programme, and Knijnik, through her

work, contributes to it. Through a participatory approach, ethnomathematics can acknowledge the people's own interests and priorities and participate in their struggles.

Certainly, the concerns of critical mathematics education are shared by much work done in ethnomathematics. To what extend a particular ethnomathematical study shares the concerns has to be discussed in every case. This is an important political challenge to ethnomathematics.

Acknowledgements

The present paper is a reworking and expansion of a text drafted for the Topic Study Group 52 (TSG 52), *Ethnomathematics*, at the 14th International Congress on Mathematics Education (ICME 14) planned to be held in 2020 in Shanghai in China.

I want to thank Melissa Andrade-Molina, Denner Barros, Arindam Bose, Manuella Carrijo, Jamaal Ince, Gelsa Knijnik, Alex Montecino, Amanda Queiroz Moura, Miriam Godoy Penteado, and Celia Roncato for their helpful comments and suggestions for improving this paper.

References

Adorno, T. W. (1971). *Erziehung zur Mündigkeit*. Suhrkamp.

Adorno, T. W. (n. d.). *Education after Auschwitz*. http://ada.evergreen.edu/~arunc/texts/frankfurt/auschwitz/AdornoEducation.pdf. Accessed 26 May 2020

Alangui, W. (2010). *Stone walls and water flows: Interrogating cultural practices and mathematics* [Doctoral thesis]. University of Auckland, Auckland.

Andrade-Molina, M. (2018) *(D)effecting the child: The scientification of the self through school mathematics* [Doctoral thesis]. Aalborg University, Aalborg.

Baber, S. A. (2007). *Interplay of citizenship, education and mathematics: Formation of foregrounds of Pakistani immigrants in Denmark* [Doctoral thesis].Aalborg University, Aalborg.

Baber, S. (2012) Learning of Mathematics among Pakistani immigrant children in Barcelona: A socio-cultural perspective. In O. Skovsmose & B. Greer (Eds.), *Opening the cage: Critique and Politics of Mathematics Education* (pp. 144-166). Sense Publishers.

Biotto Filho, D. (2015). *Quem não sonhou em ser um jogador de futebol? Trabalho com projetos para reelaborar foregrounds* [Doctoral thesis]. Universidade Estadual Paulista (UNESP), Rio Claro, SP.

Foucault, M. (2000). *Power*. The New Press.

Frankenstein, M. (1983). Critical mathematics education: An application of Paulo Freire's epistemology. *Journal of Education, 164*, 315–339.

Frankenstein, M (1989). *Relearning mathematics: A different third R – radical maths*. Free Association Books.

Frankenstein, M. (2012). Beyond math content and process: Proposals for underlying aspects of social justice education. In A. A. Wager & D. W. Stinson (Eds.), *Teaching mathematics for social justice: Conversations with mathematics educators* (pp. 49-62)., National Council of Mathematics Teachers (NCTM).

Freire, P. (1972). *Pedagogy of the oppressed*. Penguin Books.

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

Gutstein, E. (2016). "Our issue, our people —Math as our weapon": Critical mathematics in a Chicago neighborhood high school. *Journal for Research in Mathematics Education*, *47*(5), 454-504.

Gutstein, E. (2018). The struggle is pedagogical: Learning to teach critical mathematics. In P. Ernest (Ed.), *The philosophy of mathematics education today* (pp. 131-143). Springer.

Knijnik. G. (1996). *Exclução e resistência: Educação matemática e legitimidade cultural*. Artes Médicas.

Knijnik, G. (2007). Mathematics education and the Brazilian landless movement: Three different mathematics in the context for the struggle for social justice. *Philosophy of Mathematics Education Journal*, *21*, 1-18.

Locke, J. (1997). *An essay concerning human understanding* (Edited by Roger Woolhouse). Penguin Books.

Madsen, K. B. (1974). *Modern theories of motivation*. Munksgaard.

Mehrtens, H. (1993). The social system of mathematics and National Socialism: A survey. In S. Restivo, J. P. van Bendegem & R. Fisher (Eds.), *Math worlds: Philosophical and social studies of mathematics and mathematics education* (pp. 219-246). State University of New York Press.

Montecino, A. (2018). *The fabrication of the mathematics teacher as neoliberal subject*. [Doctoral thesis]. Aalborg University, Aalborg.

Moses, R. B. & Cobb, C. E. (2001). *Radical equations: Civil rights from Mississippi to the Algebra Project*. Beacon Press.

Pais, A. (2012). A critical approach to equity in mathematics education. In O. Skovsmose & B. Greer (Eds.), *Opening the cage: Critique and politics of mathematics education* (pp. 49–91). Sense.

Parra, A. I. S. (2018). *Curupira's walk: Prowling ethnomathematics theory through decoloniality* [Doctoral thesis]. Aalborg: Aalborg University Press.

Ravn, O. & Skovsmose, O. (2019). *Connecting humans to equations: A reinterpretation of the philosophy of mathematics*. Springer.

Rawls, J. (1999). *A theory of justice*. Oxford University Press.

Rosa, M. & Orey, d. C. (2016). State of the art in ethnomathematics. In M. Rosa, U. D'Ambrosio, D. C. Orey, L. Shirley, W. V. Alangui, P. Palhares & M. E. Gavarrete (Eds.), *Current and future perspectives of ethnomathematics as a program* (pp. 11-37). CME-13 Topical Surveys. Springer.

Skovsmose, O. (2011). *An invitation to critical mathematics education*. Sense Publishers.

Skovsmose, O. (2012). Critical mathematics education: A dialogical journey. In A. A. Wager & D. W. Stinson (Eds.), *Teaching mathematics for social justice: Conversations with mathematics educators* (pp. 35-47). National Council of Mathematics Teachers (NCTM).

Skovsmose, O. (2014a). *Foregrounds: Opaque stories about learning*. Sense Publishers.

Skovsmose, O. (2014b). *Critique as uncertainty*. Information Age Publishing.

Skovsmose, O. (2015). (Ethno)mathematics as discourse. In C. Bergsten & B. Sriraman (Eds), *Refractions of mathematics education: Festschrift for Eva Jablonka* (155-172). Information Age Publishing. Reprinted from Skovsmose, O. (2015). (Ethno)mathematics as discourse. *Bolema*, *29*(51), 18-37.

Skovsmose, O. (2016). What could critical mathematics education mean for different groups of students? *For the Learning of Mathematics. 36*(1), 2-7. Reprinted as: Skovsmose, O. (2020). What could critical mathematics education mean for different groups of students? *Rethinking Critical Pedagogy, 1*(1), 1-16.

Skovsmose, O. (2018). Students' foregrounds and politics of meaning in mathematics education. In P. Ernest (Ed.), *The philosophy of mathematics education today* (pp. 115-130). Springer.

Skovsmose, O. (2019). Crisis, critique and mathematics. *Philosophy of Mathematics Education Journal,* (35).

Skovsmose, O. (2020a). Critical mathematics education. In S. Lerman (Ed.), *Encyclopedia of mathematics education*. Springer. https://doi.org/10.1007/978-3-319-77487-9_34-3

Skovsmose, O. (2020b). Three narratives about mathematics education. *For the Learning of Mathematics. 40*(1), 47-51.

Skovsmose, O. (2020c). Banality of mathematical expertise. *ZDM Mathematics Education, 57*, 1187-1197. *52*(6).

Skovsmose, O. (2020d). Mathematics and ethics. *Qualitative Research Journal, 8*(18), 479-503. Special Edition: Philosophy of Mathematics.

Skovsmose, O., Alrø, H., Valero, P. & Scandiuzzi, P. P. in collaboration with Silvério, A. P. (2009). "Antes de dividir temos que somar": Entre-vistando *foregrounds* de estudantes indígenas. *Bolema*, *22*(34), 237-262.

Skovsmose, O. & Penteado, M. G. (2016). Mathematics education and democracy: An open landscape of tensions, uncertainties, and challenges. In L. D. English & D. Kirshner (Eds.), *Handbook of international research in mathematics education*, 3rd ed. (pp. 359-373). Routledge.