Socioeconomic Influence on Mathematical Achievement: What Is Visible and What Is Neglected

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Abstract The survey team worked in two main areas: Literature review of published papers in international publications, and particular approaches to the topic considering what in the literature seems to be neglected. In this paper we offer a synoptic overview of the main points that the team finds relevant to address concerning what is known and what is neglected in research in this topic.

Keywords Poverty · Early childhood · Intersectionality of positionings · Statistical reifications · Macro-systemic perspective · History of mathematics education practices

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Introduction

It is known that socioeconomic factors have an influence on mathematical achievement. Nowadays such link has become a "fact" that researchers, teachers, administrators and politicians have at hand: "the better off you—and your family—are, the more likely you will do well in school, including mathematics". Such a statement embodies its opposite: "the worse off you—and your family—are, the more likely you will do poorly in school and mathematics". Studies defining socio-economic status (SES) and showing its relation to school performance emerged at the beginning of the 20th century. The specification of the relationship for school mathematics was enunciated as a problem for society and for research in the 1960s. However, it is only in the 1980s that such issue started to be a focus of attention of the mathematics education community. What is known so far—which may be part of a commonsense understanding of the topic—and what seems to be forgotten—which are critical readings challenging the commonsense—were the central questions that have guided the work of the survey team.

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What Is Visible

A global literature review for this topic poses challenges such as the multiple languages in which research reports are made available. We gathered literature that would indicate some trends in what is known about the socioeconomic influences on mathematical achievement in different parts of the world. Most of what was reviewed was published in English.

At a general educational level, the relationship between socioeconomic factors and school achievement is inserted in the history of expansion of mass education systems and differential access to education around the world during the 20th century. Meyer et al. (1992) show that the consolidation of Modern nation states is correlated to the expansion and Modern organization of mass systems of education. Many nation states growingly focused on the socialization of citizens with a vision of progress in which the scientific rationality was an articulating element. The link between personal development and the mastery of the curriculum, and such individual mastery and the progress of the nation were established. With the expansion of mass education, the issue emerged of who has access to education and the goods of society and on the grounds of what. To know who was having effective access to education became important.

The report “Equality of Educational Opportunity” (Coleman et al. 1966) was one of the first large-scale national surveys that formulated a model to determine the extent to which educational opportunities were equally available to all citizens in the USA. It allowed individual students’ socio-economic, racial and ethnic characteristics to be connected to school inputs in terms of resources available to run education, and to students’ individual performance in achievement tests in different school subjects. Internationally, the International Association for the Evaluation of Educational Achievement (IEA) started providing international comparative information about how different national curricula provide different opportunities to learn, and the existence of a lack of equity between different groups of students. Since then, the measurement of educational quality was moved from an input-output model based on school resources to an individualization of the measurement of educational quality in terms of students’ achievement, even in mathematics. This fundamental change in the general reports on educational access is central for connecting socio-economic influences with mathematical achievement.

The discussion on what may be the socioeconomic influences on mathematical achievement emerged from general social science research and educational research. Therefore what has become visible about the topic is found in general reports on educational systems around the world, as much as in mathematics educational research literature. Thus any talk about the topic in the realm of mathematics is bound to general discussions about social and educational disparities for different types of students.

At the level of mathematics education research the concern for this connection emerged as a research topic in the 1980s. The studies that address this issue are mainly quantitative and to some extent large scale. It is important to mention that the amount of literature testing different hypothesis about socio economic influences and achievement has increased with the growing importance given to periodic, international, standardized, comparative studies such as TIMSS and PISA since the 1990s.

In different parts of the world there are results about a society’s sense of expected, normal school achievement and how different groups of students are compared to the normal expectation. While in the USA, factors that systematically generates differentiation to the expected norm are socioeconomic status (SES) and race, in other countries it is socioeconomic status as in for example in the UK and Australia, or home language and ethnicity in the case of some European countries such as Germany and Denmark, or rurality as in China or many of the African and Latin American countries. Although other factors are also present, the tendency of countries to focus on one factor has influenced the way discussions operate in these countries. In different countries the independent variables considered to be the socioeconomic influences on mathematical achievement —the dependent variable —change. What may be considered the ‘socioeconomic’ influences on ‘mathematical achievement’ depends on the systems of differentiation and stratification of the population. It is not any kind of existing, a priori characteristic of individuals and groups of students or of mathematical achievement per se.

Once the general differentiation is possible, similar statistical indicators are adopted in the studies. Prior to the existence of international comparable, standardized national data sets, the variable of socioeconomic status has been one of the most used in the studies. Since its construction in the 1920s, the measurement has been composed by a series of reliable indicators—parents' educational level, family income, possession of appliances, possession of books, etc.—which have not changed much in almost 100 years. The tendency to simplify the measurement is connected to how difficult it is to collect reliable information on this matter from children. The assignment of a socio-economic level to individual students often takes place on very thin evidence. The effect of the measurement, on the contrary, has the tendency to reify a solid state that follows individual children all through their school life. This reification has been documented in studies that have addressed how the discussion of students' differential results is dealt with in the media and public debates.

Even if many studies have a tendency to establish the relationship between a limited variables indicating differential positioning, many studies conclude that those variables intersect. This means that students whose participation in school mathematics results in low achievement experience differential positioning in schooling because they are attributed simultaneously several categories of disadvantage. For example, low achievement in mathematics in certain regions in China is explained by the intersection of rurality, parents' educational level, mother-at-work, and language (Hu and Du 2009). In other words, existing studies devise sophisticated statistical measurements to trace the factors that correlate to differential access to mathematical achievement. However, the very same statistical rationality on which those studies are based imposes a restriction for understanding how the complexity of the intersectionality of variables of disadvantage effect differential results in mathematics.

There is an over-representation of research reports addressing the socioeconomic influences on mathematical achievement in English speaking countries (USA, UK, Australia and New Zealand), while there is little research on this matter in many other places in the world. Such difference may not only be due to the extent of research in mathematics education in these countries, but also to the fact that differential achievement has not been construed as a problem. In East Asia there is little research in mathematics education investigating those who do not perform highly and why. In Taiwan research discards the focus on socio-economic variables and privileges variables such as student's learning goal orientation (Lin et al. 2009). Researchers argue that it is more meaningful to study what educators can impact positively to improve students' results. In South Korea the differentiated achievement is explained in terms of access to private tuition, which reflects a difference in resources that educational policies cannot compensate for (Kang and Hong 2008). In India, it is argued that differential achievement is due to students' mathematical aptitude, gender and urbanity/rurality, the socio-economic and cultural characteristics of communities, and the impact of child work for the lower castes and poorer communities (World Bank 2009).

Existing research both in general education and in mathematics education has constructed the positive correlation between a lower positioning of groups of students with respect to the valued norm of societies, and the results of the school mathematical experience measured in terms of achievement. Poverty, rurality, ethnicity, gender, language, culture, race, among others, have been defined as the variables that constitute socioeconomic influences on mathematical achievement. The question remains whether it is possible to interpret the meaning of "socio-economic influences" and "mathematical achievement" in ways that allow us to go beyond the facts established in the last 50 years of research. In the following sections each one of the members of the team offers a perspective on this issue.

What Is Neglected

Paola Valero on Historicizing the Emergence of Differential Access to Mathematics Education

I discuss the historical conditions that make it possible to formulate the "socioeconomic influences on mathematical achievement" as a problem of research in mathematics education. How and when the problem has been made thinkable, up to the point that nowadays it is part of the commonsense or taken-for-granted assumptions of researchers and practitioners alike? My strategy of investigation builds on thinking the field of practice of mathematics education as a historical and discursive field. There are at least three important conditions that make the problem possible:

Education, Science and the Social Question. The social sciences and educational research are expert-based technologies for social planning. In the consolidation of Modernity and its cultural project in the 20th century, the new social sciences were seen as the secular rationality that, with its appeal to objective knowledge, should be the foundation for social engineering. Statistical tools in the social sciences allow generating constructs that identify the ills of society that science/education needs to rectify. This is an important element in how educational sciences address the differential access of children to the school system. Constructs, such as students' "socio-economic status", later on expanded to school and communities socio-economic status, emerged in the 1920s in a moment where the newly configured social sciences started to address the "problems" of society. Educational sciences made it possible to articulate salvation narratives for facing the social problems for which education was a solution (Tröhler 2011). Measurements of intelligence, achievement and socio-economic status were and still are technologies to provide the best match between individuals and educational and work possibilities. The double gesture of educational sciences of promoting the importance of access to education and reifying difference by constructing them as a fact inserts human beings in the calculations of power.

Mathematics and progress. During the second industrialization the justification for the need for mathematics education was formulated clearly in the first number of

L'Enseignement Mathématique. In the times of the Cold War, the justification was related to keeping the supremacy of the Capitalist West in front of the growing menace of the expansion of the Communist Soviet Union. Nowadays, professional associations and economic organizations argue that the low numbers of people in STEM fields can severely damage the competitiveness of developed nations in international, globalized markets. The narrative that connects progress, economic superiority, and development to citizen's mathematical competence is made intelligible in the 20th century. The consolidation of nation states and the full realization of the project of Modernity required forming particular types of subjects. The mathematics school curriculum in the 20th century embodied and made available cosmopolitan forms of reason, which build on the belief of science-based human reason having a universal, emancipatory capacity for changing the world and people (Popkewitz 2008). In this way, subjects are inserted in a logic of quantification that makes possible the displacement of qualitative forms of knowing into a scientific rationality based on numbers and facts for the planning of society. Thus, from the turn of the 19th century to present day, the mathematics curriculum is an important technology that inserts subjects into the forms of thinking and acting needed for people to become the ideal cosmopolitan citizen.

Mathematics for all. That high achievement in mathematics is a desired and growing demand *for all* citizens is a recent invention of mathematics education research. Between the years of reconstruction after the Second World War and the Cold War, school curricula were modernized with focus on the subject areas for the purpose of securing a qualified elite of college students. In the decade of the 1980s the new challenge of democratization and access was formulated. At the "Mathematics Education and Society" session at ICME 5 it was publicly raised the need to move towards inclusion of the growing diversity of students in school mathematics (Damerow et al. 1984). The systematic lack of success of many students was posed as a problem that mathematics education research needed to pay attention to and take care of. Mathematics education researchers, the experts in charge of understanding the teaching and learning of mathematics as well as of devising strategies to improve them, took the task of providing the technologies to bring school mathematics to the people, and not only to the elite. "Mathematics for all" can be seen as an effect of power that operates on subjects and nations alike to determine who are the individuals/nations who excel, while creating a narrative of inclusion for all those who, by the very same logic, are differentiated.

It is on the grounds of at least these three interconnected conditions that the "socioeconomic influences on mathematical achievement" has been enunciated as a problem of research in the field. I do not intend to say that underachievement is an unimportant "social construction". My intention is to offer a way of entering into the problem that makes visible the network of historical, social and political connections on which differential social and economic positioning is related to differential mathematical achievement.

Mellony Graven on Socio-Economic Status and Mathematics Performance/Learning in South African Research

South Africa's recent history of apartheid and its resultant high levels of poverty and extreme social and economic distance between rich and poor continue to manifest in the education of its learners in complex ways. The country provides a somewhat different context for exploring the relationship between SES and education than other countries. The apartheid era only ended in 1994 with our first democratic elections. Education became the vehicle for transforming South African society and a political rhetoric of equity and quality education for all emerged. Thus educational deliberations focused on redressing the inequalities of the past and major curriculum introductions and revisions were attempted. Engagement with SES and mathematics education became *foregrounded* in policy, political discourses and a range of literature since 1994 although in must be remembered that transformation of education was a priority of the eighties period of resistance and the people's education campaign (although heavily suppressed at the time). Yet for all the political will and prioritization little has been achieved in redressing the inequalities in education.

Much of the recent data available on the relationship between SES and mathematics performance can be 'mined' from large scale general education reviews. These studies provide findings indicating patterns or correlations between school performance and socio-economic context. Several indicate that correlations are exacerbated in mathematics. These reports highlight a range of factors or areas that affect learner performance, such as social disadvantage, teachers' subject knowledge, teaching time, teacher absenteeism, resources, poorly managed schools, poverty effects including malnutrition and HIV/AIDS. In general reports present a consistent picture. In South Africa, since poverty affects more than half of our learners, studies tend to focus on the poorest (but largest) SES group when looking at challenges in education. Many reports point to numeracy scores and mathematics results being consistently below other African neighbour countries with much less wealth. Furthermore, South Africa has the highest levels of between-school performance inequality in mathematics and reading among SACMEQ countries.

What might be somewhat different from other countries exploring SES and mathematics achievement is that South African poverty levels are extreme even while there is relative economic wealth. Fleisch (2008) argues that poverty must be understood in its full complexity and not only in economic terms and argues for "the need to understand the underlying structural dimensions of persistent poverty, which engages the complexities of social relations, agency and culture, and subjectivity" (p. 58). He also notes that "Poor families rather than being just a source of social and cultural deficit, are important supporters of educational success […] poor South Africans share with the middle class an unqualified faith in the power of education. For poor families education is the way out of poverty, and as such many spend a large portion of their disposable income on school fees, uniforms and transport […]" (p. 77)

Mathematics education research conducted in South Africa almost inevitably touches on issues of equity and redress when engaging with the context of studies. One important area is research on language and mathematics education. The overlap between language of learning with SES and mathematics achievement is referred to in almost all of the large quantitative studies above (as a correlating factor) and the data provides for a complex picture that cannot easily be explained in terms of causal relationships. Setati and collaborators (e.g., Barwell et al. 2007) urge that multilingualism needs to be reconceptualised as a resource rather than a disadvantage. In this way the deficit discourse around multilingualism and how it negatively correlates with mathematics performance should be reframed. Most language 'factors' referred to in the literature above position multilingualism as a factor that correlates with low mathematics performance but this should not be read as causal.

Recent research by Hoadley (2007) analyses how learners are given differentiated access to school knowledge in mathematics classrooms. She argues that the post-apartheid curriculum with its emphasis on everyday knowledge has had a disempowering effect in marginal groups who are not exposed to more specialised knowledge of mathematics. The result is that "the lower ability student, paradoxically, is left free to be a local individual but a failed mathematics learner" (Muller and Taylor 2000, p. 68). In its implementation teachers in low SES schools struggled to make sense of these changes resulting in even further mathematics learning gaps between 'advantaged' and 'disadvantaged' learners (Graven 2002). The result has been that "students in different social-class contexts are given access to different forms of knowledge, that context dependent meanings and everyday knowledge are privileged in the working-class context, and context-independent meanings and school knowledge predominate in the middle class schooling contexts" (Hoadley 2007, p. 682).

While studies relate poverty, class, race and access to English to differentiated learning outcomes from a variety of perspectives, most, I would argue, are not sufficiently concerned with the impact of extreme income inequality within a context of widespread and deep absolute poverty. Many poor countries achieve much better educational outcomes compared to South Africa but have lower levels of inequality. A deeper understanding of inequality as a core component of SES, and not just of the nature and impact of poverty might enrich our understanding of the relationship of SES to mathematical educational outcomes.

Murad Jurdak on a Culturally-Sensitive Equity-in-Quality Model for Mathematics Education at the Global Level

Equity, quality, and cultural relevance are independent dimensions in mathematics education. I refer to this 3-dimensional framework as *culturally-sensitive, equity-in-quality in mathematics education*. In the period 1950–2008 the agendas of equity and quality in education, and of mathematics education have moved in different directions. While the provision for universal primary education was paramount between 1950 and 2000, educational quality received low priority during that period. In the first decade of the 21st century, quality education for all has emerged as a top priority. On the other hand, mathematics education literature shows that the evolution of mathematics education was dominated by quality concerns in scholarly discourse between 1950 and 1980. The social and cultural aspects of mathematics education started to emerge as legitimate research in the 1980s. Towards the end of 1980s, equity became a major concern in mathematics education. The first decade of the 21st century witnessed the beginning of convergence towards an increased emphasis on achieving equal access to quality math education (Jurdak 2009).

In the last half of the past century, the decline of colonization was a major reason for the emergence of the two-tiered system of mathematics education. During colonization, many developing countries adopted the mathematics education of their colonial rulers. However, as colonization dismantled, the developing countries invested most of its resources in increasing coverage at the expense of the quality of education, and educational research and development. Thus developing countries did not accumulate enough 'credentials' in mathematics education to fully participate in the international mathematics education community. This situation led to the formation of a two-tiered system of math education at the global level. The upper tier, referred to as the *optimal mode of development*, includes the developed countries that are integrated in the international mathematics education community. The lower tier, referred to as the *separate mode of development*, consists of the marginalized countries which have yet to be integrated in the international activities of mathematics education.

The majority of countries having average or high quality index (measured in terms of national achievement in TIMSS 2003) and low or average inequity index (measured in terms of size of between-school variation) generally fit the optimal mode of development. These countries have high or average mathematics achievement performance, contribute significantly to international research in mathematics education, and assume leadership roles in international mathematics education organizations and conferences. On the other hand, the majority of countries having low quality index in mathematics education, irrespective of its equity index, fit in the separate mode of development. These countries have low mathematics performance, have little contribution to international research in mathematics education, and normally have humble participation in international mathematics education conferences, such as the ICME. In other words, they are marginalized by the international mathematical education community and left to follow their own path in developing their mathematics education. Some of these countries use the preservation of cultural values as an argument to rationalize the lack of their integration in the international mathematics education community. Other countries do not have the resources to participate and contribute to the international math education community.

A country classified as fitting in the separate mode of development of mathematics education is likely to be relatively poor, low in the spread and level of education among its population, and belongs to a socioeconomically developing region (Arab states, Latin America, and Sub-Saharan Africa). On the other hand, a country classified as following the optimal mode of development of mathematics education is likely to be relatively rich, high in the spread and level of education among its population, and is part of a developed region (North America, Western and Eastern Europe, East Asia and the Pacific). There seems to be a divide between developing and developed countries in mathematics education, and some of the significant factors that contribute to that divide (socioeconomic status of a country, its educational capital, and its culture) seem to be beyond the sphere of influence of local or international mathematics education communities, whereas the other factors are not. For example, policies that govern international organizations and conferences may be addressed by the international mathematics education community.

The international mathematics education community has a responsibility to find ways to encourage and enable mathematics educators to be integrated in the international mathematics education community. The participation in and contribution to international mathematics education conferences and international mathematics education journals are critical for such integration. One measure in this regard would be to favour the participation of mathematics educators from developing countries. Writing and presenting in English is a major barrier to the participation of many mathematics educators in international conferences. Some form of volunteered mentoring by their colleagues who can provide their support in reviewing and editing manuscripts could be a desirable strategy. Providing opportunities for presentations in international conferences in languages other than English would broaden access to such conferences. All these measures may hopefully help enhance the integration of more mathematics educators in the international community.

Danny Martin on Politicizing Socioeconomic Status and Mathematics Achievement

In the United States discussions about the relationships between SES and schooling processes and outcomes—persistence, achievement, success, failure, opportunity to learn, access to resources, and so on—are long and enduring. These discussions have surrounded mathematics education—more so than being generated and sustained by mathematics educators—as much of the research and policy generated to support various positions about socioeconomic status has been produced in fields like sociology, economics, critical studies, and public policy.

In many of these studies there is often a deficit-oriented narrative that is generated and reified about "poor" children and families, while normalizing certain middle- and upper-class children and families. SES is often used as a proxy for "race" but the discussions are often unwilling to explore the impact of racism in generating socioeconomic and achievement differences. The dialectic between race and social class is important. In fact, a number of dialectics are important with respect to SES as one considers its racialized, gendered, and contextual nature. The processes undergirding its formation and strata in a given historical and political context may help to explain outcomes like school achievement in ways that are more insightful than just placing human bodies into various socioeconomic strata and characterizing their achievement in relation to human bodies in other strata.

There have been recent reports that consider race, class, gender, ethnicity, and language proficiency in relation to mathematics education (e.g., Strutchens and Silver 2000; Tate 1997). They support the intuitive finding that higher socioeconomic status is associated with increased course-taking and higher achievement on various measures of mathematics achievement. However, the story is less clear when one considers that many "Asian" students from the lowest socioeconomic levels in the U.S. outscore White and other students at the highest socioeconomic levels. Moreover, many of these reports leave unexplained high achievement among African American, Latino, and Native American students, who are disproportionately represented among the lower socioeconomic levels in the U.S.

I would argue that while SES is positively correlated with achievement, mathematics education research in the U.S. context still has far to go in addressing the complexity of these issues. Tate (1997), for example, noted that in defining and operationalizing socioeconomic status, "Typically the mathematics-achievement literature is organized according to a hierarchy of classes—working class, lower-middle class, middle class, and so on. This hierarchy often objectifies high, middle, and low positions on some metric, such as socioeconomic status (SES)" (p. 663). This objectification presents SES as static and uncontested and not influenced by larger political and ideological forces.

There is complexity that goes unexplored even within the socioeconomic strata that are used. In the U.S. it is generally true that even among poor and working class "Whites" and "Blacks", within-class racism often mitigates the opportunities of Blacks. Across economic strata, the sociology and economics of schooling suggest that "Whites" often enjoy the capital associated with their "Whiteness" even in a supposed meritocracy that many claim and wish for in our society (e.g., Jensen 2006). I would argue that such considerations extend to mathematics education to affect the conditions under which students learn and in which opportunities unfold or are denied.

My particular orientation is to move "race" to a more central position in the conversation on SES within the U.S. context (Martin 2009). It might be argued that "race" is not a central concern in other national and global regional contexts. I would disagree based on the histories of nationalism, colonialism, xenophobia, anti-Muslim sentiments, and anti-multiculturalism throughout Europe, South America, and other locations. Every context, without exception, experiences a historically contingent "racial" ordering of its society that also structures its socioeconomic ordering. Research on the global contexts of racism(s), in all its forms, makes this point clear for the U.S., Europe, Brazil, Asia, and so on. So, while it may not be an issue of "White" and "Black" in a particular location, there are likely to be some other forms of "race" and "racism" that are at play (including differences that result from "lighter" and "darker" skin), whether they be manifested in the lives of Indians living in Singapore, the ideologies of the Danish People's Party (DF) in Denmark, or the rise of xenophobic nationalism throughout Europe.

We know that SES does not explain all of the variation in achievement and does not explain why some "poor" or low SES children in a given context succeed academically and why some "rich" or high SES children do less well. Analyses of SES often treat it as a static variable and often do not examine human agency or the manipulation of SES by those in power. SES is intimately linked to other variables that may impact schooling processes and achievement. These other variables include gender; geographic location; language status; immigrant status and the prevailing racial context in given society including nationalism, anti-immigrant sentiment, xenophobia; quality of health care and pre-school systems; history of colonialism; the prevailing political context and ideologies that dominate that context; larger economic system; and so on.

I argue for a more politicized view of SES that takes into account race and racism, political projects, socioeconomic projects and manipulation, among others. SES may be conceptualized differently in different contexts. The common reporting line "the more economic resources one has, the greater their achievement is likely to be" is not an interesting finding even if it gets repeated in research. It does not explain why some have more resources than others. We, in mathematics education, should continue to trouble that imbalance.

Tamsin Meaney on Back to the Future? Mathematics Education, Early Childhood Centres[1] and Children from Low Socio-Economic Backgrounds

In the last two decades, early childhood has become the focus for much discussion in regard to overcoming inequalities in educational outcomes between groups. Although there is a perception that such a connection has only been newly recognised, the history of early childhood centres shows otherwise. For example, May (2001) outlined how preschools in New Zealand have changed dramatically from being charitable organisations for the urban poor in the late nineteenth century to now being seen as essential for all children, to the extent that children who do not attend are perceived as likely to be problems for society. The right to determine the appropriate care for young children through education arose during the history of early childhood centres.

[1] Throughout history and across the world, different names have been given to institutions set up outside of homes for the care and education of young children. To overcome this confusion, the term early childhood centres has been adopted.

> An activity such as preschool, like most of the welfare institutions, is marked by its history. There is a clear relationship between a country's traditions in preschool and school system and its administration and integration of new challenges and demands. (Broman 2010, p. 34; own translation)

I suggest that the history of early childhood centres as carers and educators of poor children has produced different sorts of mathematical education programmes. The physical care of young children, who are seen as unable to look after themselves, always has been part of the role of early childhood centres. As well, characteristics of the child, from their character to their imagination, have been perceived as being in need of moral care. Education, including mathematics education programmes, reflected these different perceptions of moral care. Many instigators of early childhood centres have considered that education could overcome faults in children, particularly poor children. Table 1 provides a summary of the main early childhood centres for the last two hundred years and the sorts of moral care and education provided to children.

In recent years, a moral deficiency that early childhood centres are supposed to overcome is a lack of school readiness in regards to mathematics knowledge. An analysis by Greg Duncan and colleagues of six longitudinal studies suggested that early mathematics knowledge is the most powerful predictor of later learning, including the learning of reading (Duncan et al. 2007). The mathematical programmes, now being advocated in early childhood centres, reflect society's wish to

Table 1 Summary of the kind of care and education provided in early childhood centres

	Time	Care	Education	Mathematics
Robert Owen—Infants School	Early 19th century	Care of the character	Broad curriculum	Arithmetic from manipulating objects from nature
Frederick Frobel—Kindergarten	1837 to end of 19th century	Spiritual care could only occur in schools	Playful and based on children's own interests	Geometry and other math learnt through engagement with gifts and occupations
Margaret McMillan—Nursery Schools	Early 20th century	Care of the imagination	Physical and mental development through play	Math learning was incidental to using their imagination to explore the world
Maria Montessori—Children's houses	Early 20th century	Care for children's personalities	Learning though the senses, using children's interests. School preparation	Materials were math in they required comparisons
Diversity of approaches	Middle to late 20th century	Care for psychological well-being	Learning to play with other children	Experiences were valuable for later school math learning
Present day	1990s to present	Care for academic well-being	Content becomes the focus of education	Math concepts have become the focus of preschool programs

care for poor children's academic needs, which are considered to be at risk and which could result in them being non-productive workers in the future (Pence and Hix-Small 2009). If all children could receive a quality early childhood education then the risk of society having citizens with insufficient education and unable to gain jobs would be alleviated.

A consequence of the acceptance of early childhood centres' right to determine the education necessary to appropriately care for young children is leading to the imposition of a homogenised view of young children, including as young mathematics learners. Providing mathematics programs for this homogenised child can result in a lack of recognition and undervaluing of what poor children bring to early childhood centres. Although the jury is still out on the long-term effectiveness of present structured mathematics programmes, an education that does not recognise nor value children's transition back into their home communities (Meaney and Lange 2013) will result in some children becoming failures before they begin school.

Miriam Penteado on Mathematics Education and Possibilities for the Future

The Brazilian educational system is organized as shown in Table 2 below. For both basic school and the higher education there are two parallel systems: the private and the public. Concerning basic schools, in general, private schools have more status and offer better learning and teaching conditions for students. On the other hand, public schools include the majority of the Brazilian population. The teaching and learning conditions in public schools is very poor. Many schools are in bad structural condition and there are cases of no electricity, no potable water, etc. It is known that Brazilian public schools students study less content than those in private schools. Furthermore, in Brazil there is lack of teachers. It is difficult to find people who want to be educated as a teacher, and there is a set of reasons for this: low salary, low social status, and violence. The best teacher students who graduate are hired in private schools with better working conditions than in public schools.

Concerning higher education the situation is the opposite of what happens in basic schools. *Public universities* are those with the highest investment in research and teaching. In fact, in the last years part of the policy of the Brazilian government has been to increase the investment in higher education making available to the system a considerable amount of resources. It is more difficult to gain enrolment as undergraduate student in public universities than in private, especially in more

Table 2 The Brazilian educational system

Basic school	Primary and secondary level (9 years—from 6 to 14 years old)
	High school level (3 years—from 15 to 18 years old)
Higher education	Different length

prestigious courses such as medicine or engineer. For this reason, those who attend private schools are more likely to become a student at a public university. Many students from public school do not even dream of having further education at a public university. The choice (when it is the case) is to work during the day and take a course in the evening at a private faculty.

Considering the situation it is possible to state that a person with high socioeconomic background follows the route: from private school to public university. One with low socioeconomic background follows the route: from public school to private faculty. There is financial governmental support for students from public schools to study in private faculties. Only a small percentage of the Brazilian population has further education at the tertiary level (private or public system). According to the OECD[2] the number of Brazilian people within 25–64 years old who has completed tertiary education has increased to 11 %. However it is still low when compared with other countries.

Public universities are trying to facilitate access for students from low SES, however it is not for any career. As an example, one can use a socio economic report of a public university in Sao Paulo State for the year 2010. The distribution of students in relation to their background (basic school in the private or the public system) in university courses such as medicine and mathematics is very different. While students who enter medicine have studied in private institutions (85.9 % of students have attended a private primary school and 94.6 % have attended a private high school), the majority of mathematics students (future mathematics teachers) have studied primary and high school in public institutions (an average of 72.5 % for public primary schools, and 74.6 % for public high schools). Thus one can see that medicine does not function as any social-ladder, while mathematics has the possibility to do so.

That socioeconomic factors influence students' educational life is common sense. Given this, one could think that there is not so much to say about the survey theme. However, this common sense could be challenged. When working with students in so-called disadvantaged context one can consider the question: What possibilities could be constructed together with the students?

It is important for a mathematics education to create new possibilities for students. Creating possibilities for students could mean thinking of the opportunities they might obtain for the future. One could think as students' possibilities for, later on in life, to participate as (critical) citizens in political issues. To consider the conditions for coming to "read and write" the world, to use an expression formulated by Paulo Freire (1972).

There might exist a tendency to consider low achievement related to the students and to their background. And from this perspective one can start discussing strategies for compensating the, say "low cultural capital". One can pay attention to the general living conditions of the students, including their conditions of getting to school. One can consider their learning with reference to their worlds and their foregrounds.

[2] http://www.oecd-ilibrary.org/economics/country-statistical-profile-brazil_csp-bra-table-en.

One can claim that it is an important aim for mathematics education to help to establish possibilities within the horizon of students' foregrounds (Skovsmose 2005). To make them recognise that: This could also be for me!

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