

## IN BETWEEN THE GLOBAL AND THE LOCAL: THE POLITICS OF MATHEMATICS EDUCATION REFORM IN A GLOBALIZED SOCIETY

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**Abstract:** Understanding recent globalization processes demands grasping the relationship between the social practices in micro-contexts and macro-contexts, in search of the mechanisms that have worsened the distribution of material, human and knowledge resources in the world. If mathematics education research and practices are to be committed to social equity and justice in the midst of globalization, then they need to address the ways in which they are implicated in the production of a particular social order. In order to do so, mathematics education research needs to open its scope and allow linking the classroom with other spheres of social action. In this way it is possible to gain a broader understanding of the multiple forces that constitute mathematics education, and particularly its reform. Based on a case of a Colombian school, the paper illustrates the way in which mathematics education is being constituted in between macro, global and micro, local contexts in a time of reform

**Keywords:** Mathematics education reform, socio-political research in mathematics education, macro-micro analysis in mathematics education research, mathematics education as social practices

### **A first glance at Esperanza Secondary School**

I got ready for my first visit to the school. As I drove from my home towards the west of the city, the landscape changed and green residential areas were replaced by many small businesses: bakery shops, beauty parlors, groceries stores, and plenty of garages. Public transportation became denser as buses stopped to collect the crowds of people on their way to work. Uniformed school children also tried to catch public transportation, bearing the burden of big school bags on their shoulders. I reached the school gate at around 6:30 A.M. The place was deserted, and I could only see two street children

approaching slowly in their desperate search for food in the piles of garbage. The school redbrick building was notorious for its high walls and for its height that exceeded most of the two to three stories houses in the neighbourhood. The many broken windows and the thin grid-bars behind them were also a typical symbol of a District school building. I waited outside and observed the large, empty square in front of the school. This sand-dusty area was decorated with scattered rubbish, the natural result of having many school kids around. Ten minutes later, teenagers and teachers started arriving; some jumped out of a public bus, others arrived walking, and some of the teachers came by car and parked inside the walls of the school. I decided to go in as well.

The gatekeeper let me in and told me to wait in the roughly paved school-yard. Viviana, my contact, welcomed me warmly. She introduced me to all teachers who crossed our way to the second floor, where the academic coordinator's office was situated. Irma, the academic coordinator, expressed their willingness to share their everyday with me, and their expectation of feedback. Viviana gathered the group of mathematics teachers and suddenly five women in their thirties and forties were standing by the door, ready to meet me and to go to their classrooms to start the school day. Laura, Julia, Mercedes, Ana and Viviana introduced themselves cheerfully. We shook hands and they ran to class when they heard Juan, the discipline coordinator, approaching to hurry them up into their respective rooms. I was also introduced to Juan whose cordiality and toughness helped in keeping the school under control.

Irma showed me the school building, the administration offices, the staff room, the cafeteria, the library, the computer room and the science lab. When the school bell rang, well-dressed teachers with aprons switched classrooms. There were more women than men among the 40 teachers in the school. The 910 students were adolescents between 11 and 19, and were distributed in six grades of three or four groups per grade. Each class had in average 41 students. Students wore uniforms and their appearance ranged from being very clean and neat to being dishevelled and sometimes dirty. The building, classrooms, desks, offices, walls and toilets were worn out by the continuous use and abuse that students in three different school shifts make of them during the ten months of each school year.

The school day was over. Many things struck me that day: a desk graveyard at the end of a corridor, the ill smelling toilets, the bars behind the many broken windows, and the highly risky building with its slight inclination and a severe crack. The square in front of the school was now alive: Ice-cream vendors, pirate CD and cassette retailers, fast-food sellers, hand towels and clothes bargainers spread their little informal shops all over the place. Students stormed out of the school. Teachers left in a hurry to make it on time to their next job, and I left back to my protected, privileged home, at the opposite extreme of the city.

Esperanza Secondary School, as many schools in the world at the end of the 1990s, was undergoing change. This was also evident in the teaching and learning of mathematics. The story illustrates my impressions when visiting this typical, low-class state school in Bogotá, Colombia. The story captures observations that do not seem to be related with the teaching and learning of mathematics. However, they highlight the environment in which those practices take place. While carrying out my research, I realized that it is not possible to disassociate mathematics education practices from their context, and that my research should find ways of making that context part of its gaze.

It is my contention that mathematics education research needs to open its scope in order to gain a broader understanding of the multiple levels of social action implicated in mathematics education reform. I also argue that such an opening in scope is a demand posed by globalization processes which, on the one hand, make more evident the constitutive relationship between social practices in micro-contexts and social practices in macro-contexts, and, on the other hand, have worsened the distribution of material, human and knowledge resources in the world. If mathematics education research and practices are to be committed to social equity and justice, then they need to address the ways in which they are implicated in the production of a particular social order.

In order to unfold my arguments, I start the chapter with some considerations about the notion of context and its inclusion as part of the research focus in mathematics education when adopting a perspective interested in current processes of globalization and internationalization. Then, based on the case of the Colombian educational reform in mathematics education during the 1990s, I present an analysis that highlights the connection between global trends and particular events in Esperanza Secondary School.<sup>1</sup> The examination of the case does not only intend to provide insight into a particular context, the Colombian context (about which international mathematics education research has little information), but also and primarily to illustrate that change in mathematics education is at the crossroad of global and local contradictory forces. Finally, I present some concluding reflections about the challenges that globalization poses to mathematics education research with a concern for social equity at local and global levels.

## **1. Addressing Context in Mathematics Education Research**

Let me start with some remarks about the notion of context and its significance for mathematics education research in the light of current processes of globalization. According to the Websters' Encyclopaedic Unabridged Dictionary (1996,

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<sup>1</sup> Although it is not pertinent to enter into the methodological details here, I want to point that the study followed a variety of qualitative methods that made possible to gather information about teachers and students in the classroom, teachers as a collectivity in the school, the role of school leaders in mathematics education related decision-making, and about the process of policy making at national and local level concerning mathematics in secondary schools (Valero, 2002).

p. 439), the term *context* (what goes together with the “text”) refers to “the set of circumstances or facts that surround a particular event, situation, etc.” In research, the definition of the problem and focus of a study brings with it a definition of the context of what is being researched. In mathematics education research, one can always point to the circumstances that surround the particular event or phenomenon under study. As Vithal and Valero (2003, pp. 552–554) and Valero (2002, pp. 107–112) argue, different research trends have dealt differently with the notion of context according to how theoretical assumptions help shaping the research focus of particular studies. In studies with an emphasis on mathematical learning as cognitive processes context is often related to the mathematical problems, which motivate the learning of a given content. In studies with an emphasis on the significance of interpersonal interaction for learning, context is often conceived as the social, interpersonal relation among learners and/or learner and teacher, which trigger individual mathematical thinking processes. In studies with an emphasis on the socio-cultural situation in which learning takes place, it is a socially structured situation either in the form of a classroom community or an out-of-school group, what constitutes the context of individual participation in mathematical practices and, therefore, learning. In studies with a sociological perspective, context is often constructed as the large social, political and economic structures within which meanings, practices and discourses about mathematics learning and education are generated. In the four research trends mentioned above, it is clear that the interest of the researcher is the “text” or the focus, and not so much the “context”. The context of a research object may sometimes be described or referred to, but it is very seldom taken into consideration as part of the study. Somehow the context is seen as a “recipient” which contains the substance of the study, but which hardly makes a significant alteration of that substance, and, therefore, does not need to be directly addressed.

Let us recall Esperanza Secondary School. As mentioned above, it was clear to me that the surroundings of the school with street children and the daily blooming of an informal economy at the front gates permeate the school. The following episode showed me its significance for mathematics education: A pair of students in a 10th grade class seemed not to be interested in maths and adopted a quite irritating attitude towards their surroundings. Despite of my attempts to convince them about the advantages of being good in school and at maths, one of them expressed his concern:

José: The only class I would like to pay attention to is English because I want to get out of this fucking place and go to the USA. Though, I don't even manage to say 'Hello, good morning'.

(Valero, 2004a, p. 38)

How can one interpret José's concern without linking his intentions to learn (mathematics) with the fact that, given a deep economic crisis, migrating was the only possibility for many Colombians to have a life? How can one consider policy-makers', school leaders' and teachers' intentions to transform mathematics education practices without considering the intricacies of the larger education

reform at the moment? In other words, how could I engage in the study of mathematics education practices in that school without making a clear effort to look at their larger context and making it part of my research interest? Contrary to what seems to be the case in most research in mathematics education, I tried to expand my methodology and my analysis to be able to find ways of connecting the larger social, political and economic context with the practices of teachers, leaders and students in the school and, in this way, venturing in an understanding of the sociological complexity of the social practices of mathematics education.

Out of my analysis and based on the socio-political approach to research that I had adopted (see Valero, 2004b), there emerged a notion of context that refers to the series of historical and structural macro conditions interpenetrating the micro conditions and organization of the practices of mathematics teaching and learning in schools. This definition points to the constitutive and dialectical relationship between the “text” and its “context”. It implies that research intending to grasp practices at a sociological micro level – the level of individual agency of teachers, students and school leaders in relation to mathematics education practices – has to find ways of linking them to a sociological macro level of social action – the level of structures – where meanings, discourses and systems of reason are historically constructed.<sup>2</sup>

This view of context and its significance for my research had implications for how to conceive the scenario of globalization and internationalization at the turn of the 20th century. Drawing on sociological studies, Skovsmose and Valero (2002) propose to link mathematics education practices and research with some of the characteristics of the contemporary world order. This order is characterized by the consolidation of an informational society (Castells, 1999) in which technological expansion has changed the source of value from material capital to knowledge and learning capital. It is also characterized by globalization, the process due to which our environment – in political, sociological, economic, or ecological terms – is permanently reconstructed through inputs from all corners of the world. Internationalization, understood as the increase in the exchange of social and political actors across national boundaries, is also part of the mechanisms for the constitution of a “world-village”. These processes go hand in hand with the expansion of particular economic and political models, namely late capitalism, neoliberal regimes and representative democracy. In this sense, globalization also relates to the expansion of homogenizing discourses, based on dominant Western, post-industrial culture, that install the belief on the desirability of a given social order and on the universal commitment to the achievement of certain political ideals.<sup>3</sup> More often than not, globalization processes

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<sup>2</sup> Behind this formulation there is the classical debate of the “macro-micro link” in the social sciences. For details about the implications of this debate in recent educational studies see Martín Izquierdo and Moreno Mínguez (2003).

<sup>3</sup> For a critical discussion of globalization and neoliberalism see for example Ocampo (2003), Raplay (2004) and Rupert (2000).

are effected at structural levels and impact people in their everyday lives. The meeting of processes happening in macro levels with social processes at micro level is not smooth but rather filled with contradictions and dilemmas that are sorted out in the multiple levels of social action through which globalization operates.

Such a conflictive nature has been captured in the formulation of the two salient paradoxes of the informational society, which are of relevance for the role of mathematics education in the current order (Skovsmose & Valero, 2002, pp. 384–387). The *paradox of inclusion* designates the contradiction between the discourse of the current neoliberal, globalised model of social organization, which emphasizes democracy, universal access and inclusion as a stated principle, and the deep disempowerment and exclusion that certain social sectors actually experience as a result of the practices associated to that discourse. The *paradox of citizenship* refers to the contradiction between the role of education intending to prepare for active, autonomous, critical citizenship, but at the same time ensuring adaptation of the individual to the given social order. This paradox emerges from the fact that the learning society, claiming the need of relevant, meaningful education for current social challenges, reduces learning to a matter of necessity for adapting the individual to social demands. The presence of these two paradoxes in the current global order is problematic since it challenges very basic principles of a social, radical democracy with a concern for equity and social justice. If mathematics education is seen as key practices in the current order, it is in the critical position of either contributing to the installation of the two paradoxes or of challenging the production and reproduction of the imbalances of globalization at both local and global levels.

Mathematics education research can also be implicated in the consolidation of the paradoxes of the informational society (Skovsmose & Valero, 2002). One of the ways of doing so is precisely the elimination of a serious consideration of the context of teaching and learning practices. As I have argued previously, the opening of the scope of research to see micro levels in relation to macro levels of practice is a way of placing mathematics education in the complexity of systems of action and meaning that give a role to mathematics education in our current contemporary society. Nowadays it is unavoidable to consider that many phenomena of social, political and cultural nature influence the practices and discourses of mathematics education in schools. In what follows I present an analysis of the educational reform process in Colombia and of the associated changes in mathematics education. I concentrate on three levels, namely, the general national and international frame, at the end of the 1990s, in which the educational reform took place; the policy frame for the mathematics curriculum; and the series of initiatives taken by the staff of Esperanza Secondary School in their implementation of intended educational and curricular changes. I attempt to make evident the connection between these levels in a search for possible clues about how different actors in these levels respond to the challenges posed by the paradoxes of the informational society.

## **2. Educational Reform in Colombia in the 1990s**

Colombia is a diverse country. The diversity of peoples and life experiences generated through our collective and individual history make part of both the context of Esperanza Secondary School and of its very same constitution. The teaching happening there, the experiences of leaders, teachers and students – as much of my own experience as a researcher in the school – has to be discussed in relation to the structural factors that interpenetrate the world of the school. Therefore, a starting point to examine the interplay between the context of the school and the teaching and learning of mathematics in it is considering the historical framing of events happening there during the 1990s.

Three events had a strong influence in the educational development during the 1990s in Colombia, and provided a general context for the emergence of the new Curricular Guidelines in School Mathematics (MEN, 1998). These events are: the introduction of neoliberalism as a “necessary” model for economic and political governance for the new times of globalization and internationalization; the proclamation of a new Political Constitution that in 1991 emerged as the first inclusive and participatory political agreement in the democratic history of the country; and the promulgation of a new Law of Education that intended to adjust the national educational system to both internal and external challenges.

The decade of the 1980s represented a time of change in most Latin American countries. In political terms, it was a time of democratic transition after long dictatorships. Although this was not the case of Colombia, having the most stable representative democracy in Latin America, the country entered a process of democratic progression intended to renew the old frames of political participation. Political changes went together with economic changes. The protectionist economic management that characterized the region entered a crisis when international demands for globalization pushed the adoption of neoliberal models. In economic terms, neoliberalism stands on the assumption that the internal logic of a free market can regulate all exchange relationships and, as a consequence, shape social and political relationships among rational individuals. Opposed to a centralist, paternalist and protectionist organization, neoliberalism proposes a strong decentralization of administration, a reduction of the State including its welfare functions, and transference of the provision of different services into the realm of the private (Ocampo, 2003). Together with this, the advance of the informational society (Castells, 1999) has also positioned knowledge and information as sources of value, and has altered time and space boundaries dissolving the limits of national States into broader boundaries for the exchange of traditional and virtual goods. In particular, science, technology and constant learning capacities are part of the conditions that a country must have as sources for a powerful positioning in the global, virtual village. This political and economic agenda was implemented in different ways in each Latin American country.

In Colombia, the neoliberal presidency of César Gaviria (1990–1994) echoed the international scene and introduced dramatic changes, among them a reform in

the administration of education. This reform of decentralization was seen as an effective way of tackling an endemic education crisis, made evident in the inefficient, bureaucratic, central administration; in the low levels of student achievement; in the high levels of student drop-outs; and in the lack of acknowledgement of local differences in the student population, among others (Londoño, 1998). The diagnosis was compatible not only with similar reports from other Latin American countries, and the reform was in line with the recommendations that emerged in international scenarios such as the UNESCO "World Conference on Education for All" (UNESCO, 1992). Neoliberalisation in education meant in Colombia the adoption of a universal, global agenda where "achieving education with equity and quality, decentralizing curricular policies, educating democratic subjects, adopting the scientific-technological revolution, and determining a core curriculum" (Londoño, p. 54) are priority issues. These tenets certainly do not disagree with the development of educational systems in richer nations, as Apple (1996, 2000) has discussed extensively.

The Political Constitution of 1991 also contributed significantly on shaping the political and educational landscape in Colombia. The 1990s were a critical moment of national reconciliation that led to a constitutional reform. The New Political Constitution of 1991 was the first inclusive attempt of bringing together a historically fragmented society. A popularly elected Constitutional Assembly formulated a *carta magna* that marked the end of a constitutionally closed democracy and the start of an open participatory democracy (Murillo & Valero, 1996). The Constitution declared education as a key element in the democratic reconstruction of the country and, therefore, part of the social rights to which all children should have access. The Colombian State must not only regulate and inspect the provision of education, but also protect and make effective the right of education in its fundamental function of building a democratic society (Londoño, 1998, p. 62).

Within this broader frame, the General Law of Education (MEN, 1995) and its corresponding administrative act established a new educational organization in the country. This general law embodied the vision of education and national development that underlay the whole educational reform, according to the Constitutional intentions. In order to build a Colombian society for future challenges, the individual, in all her potential, has to be put in the center of a society that needs to learn how to be socially democratic. Knowing is at the service of not only more knowledge production, but also the maintenance of the environment, the boosting of production and technology, and the consolidation of a nation that can also participate as a part of a global world. In order to achieve this vision in the formal education system, the general law set up the general aims for the whole formal education system and for each level of schooling, including the compulsory school subjects. The law also established different mechanisms of reform implementation and institutional development, created new regulations for teacher education, set up the frames for a whole new assessment system based on outcomes, and regulated the local, regional and national administration of the educational service. Shortly, the law set a framework that intended to bring the transformation of the Colombian educa-



tional service in many aspects such as policy, administration, funding, curriculum, teachers' professional development, assessment, school organization, etc. The broad educational change was conceived as a general national transformation for the challenges of both the national demands and the internationalized world.

The previous account points out the complexity of the broad macro-context in which mathematics education reform was introduced. This macro-context is far from being unproblematic. Some points of critique have been raised to the neoliberal project and the advance of democracy in general, and to the implications of this discourse in the formulation of particular educational policies in Colombia. First of all, it is not a secret that the theoretical assumptions of neoliberalism have not worked so well in practice. After at least a decade of the expansion of these ideas in many developed nations, and their enforcement into almost all developing nations, it is clear that freer markets and freer individuals do not necessarily lead into stronger economies and democratic political relationships (McLaren, 1999). On the contrary, the gap between rich and poor, nationally and internationally, has increased due to the adjustment of national political and economic structures to the new international parameters. Problems of equity and social justice have also increased, putting at stake the democratic discourse associated to all these adjustments. In education there are significant examples of these contradictions. In the cases of the USA, England and Australia, Apple discusses how the assumption of the improvement of quality in the educational service given the introduction of competition into it does not hold in reality. He shows that the atomization of decision-making in highly stratified societies creates the fallacy of equal opportunities and participation. Apple concludes that "neoliberal policies involving market 'solutions' may actually serve to reproduce – not subvert – traditional hierarchies of class and race" (Apple, 2000, p. 247).

Second, globalization in education has been associated with discourses that emphasises the need to form flexible, ready-for-change individuals, whose main competency is their ability to "learn to learn". Masschelein (2001) argues that this type of discourse about the learning society reduces the whole educational enterprise to a mechanism of *zoological* survival. This view opposes a conception of life as *human* existence, where unique subjects search for meaning, in an attempt to initiate events that contribute to secure a sustainable, durable common world. As a richer conception of education is suppressed, education becomes a mechanism that strengthens individualization and the selection of the most adaptable beings. Education – under a façade of accessibility–promotes stratification. As Flecha (1999, p. 67) points, "the knowledge prioritized by the new forms of life is distributed unevenly among individuals, according to social group, gender, ethnic group, and age. At the same time, the knowledge possessed by marginalized groups is dismissed, even if it is richer and more complex than prioritized knowledge. More is therefore given to those who have more and less to those who have less, forming a closed circle of cultural inequality".

Third, Londoño (1998), in her analysis of the Colombian General Law of Education as a national project of school autonomy and democracy, discusses how

the grounding of the Law in neoliberal ideology poses two main difficulties. On the one hand, neoliberalism has set homogenizing forms of thinking and feeling, by means of an “unlimited expansion of the rational domain” (p. 58) and the institutionalization of techno-scientific processes for the production of the social world. Educational autonomy and the discourse of educational democratization can only have an instrumental connotation since they refer to the “efficient and effective execution of assigned tasks according to parameters previously established by extra-social organisms” (p. 59), but not to an authentic possibility for participants in educational processes to set their agenda. In this sense the contradictions of a restricted autonomy are installed in the educational arena. In such a landscape it is very easy for the most apt – the quickest to grasp the official discourse and the strongest to bring it into practice – to “survive” and be able to put forward their interests. A growing gap between people and their actual capacity to act constitutes a democratic challenge. On the other hand, the extreme emphasis on the individual and the conception of liberal democracy through representation in decision-making goes against views of radical, collective, deliberative democracy in which groups of people act together for the transformation of their life conditions (Valero, 1999). These two obstacles point towards the inconsistency of achieving a democratic social reconstruction, such as the one intended by the Political Constitution of 1991, through education, as proposed by the law of 1994, in a dominantly neoliberal economic and political scenario. As Londoño (1998, p. 60) concludes it is questionable the extent to which it is possible to build a new social imagination, that can represent a change from old, traditional democratic and educational projects.

The problems and contradictions in the macro context may pose serious challenges to mathematics education in countries such as Colombia and in schools such as Esperanza. It is clear that the Colombian process of educational reform is formatted by global trends in ways that evidence how easily the paradoxes of the informational society can also become paradoxes at a national level. In what follows I get closer to mathematics education in Esperanza Secondary School through the presentation of the policy frame in which mathematics education in the country was supposed to be carried out and the way it meets the mathematics education practices in the school. My hope with such a presentation is to provide elements to analyze whether, at least in a policy level, there is a possibility for mathematics education to engage in responding to the paradoxes of the informational society.

### **3. Mathematics Education Policy in Colombia during the 1990s**

The General Law of Education established a broad aim for mathematics education in both basic secondary and middle school: mathematics education should develop “reasoning capacities through the mastering of numerical, geometrical, metric, logic, analytic, sets, and operations and relations systems; and through their use in the interpretation and solution of scientific, technological and everyday problems” (MEN, 1995, Amend. 22). This aim was the basis for the formulation of curricular guidelines in mathematics. Led by the mathematics education research team in

the Ministry of Education, a national group of researchers, teacher educators and teachers produced the Curricular Guidelines in School Mathematics (MEN, 1998). This document was meant to inspire teachers to discuss fundamental issues about the teaching and learning of mathematics. In this way, it could help teachers making informed decisions in their task of designing and implementing curricular programs.

The Curricular Guidelines intended both to overcome the limitations of the previous centralized, national curriculum of the 1980s and early 1990s, and to build on its achievements. The old curriculum, based on “Systems Theory” in mathematics,<sup>4</sup> integrated the positive aspects of the structuralist program of the “New Mathematics” with a Piagetian constructivist learning theory and its didactical implications (MEN, 1991). This old curricular proposal did not have the expected results in improving student’s conceptual understanding due to its internal contradiction between contents, teaching methods and aims for the teaching and learning of mathematics (Agudelo, 1996); teachers’ rejection of its structuralist and didactic-technological nature (García, 1996); its detailed prescription of syllabi together with national high stakes tests in mathematics which led to procedural teaching and rote learning (Valero, 1997); and the lack of opportunities for teachers to question traditional teaching practices in favour of the adoption of the new proposals (Perry, Valero, Castro, Gómez, & Agudelo, 1998). Despite the pitfalls, the curriculum of the 1980s represented advances for mathematics education in the country because it was the first systematic attempt to spread strong ideas about the didactics of mathematics among mathematics teachers and it institutionalized discussions about mathematics education, especially around the idea of “systems” (García, 1996).

The new Curricular Guidelines of 1998 (MEN, 1998) kept the idea of school mathematics as knowledge systems, but introduced the advances of international mathematics education research concerning constructivist, problem-solving oriented teaching and learning processes as fundamental ideas about how teachers and students could interact in a classroom. In contrast with the previous guidelines – and in agreement with the discourse of autonomy and decentralization in the Political Constitution and the Law of Education – these guidelines do not intend to be a centralized and detailed prescription of teachers’ work, but an open guide for reflection among teachers in their role as curriculum designers and implementers. Mathematics teachers have the responsibility of choosing contents and methodologies that are appropriate to their particular students, and which are in agreement with their school’s educational project. Nevertheless, the guidelines set the ultimate goals and outcomes of all mathematics education, which are “to improve students’ conceptualization capacities, to promote their understanding of their possibilities, and to develop competencies for tackling the complexity of life and work, dealing with the resolution of conflicts, managing uncertainty, and strengthening the culture for a healthy, holistic life” (MEN, 1998, p. 17, my translation).

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<sup>4</sup> The curriculum was based mainly on the ideas of Carlos Vasco who defines a mathematical system as a set of objects and their relations and operations (MEN, 1991).

The Guidelines put forward five topics that teachers need to address when designing their own curriculum. First, teachers need to reflect about different positions in the philosophy of mathematics and the implications that adopting a particular view has on mathematics education in the school. Second, teachers need to consider the reconceptualisation of mathematics education based on research results. In particular the guidelines highlight the work of Ernest (1991) about the connection between philosophy of mathematics and mathematics education, and Brousseau's (1986) theory of didactic situations.<sup>5</sup> Third, teachers need to consider views of school mathematics as a "powerful intellectual tool whose mastery provides intellectual privileges and advantages" (MEN, 1998, p. 29, my translation), and as knowledge embedded in a social and cultural context. Therefore, the learning of such type of knowledge demands taking into consideration students' interests, feelings and culture. Fourth, teachers have to discuss curricular models. A three-dimensional tool for curriculum organization includes a reflection about the general learning processes at stake, the basic knowledge and specific processes linked to a particular mathematical system, and the students' contexts which give meaning to the mathematics they learn and which are captured in problem situations – of mathematics, of daily life, of other sciences – that teachers present to students in order to learn mathematics. These three dimensions can be combined in different ways in order to produce different curricular models. The guidelines invite teachers to develop their own. Fifth, teachers need to consider assessment. The guidelines discuss the central ideas for mathematics education related to broader changes in the assessment system where a variety of assessment forms are put together in a qualitative system in which general outcomes, described in terms of minimum levels of achievement, are operationalised as observable indicators of behaviour. The latter allow teachers to make a judgment of students' achievement in relation to stated outcomes.

The Curricular Guidelines for School Mathematics are at the crossroad of the global international transformation of education and the particular national and educational change in Colombia, during the decade of the 1990s. On the one hand, these policy recommendations about the direction of mathematics education in Colombian schools is permeated by global political agreements about the role of education in current societies, as expressed in UNESCO (1992), and are implemented within the administration frames of neoliberal regimes. It is interesting to notice that many of the changes that have been described for the Colombian case are similar to processes in other countries in the world. Despite national particularities, educational changes have followed similar patterns in, for example, the marketisation, corporatisation, commercialisation and privatisation of educational services.<sup>6</sup> On the other hand, the intended changes in mathematics education are influenced by a growing political interest in the strengthening of mathematical

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<sup>5</sup> For a discussion of the effects of the internationalization of mathematics education research and national curricula in developing countries see Vithal and Valero (2003).

<sup>6</sup> See for example Mok and Welch (2003) for the case the Asia Pacific region and Berryman (2000) for some European and Central Asian countries.

competencies for improved economic productivity and social democratization (see Skovsmose & Valero, 2001) and by the expansion of an international research field which provides a foundation for discussions about the different components of the mathematics curriculum.

In relation to the latter, an analysis of the discourse of the Colombian Curricular Guidelines (Valero, 2002, pp. 131–133) shows that it privileges a view of mathematics as a powerful thinking tool, and focuses on conceptualization and abstraction as aims of the curriculum. The maintenance of the view of school mathematics as systems (in contrast to other possible organizations of school mathematics) keep a link to structuralist views of school mathematics which have been associated with the abstract, procedural character of school mathematics in the previous curricular guidelines. The choice of particular research literature (Brousseau's theory of didactical situations) for the understanding and reconceptualising school mathematics reinforces an internalistic view of the discipline and of the practice of teaching and learning mathematics (Skovsmose & Valero, 2001, pp. 40–41).

The depth of the explanation given to these ideas contrasts with the loose and tentative statements provided in relation to other curricular dimensions such as the psychological, cultural and sociological (Skovsmose & Valero, 2002). Concerning the psychological orientation of the guidelines, there is not much that will give an indication of the concern for the inclusion of psychologically meaningful ideas in the curriculum, except for the mention of constructivism as a recommended epistemological position to adopt when thinking about mathematical learning. Although the guidelines mention the issue "paying attention to students' culture" (MEN, 1998, p. 30), it is not clear whether the interpretation of culture adopted transcends a simple recognition of all people making part of a human group – with particular features and particular preconditions for learning. The mention and discussion of culture and its role in mathematics education is not as broad as the description and emphasis on the mathematical content. Besides, considerations of cultural context seem to be reduced to the necessity of providing a task-context in problem situations. Finally, there is not a clear indication in the document of a critical, sociological interpretation in relation to the role of mathematics and mathematics education itself in social and technological action. Whereas other curricular guidelines (e.g., NCTM, 2000) clearly justify the teaching of mathematics in society (what may open a sociological and political space in the curriculum), the Colombian guidelines do not provide a contextualization for the teaching and learning of mathematics within a broader social and political theoretical justification.

The Curricular Guidelines for mathematics in Colombia, as a frame of reference for teachers' curricular design in mathematics, offers an incomplete frame for tackling the challenges raised to mathematics education by the current global, informational society. Mathematics education, intending to face the paradoxes of inclusion and citizenship, needs to adopt logical, psychological, cultural and sociological perspectives of mathematics and its curriculum as essential and complementary. The dominance in a curriculum of one of those interpretations may reproduce imbalances that have been associated with the exclusion of many students

from mathematics education practices (Skovsmose & Valero, 2002). Still, as a guide for curriculum design and implementation, there could be possibilities for teachers to integrate the missing perspectives.

#### **4. Mathematics Education Change in Esperanza School**

In 1999 Esperanza Secondary School was in constant transformation. The slow bureaucracy in the local administration had left the school without a formally appointed rector. Confrontations between the Teacher Union and the national government, which started plans of privatization of state schools, led to frequent long strikes, which forced teachers to reschedule activities during weekends to catch up with missed lessons. Parents supported school activities but also caused troubles. Extraordinary teachers' meetings took place to solve conflicts with parents. The change in the National System of Evaluation of Educational Quality forced the school to participate in a standardized test for 7th and 9th graders. This implied not only students' preparation, but also discussion of the effects of such an evaluation on teachers' career. In short, mathematics education at Esperanza was taking place in an environment of constant perturbation. Mathematics teachers had to respond not only to mathematics-related challenges, but also to the larger challenges that the local, national and global contexts were imposing on them.

Mathematics teachers have sailed through the changes that the educational reform of 1994 introduced. They had organized the teaching of the approximately 910 students in the school, from 6th to 11th grade, all of whom had mathematics as a compulsory subject. Julia, Mercedes and Viviana had been involved in a one-year professional development program run by a team of mathematics education researchers in a private university. This program, part of a teacher professional development initiative of the local educational authorities, gave them practical and conceptual tools to actively engage in curriculum design, implementation and inquiry in their school. Ideas such as higher order mathematical thinking, social constructivism and use of graphing calculators and educational software such as Cabri Geometry in teaching had got their interest. These three teachers have also managed to "infect" Ana and Laura and the school leaders with the bug of innovation. The group was moving forwards, but still struggling with the many demands of change.

Although the reform provided a frame for teachers to design their own curriculum – in agreement with the school's institutional educational project and taking into consideration the Ministerial Curricular Guidelines – the team of teachers had not been able to dedicate much time to this activity given the multiple new demands that divided their attention. One of the most challenging transformations was the creation of a new assessment system and the demand of constructing a qualitative outcome-based assessment system that suited the school and teachers' collective formulation of outcomes. Teachers perceived this as a task that could not wait, not only because of its implications for everyday assessment, but also because of the general change in the national high stakes examination at the end

of Grade 11. Teachers had to make sure that students had a chance of coping with qualitative assessments both in the daily life and at the end of their schooling. Thus, teachers continued to use the previous compulsory curriculum (MEN, 1991) as a reference, but made advantage of a diversity of new textbooks to guide their teaching. Teachers individually and as a group tried to respond as well as they could to the process of change.

The team of mathematics teachers and the physics teacher designed a project in order to tackle the problems that they had identified in their subject. The project starts from the recognition of the connections between the general current demands to students from the Colombian society – as formulated in the Political Constitution and the General Law of Education; the commitment of the school with the improvement of students' life conditions – as formulated in the school's institutional educational project; and the potential contribution of mathematics education to the education of democratic citizens – as formulated in the Colombian Curricular Guidelines and international trends of mathematics education reform. The justification for the project and its theoretical foundations make clear that teachers interpret the demands of mathematics education reform in relation to the large social order in which their practice is embedded. The project intended to formulate a set of actions that teachers could use and develop in their teaching.

It is possible to find relations between the project and diverse ideas that make part of the cultural frames that, at the end of the 1990s, dominated in Colombia. The project was conceived as a long-term strategy with the intent of developing seven interconnected actions: (1) The use of portfolios as means of consolidating students' learning and supplementing assessment. (2) The realisation of special workshops in which students will have the chance of using diverse concrete materials in playful activities that contribute to a more meaningful mathematical learning. (3) The development of real-life projects which allow students establishing connections between mathematics and society, and developing a critical stance towards the role of mathematics in society. (4) The introduction of graphic calculators as a technological resource in mathematics teaching and learning in order to promote richer mathematical experiences for students. (5) The realization of school and inter-schools "Mathematics Olympiad" in mathematics and physics, with the intent of promoting problem-solving capacities and developing a sense of healthy competition among students. (6) The participation of teachers in diverse professional activities, inside and outside the school, in order to implement the previous five actions, reflect on their practice, and communicate to other colleagues the achievements reached. (7) The engagement of teachers in a systematic enquiry of student's learning as a means of tracking the impact of the previous six actions on mathematics education in the school, and of providing feed-back for the further development of the strategy in the long-term (Esperanza, 1999, pp. 3–4).

Even though these actions emerged from the teachers' perceptions of their needs and problems in the teaching of mathematics to the students of Esperanza School, they keep a connection with different discourses that, from the macro-context, pose demands to teachers' work. These discourses penetrate practice and become

reified in the micro-context of mathematics education in the school. It is possible to identify the following ideas in operation. First, the need for accountability of social processes illustrated by means of educational assessment has been particularly emphasized by the technocratic rationality of political parties with neoliberal and neoconservative agendas around the world and in Colombia, as well. The discourse of evaluation and assessment is recontextualised by mathematics teachers and, in the case of Esperanza, is expressed in a concern for constructing functional assessment devices. Second, the need of individual engagement in learning through motivation and creation of affective bounds is one of the central points of individualization processes. For teachers in Esperanza attention to the individual goes hand in hand with providing sources of meaning for mathematical instruction. Third, the need of connecting school with other arenas of practice, such as everyday-practice and work, are demands being posed by the role of education as a tool of governmentality. The idea of education as preparation for active participation in society and in the labor market is transformed by the group of teachers to a concern for making mathematics learning useful in students' lives. Fourth, the need of getting involved in the technological development of society and in the consumption of technology is constantly highlighted as part of the discourse of the informational society. For teachers this is transformed in the concern for the involvement of IT tools (computers and calculators) to support mathematical learning (in an environment with precarious resources). Fifth, the need of creating standards of competition which are an important element in the discourse of internationalization, globalization and the open markets economy is transformed by teachers in a concern for allowing students to have positive competition experiences in mathematics, among themselves and with other schools. Finally, the need for the professionalisation through innovation and research is a paramount feature of the "learning society" discourse. Teachers have participated in professional development strategies and have translated these ideas and demands into a commitment to an active learning from a systematic, collective examination of their own practice.

These discourses and their reification in different spheres of practice constitute frames of action for mathematics teachers in Esperanza. In the every day of school life, and in each of the mathematics lessons teachers are finding ways of coping with and responding to the multiplicity of challenges that fall upon their shoulders. With this variety of strategies they struggle to provide a mathematics education that may contribute to students' lives. Whether their efforts actually represent a reaction to the paradoxes of inclusion and citizenship is uncertain, but it is at least the best they can offer to the students of Esperanza Secondary School.

## **5. Linking the Local and the Global in Mathematics Education Research**

There is no doubt that school mathematics change, alongside general school change, is a complex phenomenon and an understanding of its intricacies and contradictions has been a central challenge for mathematics education research in the last two



decades. A great amount of research in many countries has been associated with the development of improvement initiatives and with the evaluation of reform projects, and many results have illuminated the advances and pitfalls of change. Kilpatrick (1997) reminds us that one of the most important lessons to be learned from the attempts of reform in mathematics education since the time of the “Sputnik Shock” is that, despite being often construed as a technical problem, “changing how and what mathematics is taught to our children is not a technical problem. It is a human problem that demands an understanding and appreciation of how people work together in classrooms to learn and teach and do mathematics” (p. 6). I would add to this realization saying that the human problem of mathematics education reform, especially at the turn of the 21st century, demands an understanding that goes beyond classrooms. In fact a great deal of research literature during the last decade has provided more insight in the operations of reform in classrooms (for example, Cobb, Yackel, & McClain, 2000). Such an understanding needs to embrace the organization of mathematics education in schools as a whole (Perry et al., 1998) and the organization and construction of mathematics education discourses and practices in larger fields of social action (Valero, 2002), including international and global spaces.

In my analysis of change in Esperanza Secondary School I illustrated how the global political, economic and educational trends are brought together in an historical moment, which determines the paths of educational transformation in Colombia. The larger scenario of change is reconstituted in particular initiatives and discourses about the mathematics curriculum. These discourses and ideas enter schools, where teachers in their everyday initiatives for improving mathematical instruction recontextualise and accommodate discourses and practices according to their possibilities. In all this process there are not only internationalized ideas about what educational development should be (such as the outcomes education agenda that dominated in the 1990s) but also about what the very same teaching and learning of mathematics could be (thanks to the expansion and internationalization of research findings in mathematics education). Through the case of Esperanza Secondary School I showed how the diversity of layers of context inter-connects and how the examination of their connections allow constructing a fuller picture of the complexity of mathematics education reform. The intermeshing of the global and the local allows raising questionings to the way in which mathematics education change may be contributing to the installation or the eradication of the paradoxes of the informational society.

Seeing the world from a perspective of globalization and internationalization does certainly imply widening the lenses of research. Research on mathematics education using lenses adjusted to see the intricacies of micro-levels of practice risks ignoring the challenges posed by current social processes operating far away from classrooms, but having a definite impact on them. The systems of reason that provide meaning to educational practices are partly produced in macro-structures. Mathematics education research needs to grasp the way in which macro and micro levels of practice are constantly intermeshing in the constitution of mathematics

education. I hope to have illustrated that facing the paradoxes of the informational society is a task not only for practitioners but also for researchers. A globalised world also puts at stake the constructions of mathematics education research.

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