IDEOLOGICAL ROOTS AND UNCONTROLLED FLOWERING OF ALTERNATIVE CURRICULUM CONCEPTIONS

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With this contribution, we intend to initiate a discussion of alternative curriculum conceptions in terms of how these might facilitate or restrict access to valued forms of mathematical knowledge. For this purpose, we characterise conceptions of school mathematics as realisations of a process of dual recontextualization. As we will argue, different alternative ways of recontextualizing practices of professional mathematicians as well as everyday practices, implicate different potentials, pitfalls, (dis-)advantages and discriminations for different social groups. We will attempt to link the discussion to the political bases of the alternatives we have chosen to discuss.

INTRODUCTION

Curriculum conceptions for mathematics education are the product of a social process, including ideological struggles between stakeholders pursuing diverse economic and political goals. In many cases, the result represents a compromise between different or differently nuanced social positions and agendas. As an example, consider the curricular transformations initiated in many countries after the Programme of International Student Assessment (PISA) and the Third International Mathematics and Science Study (TIMSS) have been launched.

As curriculum conceptions often represent ideological hybrids, the consequences of mathematics curricula for different student groups in terms of their access to mathematical knowledge, their formation of mathematical identities and their positioning in the 'knowledge society' are rarely directly visible. However, these consequences are not simply more or less accepted side effects of the practice of schooling. They reflect a differential distribution of legitimate and valued forms of knowledge and position intended to reproduce or develop social structures.

Mainstream curriculum and positions of resistance

One can take the standardised curriculum versions that are manifested in official curriculum prescriptions, textbooks and test-designs as representing the mainstream in a given context. To the extent to which curriculum documents are results of compromises, they leave more or less space for alternative readings by teachers and students. Identifying these spaces requires an analysis of its own.

The students are the 'consumers' of the privileged meanings established in the curriculum, and if they successfully acquire the intended interpretations, the resulting certificate and/or the mathematical knowledge is of symbolic value and eases access to further education. As curriculum conceptions construct their ideal readers, with distinct dispositions for mastering its explicit and implicit demands, differences in "orientations to meanings" (Bernstein, 1990) generate patterns of achievement in line with social differences (such as gender, ethnicity, social class).

Alternative curriculum conceptions aim at redistributing access to privileged discourses. This can be achieved at different levels. Protagonists might be concerned with expanding the repertoire of individual students with a focus on marginalised groups and their orientations to meanings, without challenging the available reservoir of cultural meanings (such as "mathematics as thinking and problem solving" or "mathematics as a universally applicable technology"). On the other hand, more radical alternatives challenge the available reservoir of meanings. The first option might be described as a form of tactical resistance, whereas the second is aiming at deconstruction of culturally inherited meanings. In interpreting mathematics curriculum conceptions as texts in a social context that position their readers, one could attempt to classify alternative conceptions according to their position towards mainstream conceptions in a similar way as Martin (1993) differentiates resistant reading positions in the context of research on literacy: as tactical resistance versus deconstructive resistance and oppositional versus subversive deconstructions (see figure 1).

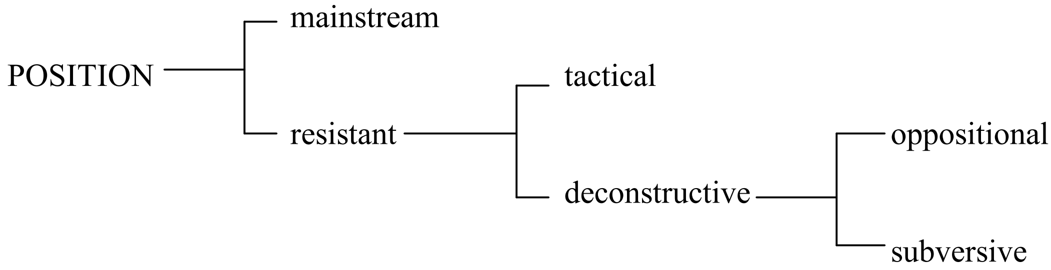

Figure 1. Dimensions of position (modified from Martin, 1993, p. 159)

It can be argued that informed opposition and dissent to mainstream curriculum conceptions (and their concomitant distributions of mathematical discourses and position) requires insight into the discourses that are the focus of critique. Apparently, there is a tension between a pedagogy of access and a pedagogy of dissent: Is access to valued forms of mathematical knowledge a precondition for a critique of social mathematical practices and their constituting discourses, or is access to valued forms of mathematical knowledge possible by critiquing mainstream discourses? How can these two poles be balanced?

In a given context, conceptions that are alternative to the curricular mainstream might be classified according to this scheme. However, what counts as the curriculum mainstream is different in different social and political settings. What currently is mainstream in one place might resemble, for instance, a tactical resistance position in other places, or a short-lived reform that has been followed by a counter-reform. The world of school mathematics curricula is not (yet) fully uniform.

Moreover, tactically resistant positions tend to aim at becoming the mainstream, hence the label 'tactical'. As a consequence, it is often difficult to identify what the mainstream position exactly consists of, even in a rather local setting. Practices of mathematics instruction are constantly (even if only slightly) changing, integrating aspects of tactical resistant positions into the mainstream. Bernstein (1996, p. 48) distinguishes between an "*official recontextualizing field* (ORF) created and dominated by the state and its selected agents and ministries, and a *pedagogic recontextualizing field* (PRF)". The PRF consists of teachers, researchers, private research foundations etc. What is considered as mainstream might be different in these recontextualizing fields.

Mathematics curricula as a product of dual recontextualization

Curriculum conceptions for mathematics education can be described as the specific product of a dual recontextualization. On the one hand, school mathematics can be seen as the result of a subordination of the practices of generating new mathematical knowledge (exploration, systematisation, proof) to the pedagogic and didactic principles of the transmission of knowledge. On the other hand, school mathematics recontextualizes vocational, domestic and leisure time activities by subordinating them to a mathematical gaze. There is a variety of ways in which this dual recontextualization can be realised in the mathematics curriculum. Some common versions of the mathematics curriculum in place, in which this dual recontextualization constructs a hybrid between domestic and mathematical knowledge, have been shown to be socially biased and self-referential.

Different alternative ways (focus on investigations and problem solving, ethnomathematics, mathematical modelling, critical mathematical literacy) implicate different potentials, pitfalls, (dis-)advantages and discriminations for different social groups. They differ in what knowledge is accessed in classrooms and in how this knowledge is made accessible. In an elaboration of Bernstein's sociology of education (Bernstein, 1996), the underlying principles can be termed *classification* and *framing*:

> I will now proceed to define two concepts, one for the translation of power, of power relations, and the other for the translation of control relations, which I hope will provide the means of understanding the process of symbolic control regulated by different modalities of pedagogic discourse. …
> I shall start first with power. We have said that dominant power relations establish boundaries, that is, relationships between boundaries, relationships between categories. The concept to translate power at the level of the individual must deal with relationships between boundaries and the category representations of these boundaries. I am going to use the concept of *classification* to examine relations between categories, whether these categories are between agencies, between agents, between discourses, between practices. (Bernstein, 1996, pp. 19-20)

In the context of mathematics education, classification refers to categorizing areas of knowledge within the mathematics curriculum. Strong internal classification means that clear boundaries between mathematical areas are maintained. Strong external classification indicates that few connections are made to other disciplines or everyday practice.

Framing draws on the nature of the control over the selection of the communication, its sequencing, its pacing, the evaluation criteria, and the hierarchical rules as the social base which makes access to knowledge possible (p. 27):

> I am going to look at the form of control which regulates and legitimizes communication in pedagogic relations: the nature of the talk and the kinds of spaces constructed. I shall use the concept of framing to analyse the different forms of legitimate communication realized in any pedagogic practice. (p. 26)

The concepts of classification and framing are useful to describe the kind of knowledge emphasised in alternative curriculum conceptions as well as the way in which this knowledge is assessed.

The following selection of alternative curriculum conceptions is made on the grounds that some of these conceptions were positioned as non-mainstream when they emerged, even though they might in the meantime have become mainstream in some places, while others still represent resistant construals of mathematical meaning. Examples and references are exemplary and not representative of the conceptions.

INQUIRY-BASED MATHEMATICS EDUCATION

Inquiry-based mathematics education starts from the assumption that young learners can be regarded as miniature scholar-specialists whose mathematical activity is not qualitatively different from that of a mathematician. Academic mathematics, often described as "the science of patterns" is mirrored in the mathematics classroom where students are engaged in discovering and exploring regularities, identifying relationships and applying their mathematical knowledge in new mathematical situations. The general idea behind has been summarised by Bruner (1960, p. 14): "Intellectual activity anywhere is the same, whether at the frontier of knowledge or in a third-grade classroom." More provocatively: "In teaching from kindergarten to graduate school, I have been amazed at the intellectual similarity of human beings at all ages, although children are perhaps more spontaneous, creative, and energetic than adults" (p. 40). This view has been criticized as "romantic" (Tanner & Tanner, 1980, p. 535) as it neglects the fundamental differences between the production of knowledge and its reproduction in schools, as witnessed in the following quote:

> The pedagogical tradition calls for transmittal of the 'given'. It is a tradition of the transmittal of certainty, not of doubt. But doubt is precisely the quality of the scholar. The scholar, taken as an intellectual, is one 'who makes the given problematic.' Our pedagogical tradition does not deal with problematic material. If we obey our tradition, we take what is problematic and make it into sets of certainties, which we then call upon the students to 'master'. In too many instances, our sets of certainties come dissociated from the fields of knowledge out of which they originally grew. In some cases, the

> contrast between the school subject and its underlying field of knowledge is ludicrous (Foshay, 1961, p. 32-33).

An inquiry-based mathematics curriculum can be understood as an attempt to overcome this pedagogical tradition by reconciling content and method: to find material that can be made problematic in order to develop knowledge both about how material is to be made problematic, and about the mathematical generalizations. Inquiry-based mathematics education is thus working in a combination of the inductive and the deductive mode.

The inductive part of inquiry-based mathematics education has been characterized by Dowling (2009) as involving skills and, moreover, tricks. By drawing on a commonly found example of school mathematical investigations he shows how the 'investigative' approach to school mathematics is actually introducing new areas of weakly classified strategies – skills, tricks – in a discipline that is apparently strongly classified. This might be misleading for some students, as the latter is generally preferred in mathematics. What makes a skill or a trick mathematically meaningful can tacitly be decided on the grounds of previously acquired mathematical knowledge. In most cases however, this decision is made through the mathematical authority of the teacher in the face of the standards of mathematical knowledge to be acquired – the abovementioned sets of certainties.

The construction of mathematical meaning through generalization of weakly classified activity and idiosyncratic notation of findings is a crucial component of inquiry-based mathematics instruction. For establishing generalized mathematical meanings when students are engaged in such activity in the mathematics classroom, two conditions (at least) have to be fulfilled. First, there have to be students who have already acquired the sufficient mathematical skills and tacit knowledge about what to look for and what to strive for when confronted with an open investigative mathematics problem; otherwise no valued generalization can be made at all. Second, only highly qualified teachers will be able to develop mathematical generalizations from the students' idiosyncratic and often not fully developed problem solutions. In many places of the world, these conditions are only partly met, and the inquiry-based curricular approach to mathematics education appears as a rather elitist option.

Inquiry-based mathematics education is problem centred and characterized by strong external classification. It has been legitimised as a contrast to the conception of the 'core curriculum':

> In the past, we saw a reality that the problems of life do not come in 'disciplined' packages. For example, a good many of the public problems we must deal with – housing, crime, transportation, and the like – go beyond the boundaries of any one discipline and must be studied on a multi-disciplinary basis. The most notable of the curriculum reforms intended to deal with this reality was the core curriculum, a problem-centered approach to learning, in which the mode of inquiry was to be dictated by the nature of the problem itself. We don't want our students ill-prepared for the practical

problems of life, but there is another reality which we have tended to overlook. This second reality is that each of the disciplines, as they are organized, contains within its domain and methodology the best thought about reality in its own field. For example, one who knows how a chemist thinks can see more deeply into what is 'chemical' about an industrial problem than one who does not know how a chemist thinks (Foshay, 1961, pp. 33-34).

If argued like this, the conception resembles a tactical resistance position as it tries to point out why a conception with a focus on mathematical modes of inquiry is better suited for engaging with the same public reality as a curriculum stressing factual knowledge, that is, pursuing the same educational ends by different means. The details of this public reality given in the quote above – e.g. industry, economy, crime – and the claims suggest a prospective neo-conservative ideology.

In the course of the reforms and counter-reforms of the mathematics curriculum in Victoria, Autralia, the inquiry-based curriculum seemed to have a different ideological base, the main focus being on offering access for all through a conception that overcomes the levelled hierarchical nature of the traditional mathematics curriculum: "It had the potential to generalize the social reach of mathematics and to place school curricula on a new basis" (Teese, 2000, p. 169). However, the results on the "investigative project 1992" turned out to be disastrous for working class girls: 43% percent received the lowest possible grade or could not even master the minimum criteria for getting a grade (Teese, 2000, p. 171). But it was not the concern for exclusion of disadvantaged groups but the judgement by academic mathematicians that students would not learn enough and that the most talented students would be "punished" that marked the end of these reform efforts.

ETHNOMATHEMATICS

Ethnomathematics as a programme emerged in opposition to mainstream discourse in mathematics education. A Eurocentristic bias of mathematics education is most salient in curricula and textbooks developed in industrialised states and imported into former colonies. Vithal and Skovsmose (1997) interpret the emergence of ethnomathematics as a reaction to naïve modernisation theory and the cultural imperialism implied by it. By uncovering the cultural bias in historical accounts of mathematics and by documenting and analysing local mathematical practices, ethnomathematics set out to deconstruct mainstream discourse and offer new views on what counts as mathematics. Earlier work was often carried out from the perspective of cognitive anthropology, as witnessed in the reference list "Ethnomathematics: A Preliminary Bibliography" provided by Scott (1985) in the first Newsletter of the International Study Group on Ethnomathematics. The term „ethnomathematics" suggests a broad interpretation of both mathematics and "ethno". The latter encompasses "identifiable cultural groups, such as national-tribal societies, labor groups, children of certain age brackets, professional classes, and so on" (D'Ambrosio, 1985, p. 45).

In line with this agenda, a base for the development of an ethnomathematical curriculum consists of uncovering and describing the mathematical concepts and procedures that are more or less implicit in practices of sub-ordinated and oppressed people and marginalised groups. This type of research can be described as ethnographic. Ethnographic work can be done from different positions, as for example from a dominant position of racial classification, such as the "White-on-black" research, witnessed in several studies carried out in South Africa (see Khuzwayo, 2005). Ethnographic ethnomathematical research finds itself in a difficult position because there remains the issue in whose terms the ethnomathematical practices are to be described. When incorporated into the curriculum, there is a related problem. For local practices that might be of interest to the students and are identified to contain some mathematics, there is a risk that incorporation into classroom discourse amounts to a recontextualisation for the purpose of exploitation in terms of traditional school mathematical topics. Fantinato (2008) points to the difficulties that might be faced at the level of classroom interaction:

> However, it is important to keep in mind that the mathematics teacher stands for the official mathematics image in the classroom. This person holds a knowledge considered superior to students daily knowledge due to its privileged social position in our society. This uneven status position interferes in the relations among different types of knowledges, which take part in the classroom cultural dynamics. When voicing students' knowledges, the dialogic attitude of the teacher entails an awareness of the mythical status of his math and the depreciation of other math as an effort to reverse this difference (pp. 2-3).

Curriculum alternatives more closely linked to the original conception of ethnomathematics include the use of (historical) examples of culturally relevant practices as a springboard for developing mathematical notions (e.g. Jama Musse, 1999) or mathematical analysis of traditional artefacts, as for example decorative pattern designs (e.g. Gerdes, 1990).

The first alternative might assist in overcoming cultural alienation, but faces the same problématique as developing school mathematics on the basis of recontextuaised domestic practices. The recontextualisation of everyday domestic practices, which amounts to a collection of their traces in the form of contextualised tasks, generally has a tendency to amount to an implicit pedagogy with weakly classified content that disadvantages marginalised groups (e.g. Chouliaraki, 1996; Cooper & Dunne, 2000; Gellert & Jablonka, 2009; Hasan, 2001; Lubienski, 2000; Morais & Miranda, 1996). A similar pitfall is inherent in some versions of a mathematical modelling conception (see below).

The following task (see figure 2) provides an example of the second alternative, used in a teacher education course (Gerdes, 1999):

How many possible band patterns of the *sipatsi* type of given dimensions p and d do exist, whereby p denotes the period of the respective decorative motif and d its diagonal height? Figure 2 shows the possible patterns of dimensions 2x4. The images on the left side display the generating motives.

Figure 2. *Sipatsi* patterns and generating motives (Gerdes, 1998, p. 44)

As to the classificatory principle, this task (if posed without an initial introduction into the mathematical description of the pattern dimension) resembles an inquiry mathematics task. If already mathematised, the criteria for the inquiry become more explicit. It is then a mathematical task on a comparatively advanced level. The prospect of producing computer-generated imitations of pattern designs, based on such mathematical explorations, might for some amount to a disenchantment of the wisdom and skills of traditional crafts. Kaplan (2003), for example, presents a process for creating computer-generated Islamic Star Patterns on a web-page on which one can play around with a Taprats Applet. If the complexity of the mathematical algorithm provides an argument for the complexity of the skills involved in traditional crafts, then this value judgment privileges Western mathematics. The incorporation of local practices through their (school) mathematical recontextualization in order to ease access represents a tactical position.

D'Ambrosio (2007) locates ethnomathematics within a wider project of social change that points to the responsibility of mathematicians and mathematics educators in offering venues for Peace (p. 26). He proposes a curriculum that is conceptualised as a modern trivium, including Literacy, Matheracy and Technoracy, that aims at providing "in a critical way, the communicative, analytical and technological instruments necessary for life in the twenty-first century" (p. 28). Matheracy is connected to the capability of inferring, proposing hypotheses, and drawing conclusions, that is, to classical academic virtues associated with mathematical thinking access to which has been restricted to an elite. This conception indicates a critical stance towards teaching mathematical modelling and applied mathematics and also a departure from earlier envisaged forms of ethnomathematics. He also stresses that teaching "ethnomathematics of other cultures, for example, the mathematics of ancient Egypt, the mathematics of the Mayas, the mathematics of basket weavers of Mozambique, the mathematics of Jequitinhona ceramists, in Minas Gerais, Brazil, and so and so, it is not because it is important for children to learn any of these ethnomathematics" (p. 33). The main reasons for doing so include to "de-mystify a form of knowledge [mathematics] as being final, permanent, absolute, unique." This is to overcome the damaging misperception "that those who perform well in mathematics are more intelligent, indeed 'superior' to others, and to illustrate intellectual achievement of various civilizations, cultures, peoples, professions, gender" (pp. 33-34).

Knijnik (2000) provides an example from her work with settlers of the Landless People's Movement (MST) in Brazil where the practices of production and sale of melon crops were "naturally" changed through the process of confrontation and translation of different forms of knowledge. She argues that if the pedagogical process were limited to the recovery of the native knowledge, this would restrict access to useful knowledge and as a consequence reinforce social inequalities. Identifying practices, which could profitably be transformed by a mathematical recontextualisation remains a major and continuous task for overcoming problems of discontinuity and disjuncture between different mathematical practices and school mathematics. Which out-of-school practices are to be selected as representative of the students' cultures remains a political issue.

MATHEMATICAL MODELLING

"Mathematical modelling" is a rather vaguely defined term for a curriculum conception that comprises many different classroom practices. Modelling conceptions can be distinguished by the strength of the internal and external classification of the respective knowledge domains as well as by the value attributed to the different knowledge domains in classroom modelling practice. A version of school mathematical modelling that stresses that the external classification remains as strong as in mainstream curriculum conceptions, is provided by Zbiek and Conner (2006):

> The primary goal of including mathematical modeling activities in students' mathematics experiences within our schools typically is to provide an alternative - and supposedly engaging - setting in which students learn mathematics without the primary goal of becoming proficient modelers. We refer to the mathematics to be learned in these classrooms as 'curricular mathematics' to emphasize that this mathematics is the mathematics valued in these schools and does not include mathematical modeling as an explicit area of study … we recognize that extensive student engagement in classroom modeling activities is essential in mathematics instruction only if modeling provides our students with significant opportunities to develop deeper and stronger understanding of curricular mathematics. (pp. 89-90)

Such a version is reflected in the approach of the *Realistic Mathematics Education*, where models are seen as vehicles to support 'progressive mathematization' (Treffers & Goffree, 1985), as van den Heuvel-Panhuizen (2003) points to:

> Within RME, models are seen as representations of problem situations, which necessarily reflect essential aspects of mathematical concepts and structures that are relevant for the problem situation, but that can have various manifestations. (p. 13)

A version of school mathematical modelling in which the external classification is weakened considerably constructs modelling as new (but vague) content. This version is sometimes referred to as *emergent modelling*:

> This second perspective [RME is the first one], which we favour, does not view applications and modelling primarily as a means of achieving some other mathematical learning end, although at times this is valuable additional benefit. Rather this view is motivated by the desire to develop skills appropriate to obtaining a mathematically productive outcome for a problem with genuine real-world connections ... Here the solution to a problem must take seriously the context outside the mathematics classroom, within which the problem is located, in evaluating its appropriateness and value … While the above approaches differ in the emphases they afford modelling in terms of its contribution to student learning, they generally agree that modelling involves some total process that encompasses formulation, solution, interpretation, and evaluation as essential components. (Galbraith, Stillman & Brown, 2006, p. 237)

Given the diversity of agendas and examples, the unifying principle of the modelling discourse in mathematics education can be seen in the differences constructed in relation to mainstream school mathematics without applications or in the differences to other forms of insertions of non-mathematical practices (such as word problems). There are some characteristic knowledge claims reflected in mathematical modelling: an ontological realism that acknowledges an independently existing reality that is the object of knowledge and the properties of which provide objective limits to how we can know it. However, these are seen as open to revision: a fallibility principle is acknowledged. This is a difference in comparison to school mathematics with a focus on both procedures and algorithms as well as on mathematical relationships and proof.

Julie (2002) summarises the differences as follows: a change of criteria towards acceptance of different non-equivalent answers, unrestricted time, acceptance of the provisional status of the outcome, and presentation in a format chosen by the students. The social base changes from individualistic to working in collaborative teams. Texts are not objects to be mastered, but used as resources. In a classroom such a shift would indicate a shift in the authority relationship between teachers, texts and students. Underpinned by learning theories that stress the agency of the learners, school mathematical modelling activities are also intended to encourage students to communicate their own ideas and to scrutinise the ideas of others (English, 2006).

The situation chosen as a starting point for modelling might be selected because of mathematical reasons or because of social reasons (Julie, 2002). In the first case the context is arbitrary and the mathematical concepts, procedures etc. are those specified in the curriculum; in the latter, the context is given (or selected by the students) and the mathematics is arbitrary. But any mathematics curriculum in the end prescribes a set of valued forms of mathematical knowledge. It also specifies the contexts in which this knowledge has to be applied, but only implicitly (Dowling, 1998), if it is not a critical mathematical literacy curriculum (see below).

Different versions of mathematical modelling in the classroom imply variations of classification. If the situation chosen to be modelled is selected because of mathematical reasons, the external classification might still be strong whereas the internal classification becomes weaker as a mix of different mathematical topics and procedures is legitimate. If, in contrast, the situation chosen for a modelling activity is selected because of social reasons, then the external (as well as the internal) classification might be rather weak.

It can be argued that the two modes of school mathematical modelling, which are different in terms of the relationships between the knowledge domains involved, relate to differential access to mathematical knowledge. If modelling is not subordinated to the principles of school mathematics, then the question arises to the principles of which discourse it refers. As mathematical modelling is not a uniform practice, but a set of interrelated activities in different domains, there is no set of uniform criteria for performing mathematical modelling. Consequently, the discourse of school mathematical modelling, if it is not subordinated to accessing mathematical knowledge, leaves an open space for promoting different agendas, such as developing human capital by channelling students into an engineering career pipeline, expressing and rethinking cultural identity, educating critical consumers or promoting social change.

When mathematical modelling is seen as a way to promote 'curricular mathematics' (cf., Zbiek & Conner, 2006), then it hardly can be regarded as a resistance position towards mainstream. In fact, the implementation of conceptions like RME demonstrates how well established the focus on mathematical models and progressive mathematization already is. In contrast, the focus on skills appropriate to obtaining a mathematically productive outcome for a problem with genuine real-world connections defines a resistant position to a curriculum structured by mathematical domains. This resistance is tactical when it (1) aims to complement rather than to overcome mainstream mathematical education practice and, simultaneously, (2) does not question the mathematical structure of the mathematics curriculum by imposing an order that takes the out-of-school problems to be modelled into account. There is no serious intention to deconstruct or subvert the mainstream mathematics curriculum.

The conceptualisation of modelling as a set of generic competencies that could be provided by mathematics education seemingly transcends the difficulties arising from cultural differences and economic inequalities because the activity of constructing mathematical models, through which these competencies are to be developed, is not seen as culture-bound and value-driven. Such a conception masks the fact that the construction of mathematical models depends on the perception of what the problem to be solved with the help of mathematics consists of and what counts as a solution. But depending on the subject position of the "modeller" in a practice, there are different models of the same problematic situation:

> For example, if the problem of a bank employee, who has to advise a client (aided by a software package), is the comparison of financing offers for a mortgage, for the manager of the bank this is a problem of profitability, and for the customer it is one of planning her personal finances. (Jablonka, 2007, p. 193)

This is not to suggest that mathematical models should be scrutinised exclusively in terms of the values connected with the underlying interests. But the discourse of mathematical modelling as providing individuals with generic competencies that enable them to become adaptive to the conditions of technological development, to overcome the limitations of specialised knowledge, to gain competitive advantage on the labour market and become critical consumers and democratic citizens, is mythologizing mathematical modelling because the causality between participating in mathematical modelling activities and the diverse educational potentials attributed to this experience is mythical. The myth embodies the claim of the ethical neutrality of mathematical modelling practices.

The popularity of modelling can be explained by the fact that it achieves a fictitious marriage between two strands of critique of a strongly classified mathematics curriculum. Such critique is on the one hand an outcome of an attack on a neo-conservative defence of canons of disciplinary specialised knowledge, which (at least historically) comes together with the reproduction of inequality of access to such specialised knowledge. On the other hand, the critique of strongly classified curricular knowledge comes from the side of those called "technical instrumentalists" by Moore and Young (2001) who advertise economic goals. Preparation for the "knowledge-based economy" is a major concern. Moore and Young observe that the scope of instrumentalism has extended from vocational training to general education under the guise of promoting the employability of all students. There is a danger that the myth of the neutrality of generic modelling skills discards the tension between neo-liberal ideology with a focus on human capital preparation and a conception of education for social change.

CRITICAL MATHEMATICS LITERACY

Critical mathematics literacy aims at identifying and analysing critical features of social realities and at contributing to the development of social justice. One strategy of pursuing these goals is sensitizing students to social problems and helping them to articulate their interests as citizens. These social problems include the particular hidden injustice students face because of their race, social class, cultural origin etc. A second strategy is directed towards the analysis of mathematics itself because of its function as part of technology, including social technology. A third strategy is concerned with the mostly discriminative practice of mathematics education itself:

How does mathematics education reproduce or reinforce social inequalities? (For a discussion of different strategies see Jablonka, 2003; Skovsmose & Nielsen, 1996).

Published experience with critical mathematical literacy in (most often) secondary schooling has mainly focused on two features: On the one hand, critical mathematics literacy is strongly connected to the construction and use of data and statistical diagrams. Examples from the previous MES conference include a discussion of a "race & recess chart" (Powell & Brantlinger, 2008) and "supposedly random traffic stops" (Gutstein, 2008). On the other hand, critical mathematics literacy is directed at the official use and interpretation of socially relevant data in form of quantitative arguments. Examples from the previous MES conference include analysing the "discounting of Iraqi deaths" (Greer, 2008) and the ways numerical information can be presented in order to augment or reduce its comprehensibility (Frankenstein, 2008).

The subversive rather than oppositional deconstructive resistant position of critical mathematical literacy is apparent as critical mathematical literacy explicitly aims at demolishing the correlation between social class, race and academic achievement by demystifying the "naturalness" of this relation (Martin, 2010). It is subversive because it aims at eroding and undermining hidden principles of school mathematics instruction and social stratification. These principles serve to perpetuate the hierarchical structure of society and societies. Critical mathematics literacy scrutinizes the mechanisms by which race and social class structures are reinforced.

The examples from previous MES conferences point to a common problématique: Critical mathematics literacy intends to be simultaneously a pedagogy of access and a pedagogy of dissent (McLaren, 1997; Morrell, 2007). This includes access to higher education, to rewarding professional employment and to civic life particularly for marginalized populations, though access might also be understood in terms of personal and social emancipation. However, advanced mathematical literacy does not automatically translate into power, and it does not translate into power equally for everyone who possesses it. In a pedagogy of dissent students develop a language of critique of systems of social reproduction and of inequitable power relations in society. They critically analyse the role that mathematics and mathematics education play in legitimating and perpetuating these conditions. Is this *simultaneously* possible?

Eric Gutstein has worked in a setting characterised by a separation of pedagogies of access and dissent:

> The class I refer to here has intermittently completed social justice mathematics projects since the week they started school. Although we have only spent perhaps 15% of our total time, on three or four projects a year, they have been evidently been sufficient meaningful and memorable to students that none reported it as unusual to hear that particular framing of mathematics. (Gutstein, 2008, p.15)

Though the intention is to reverse the proportion of "standards-based mathematics" and "social justice mathematics" (p. 18), what students learn and develop in both cases is structurally different. The discourse of a mathematics pedagogy of dissent is necessarily weakly classified. Within the Freirean students' generative themes, which are the focus within a pedagogy of dissent, the mathematics might play a crucial role yet not in a very simple and visible way (Jablonka & Gellert, 2007). For the prominent case of "random traffic stops", Dowling (2010, p. 4) argues:

> One might suppose that police are often not able to estimate the ethnicity of a driver until after they have made the stop. This would seem to suggest that, if there is a correlation between ethnicity and the probability of being stopped, then we might look for the presence of intervening variables for an explanation; a correlation between ethnicity and relative poverty and the association of the latter with the use of elderly and poorly maintained vehicles having visible defects, for example.

The traffic stop problem is apparently much more difficult and not easy to grasp mathematically. As a consequence, the relation between the weakly classified social justice issue and the strongly classified relevant mathematical knowledge is obscured. In fact, students may get used to handle a piece of legitimate school mathematics – expected value in random experiments –, but this at the risk of misjudging the relationship between mathematics, social structure and social technology. In terms of a pedagogy of dissent, the dissent is only constructed towards a critique of societal power relations, but not towards the role mathematics plays in formatting these power relations. In terms of access, access is given to applications of the mathematical concept of expected value, though this in a context only marginally relevant for professional promotion or academic success.

TOWARDS A "RADICAL CONSERVATIVE PEDAGOGY" IN MATHEMATICS EDUCATION?

According to Bernstein's (1990) characterisation of a conservative pedagogy, a traditional strongly classified mathematics curriculum that establishes an explicit hierarchical relationship between teacher and students and includes explicit sequencing rules as well as explicit specific criteria is an example of a realisation of such pedagogy. It is underpinned by a theory of instruction that focuses on intra-individual changes in terms of individual's competences or performances rather than on changes in the relation between social groups. Consequently it does neither highlight shared competencies nor the sharing of experiences.

Inquiry-based mathematics and mathematical modelling do not solve the problématique of providing alternative conceptions that relate to social justice for a socially marginalized student population. As Bernstein argues, this is particularly due to focussing on the mathematical capability and development of the individual student. He also deconstructs "progressive" pedagogy because of its differential effect stemming from the implicitness of the recontextualisation principle, which makes invisible the classificatory principle of the knowledge to be acquired.

Ethnomathematics and critical mathematics literacy explicitly focus on groups of marginalized students and look for the empowerment of social groups. However, the tension between, on the one hand, the students' generative themes or cultural heritage, and, on the other hand, an institutionally valorised mathematics can only partly be mitigated by these curriculum conceptions.

A further position of subversive resistance has been theoretically argued by Martin (1993) and outlined by Bourne (2004). Both draw on Bernstein (1990) who sketches "an apparently conservative pedagogy yet to be realized" (p. 214). In a radical realisation of a conservative pedagogy the emphasis is on "the *explicit* effective ordering of the discourse to be acquired" (p. 214). As Bourne (2004) demonstrates in a case of literacy teaching, by establishing an overtly highly regulated discourse the teacher successfully inducts students to valued and powerful new discursive opportunities and, at the same time, coordinates the everyday discourse that students are familiar with. By managing changes in place, pace and deportment, the teacher makes the strong classification of school and community knowledge visible. As Bourne (p. 65) remarks: "Visible pedagogy is explicit in acknowledging responsibility for taking up a position of authority; invisible pedagogy (whether progressive or 'emancipatory') simply masks the inescapable authority of the teacher." Bernstein (1990) characterises the logic of a radical conservative pedagogy as a logic of transmission in which the teacher is explicitly responsible for the ordering of the discourse. This is contrary to a logic of acquisition, on which progressive pedagogies as well as revolutionary pedagogies (Freire, 1971) are based. A radical realisation of a conservative pedagogy highlights shared competences and stresses that the acquirer is *active* in decoding and regulating a necessarily recontextualised practice. In a radical conservative pedagogy the students collectively access and participate in academically valued social practices and get introduced and used to the discourses by which academically valued practices are constituted. This would lead to acquire insights into the discourses that are the focus of critique and has the potential to reconcile a pedagogy of dissent with a pedagogy of access.

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