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ABSTRACT

A movement of educational change in Portugal aimed at giving schools larger autonomy in curricular decisions is described. In reconceptualizing curriculum, the concepts of competence and innovation played a central role. An analysis of the curriculum development process is included and some suggestions are offered for future research and debate. (Contains 32 references.) (DDR)

REVISITING THE GOALS AND THE NATURE OF MATHEMATICS FOR ALL IN THE CONTEXT OF A NATIONAL CURRICULUM

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Abstract

A movement of educational change has been developed in Portugal, aiming at giving the schools a larger autonomy in curricular decisions. In reconceiving the view about the curriculum, the concept of "competence" plays a central role while the process of innovation constitutes a major aspect. This movement is described and analysed, in particular by discussing the notion of competence and the characteristics of the process of curriculum development. A special focus is on the way in which mathematical competence for all may be interpreted and how it is related to developments in mathematics education. The analysis of obstacles emerging in a large-scale educational change may be relevant for discussion in an international context and offers some suggestions for future research and debate.

1. New trends in the Portuguese educational system

The evolution and recent developments of the Portuguese educational system in the last two decades, as well as the related perspectives on the curriculum, and on the mathematics curriculum in particular, raise some issues that might be of general interest for reflection and discussion.

1.1. The context: some contradictory aspects

In 1974, when we could finally restore the democracy after 48 years of a dictatorship, the extension of compulsory education up to 6 years of school – instead of the old and traditional primary school of 4 years – was a recent fact. This hardly reflected the reality in the poorest regions of the country. Illiteracy was very high among adult population. It was only in 1986 that a new general law for education fixed compulsory school attendance for all 6-15 year olds (that is, a "basic school" of nine years). In fact, we had to wait almost for the end of the twentieth century to see practically all our children and youngsters of those ages in our classrooms. At the same time, it was only after 1995 that pre-school education became a new reality, finally involving in 2000 the large majority of children of the 3-5 age level.

As a result of its rapid and original development, in particular due to the fact that its basis was partly designed during a sort of "revolutionary" period, this educational system has some characteristics that may be seen as contradictory.

On the one hand, we have a number of very "advanced" laws and regulations. In our system, there is a comprehensive and "inclusive" basic school of nine years for all,

similar to the Scandinavian traditional organisation, and a secondary education of three years, with different branches (general, vocational, professional) all of them giving equal access to further studies. Since 1997 teachers of all school segments, from pre-school to university, must have the same academic degree at the beginning of their profession. Moreover, all teachers may use, from time to time, a sabbatical year or they can apply to a bursary in order to develop projects or to do a post-graduate course. In the second and third cycles of basic education (10-15 year olds), teachers work a maximum of 22 and a minimum of 14 class periods of 50 minutes per week, according to their age.

On the other hand, all this was conceived and implemented on a tradition of a centralised and rigid school system, which was affected by lack of resources in many schools – a problem that has taken us many years to overcome. It was only in the nineties that a new law to increase the administrative autonomy of schools was adopted. Dominant public views about the curriculum tend to see it as a set of disciplines with "programmes" indicating for each subject what (and how) must be "covered" each school year. This process is actually mediated by the power of the textbooks – even if those programmes are aligned with modern international trends in most disciplines. Although there are no national exams except at the end of the secondary school, assessment is dominated by traditional written tests. Although there is an official logic of evaluating students progress throughout each cycle, the old "principle" of deciding that the student must repeat the same school year if he/she does not succeed in two or three disciplines still guides the way how many people think and act, both outside and inside the school.

When focusing on mathematics education, there are also other contradictory aspects in the situation, just like in most European countries. However, Portugal probably stands in a clearer contrast. In Portugal, the community of mathematics education (teachers, teacher educators and researchers) has become quite strong in these last fifteen years. All these groups support and are involved in the Association of Teachers of Mathematics (APM), the biggest association of its kind, which was created in 1986 and has now about 6000 members. This number would be equivalent (proportionally to the population) to 24000 in Spain, more than 30000 in France or UK, and approximately 9000 in Holland! About 2000 participants attend the annual meeting organised by APM. Many Portuguese teachers and researchers began to participate in international congresses on mathematics education: in ICME-8, in 1996, they formed the third largest national representation among European countries, after Spain and UK.

At the same time, a considerable number of teachers are following post-graduate studies on education, in particular on various aspects of the didactics of mathematics, and some of them are participating in projects which involve both a strong component of curricular innovation and a research dimension. Since the creation of APM, and following the experience of the MAT789 project (Abrantes, 1993), the co-operation between teachers and researchers became an interesting feature of

Portuguese mathematics education – see, for example, Oliveira et al. (1997), Ponte et al. (1998) or Porfírio and Abrantes (1999). It is not surprising that curricular innovation and teachers professional development became two major areas of research.

However, this community is under a strong public pressure, as a consequence of the scores in the exams at the end of secondary school or the very low position of Portugal in the rankings of the international comparative studies. Like elsewhere, as Keitel and Kilpatrick (1998) have pointed out, these rankings are frequently used without any serious consideration about what they mean or do not mean. They are used, for example, as an argument to propose not only the return to a greater emphasis on training routine skills, but also "solutions" like more exams and more comparative studies! Many teachers seem to have mixed feelings. They have sympathy with the new ideas about curriculum development, but they are also moving in a culture of school still dominated, inside and outside the school, by the old ideas and values.

1.2. Recent developments in basic education

In the last four years, after one year of debate and preparation, the Ministry of Education initiated a movement towards a new curricular organisation. The starting point was the consideration that the traditional structure was not adequate to ensure significant learning experiences to all children and to avoid school failure and abandon.

For the "basic education", this movement started with a project, labelled as "flexible management of the curriculum". This project aimed at giving the schools a larger autonomy in the decisions about the various disciplines and connections among them, as well as about new interdisciplinary components – a "project area", an "oriented study area" and a "citizenship area". This autonomy relates to the teaching and learning process and refers both to the activities to be developed and the time and space dedicated to each component of the curriculum. Emphasis is put on the role of the teachers and their collective structures in school, namely – at 2nd and 3rd levels of basic education (10-15 year olds) – the class council, this is, the group of professionals who work directly with each group of students.

This movement was justified by the need to promote a new conception of the curriculum, both the intended curriculum and the implemented one. The former requires the educational authorities to express the curriculum in terms of "essential competences" and types of "educational experiences" that the school should consider for all pupils (in each cycle), in opposition to the usual programmes of content topics to be covered and corresponding methods (in each year). The latter challenges the teachers and the schools to assume a much larger responsibility in the search for the adequate decisions for the specific pupils they work with, taking into account their cultural and social environment, their educational needs and the human and material resources that exist or can be made available. In other words, under the guidance of a

national curriculum expressed in general and broad terms, the process of curriculum implementation is seen like a project to be conceived and developed by the school, including more specific projects concerning each individual class.

From 1997 on, schools could participate in the so-called "flexible management of the curriculum" movement by presenting their own curricular projects, under a minimum number of general rules. This participation, on a completely free basis, began with 10 schools in 1997/98, increasing in the three following years up to 184 schools all over the country. These schools constituted a sort of informal network exchanging materials and points of view, and participating in local, regional or national meetings organised by the educational authorities.

1.3. The case of mathematics

Meanwhile, the Ministry of Education started to produce draft versions for discussion of the so-called "essential competences". Some documents focussed on aspects crossing all school subjects, while others related specifically to the various disciplines. This activity has been developed by working groups with a strong participation of members of the associations of teachers, together with researchers and other professionals.

In the case of mathematics, the corresponding document states the ultimate end of mathematics in basic schools as follows:

> Mathematics is a part of the cultural patrimony of human kind and a way of thinking, which should be made accessible to all. Every child and youngster should have the opportunity
>
> - to contact, at an adequate level, with the fundamental ideas and methods of mathematics and appreciate its value and nature;
> - to develop the capacity of using mathematics to solve problems, reason and communicate, as well as the self-confidence to do it.

This document refers then to major aspects of "mathematical competence" for all in the following way:

> The mathematical competence that all pupils should develop through the basic education integrates attitudes, skills and knowledge, and includes:
>
> - the disposition and capacity to think mathematically, this is, to explore problematic situations, search for patterns, formulate and test conjectures, make generalisations, think logically;
> - the pleasure and self-confidence in developing intellectual activities involving mathematical reasoning and the conception that the validity of a statement is related to the consistence of the logical argumentation rather than to some external authority;
> - the capacity to discuss with others and communicate mathematical thoughts through the use of both written and oral language adequate to the situation;
> - the understanding of notions such as conjecture, theorem and proof, as well as the capacity to examine the consequences of the use of different definitions;
> - the disposition to try to understand the structure of a problem and the capacity to develop problem solving processes, analyse errors and try alternative strategies;

- the capacity to decide about the plausibility of a result and to use, according to the situation, mental computational processes, written algorithms or technological devices;
- the tendency to "see" the abstract structure underlying a situation, from daily life, nature or art, involving either numerical or geometrical elements or both.

In a second part, the document elaborates on what this means, in terms of each of the main areas of the mathematics curriculum – Numbers and Operations, Geometry and Measurement, Statistics and Probability, Algebra and Functions – through all the basic education and in each of the three age level cycles. Finally, pointing out problem solving as a general guide-line, it states that all pupils in their mathematics classroom should be frequently involved in mathematical investigations, projects, practical tasks, discussions, reading and writing about mathematics, exploration of connections inside mathematics and relating it to other areas, as well as they should have various opportunities to use technology, manipulatives and games in relation to their mathematical activities.

2. Scope and meaning of the process of educational change

What is going on in Portuguese basic education is undoubtedly a change of paradigm. Other reforms in the past introduced interesting innovations, but all of them left untouched the power of central authorities in defining the curriculum, the usual way of testing and implementing it, the traditional separation between curriculum guidelines and school organisation, and the nature of teacher's role and professional activity. The current movement, for the first time in the history of our education, has to do with changes in all these aspects. Generally speaking, it could be described as a change from the "conventional" paradigm to a new one influenced by the "constructivist" and the "critical" paradigms – to use the terms of Galbraith (1993).

The evolution of the concept of curriculum in relation to school organisation and teacher development has been largely discussed in the literature – for example, Fullan and Hargreaves (1992), Fullan (1993), Goodson (1997) and many others. From a theoretical perspective, the current movement in Portugal – tending to view the curriculum as a project in the context of the school as a learning organisation – is far from being original. In practical and political terms, we can find some similarities with the reform developed in Spain about ten years ago. On the other hand, the formulation of the intended (national) curriculum in terms of "essential competences" is not original as well – there are other cases, for example, in Belgium or in Québec.

However, the recent evolution in Portugal deserves some exploration and discussion for three major reasons. Firstly, it is worth elaborating on the adopted concept of competence since the term "competence" is not used everywhere with the same meaning. Secondly, it seems promising to explore the way in which "competence" is interpreted in the specific context of the mathematics curriculum. Thirdly, it may be relevant to focus on the process of curriculum development and innovation, which is quite unusual at a national level.

2.1. The concept of "competence"

The shift from content topics and objectives to competences requires a clarification about the meaning of the term "competence". I do not intend to introduce a universally accepted definition, yet I would like to avoid ambiguity and misunderstanding.

Following Perrenoud (1997), it should be clear that, in spite of a possible confusion with a behaviouristic interpretation, the term "competence" does not indicate some kind of specific behaviour that "can be observed", neither does it refer to performance. In this author's view, competence is related to the process of activating resources (knowledge, skills, strategies) in a variety of contexts, namely problematic situations. Perrenoud quotes Chomsky (1977) to support the distinction between competence and performance, and the idea that competence is related to the capacity to improvise, but emphasising the fact that, in his view, competence develops as a result of learning and not spontaneously.

Short (1985) has shown that the concept of competence may be used (or misused) with several different meanings ranging from a connotation with behaviour and performance to an identification with a quality of a person or a state of being. In this last conception, the holistic nature of competence is emphasised. Knowledge is obviously involved, as well as the skill necessary to use it, but this use is an emancipatory action, based on reflection and implicating some degree of autonomy.

It may be interesting to note that there is a parallel evolution of the key concept used by the studies on literacy. Initially, "alphabetisation" was identified with school attendance; in a second phase, the important matter was the acquisition of the knowledge, whether or not the person had attended a given school level; finally, the focus of literacy moved from the acquisition to the use of the knowledge in concrete situations (Kirsch and Mosenthal, 1993). Since this is not necessarily limited to the direct application to routine situations, the (mathematical) literacy could be interpreted as the (mathematical) competence that all students should be helped to develop in the school.

In Portugal, the reform in the late eighties pointed out that educational goals went far beyond content knowledge, including skills and attitudes as well. The programmes stated three lists of general objectives to involve these three kinds of goals. After this, however, the programme for each school year indicated the content topics to be covered, together with "specific objectives" and methodological suggestions related to those topics. It is not surprising that a common interpretation of the intended curriculum tended to see skills (for example, deductive reasoning or problem solving strategies) and attitudes (for example, persistence or solidarity) as elements to be "added" to the content knowledge.

In the present movement, the concept of competence intends to emphasise the idea of integration of knowledge, skills and attitudes, where integration is the key idea. The choice of the expression "essential competences" is a deliberate attempt to distinguish

what is being proposed from the "basic skills" or the "minimal objectives", which were common expressions in the official discourse some years ago. This distinction is a particularly important pedagogical and political issue in a country where education for all is a relatively recent principle and it is necessary to resist to systematic proposals to achieve this goal by creating hierarchies and inequalities among students.

2.2. Mathematical competence in a national curriculum for all

Resnick (1987) has consistently argued in favour of the idea that basic skills and higher order skills cannot be clearly separated. She also added the role of attitudes, namely by stating that the school should cultivate a broad disposition to higher order thinking. The integration of cognitive abilities and motivation is especially emphasised: "Motivation for learning will be empty if substantive cognitive abilities are not developed, and the cognitive abilities will remain unused if the disposition to thinking is not developed" (p. 50). Integration also played a central role in the definition of "mathematical power" as it was introduced by the NCTM (1989) Standards.

In the above list (section 1.3) of aspects of mathematical competence for all, the concern with the integration of knowledge, skills and attitudes is quite apparent. We should also add the clear concern with beliefs and conceptions about mathematics, which play an important role in students' learning process (Borasi, 1990; Schoenfeld, 1992). This aspect has been almost always absent in the curricular guidelines defined at an official and national level.

Another characteristic of the above listed aspects is the explicit attention to the nature of mathematics. As Bishop (1991) points out, it is not enough to teach (some) mathematics, it is indeed necessary to educate *about*, *through* and *with* mathematics. In this point, it should be emphasised that the mentioned aspects of mathematical competence cannot be seen in isolation from the educational experiences that all children should live in school, namely investigations and projects involving both mathematical ideas and their relations with different sorts of problems. Obviously, the idea is not to "enrich" the knowledge of facts and the training of procedures with some sort of rhetoric about the nature of mathematics as a science.

This concern with mathematical activity in relation to understanding the nature of mathematics is a central issue in several different approaches. Bishop (1991), in the search for "mathematical similarities", points out six activities that are "significant (...) for the development of mathematical ideas in any culture" (p. 23) – counting, locating, measuring, designing, playing and explaining. Goldenberg (1996) proposes "habits of mind" as organisers of the curriculum – for example, the tendency to describe relations and processes or the tendency to look for invariants. The NCTM (2000) states "process standards" to refer to "ways of acquiring and using content knowledge" (p. 29).

The present challenge we face is to help all children to develop their mathematical competence in a way that will avoid interpretations reinforcing the perspective of a curriculum of training procedures, skills and rules (for all) with the expectation that this kind of training will constitute (for some) a pre-requisite to future uses of mathematics. To do so, we have indeed to question the basis of the "technique-oriented" curriculum which has never been done except in some small-scale innovative projects. "A technique curriculum cannot educate (...) For the successful child it is at best a training, for the unsuccessful child it is a disaster" (Bishop, 1991, p.9). Perrenoud (1997) insists that the formulation of the curriculum in terms of competences should be strongly connected to the purpose of striving against school failure and taking into account all children, namely those with a cultural background not similar to that of the "traditional school".

If, at the level of the intended curriculum for all, our option is to reconceive the components of the mathematical competence, together with a larger variety of kinds of educational experiences, then a consequence is a reconsideration of the extension and complexity of topics included in the curriculum. For Bishop (1991), the curriculum should be relatively broad (in the variety of contexts offered) and elementary (in the mathematical content). Similarly, when discussing the problem of the construction of competences in the school, Perrenoud (1997) points out that, if our option is education rather than instruction, then it is necessary to reverse the tendency to include the teaching of more and more topics in the compulsory school curricula.

In the current movement in Portugal, it was announced that the number of content topics considered in the curriculum, in every discipline, would be reduced. This was not yet done for reasons that have to do with the process of curriculum development that I will comment on in the next section.

2.3. The process of curriculum development

The most original aspect of the recent development in Portuguese educational system is, probably, the fact that a curricular reform at a national level (indeed not even labelled as a "reform") is not following the RDD (standing for "research-development-dissemination") model.

The criticism on this strongly dominant model of curriculum development and implementation is far from being recent. Twenty years ago, Howson, Keitel and Kilpatrick (1981) have discussed the origins, assumptions, values and consequences on mathematics education pointing out emergent alternative perspectives. More recently, in the context of the so-called realistic mathematics education, Dutch researchers have developed this discussion into new and promising directions.

Gravemeijer (1994) explains that, in his approach, curriculum development is embedded in a holistic framework, taken from the concept of "educational development" as Freudenthal (1991) uses it. A central idea is that the process of curriculum innovation has to consider all the actions needed from the initial purpose

to the actual change, incorporating teacher education, counselling, assessment and opinion shaping. Furthermore, unlike the RDD model, initial theory is much like a philosophy or a vision and it will evolve in the interaction between theoretical and empirical justifications.

The last reform in Portugal, in the late eighties, constituted an almost perfect example of the RDD model. Teams of invited experts prepared new programmes during two or three years; these programmes were implemented in a small number of "experimental schools" where motivated teachers worked together and prepared their own materials in the absence of textbooks; finally, after suffering slight corrections, the programmes were "generalised" to all schools. The "consumers" were introduced to the new finished "product", usually in the form of new textbooks. The result was not surprising: to solve the visible problems of low take-up, dilution and corruption of major ideas of the intended curriculum – to use the terms of Burkhardt (1989) – those responsible for the reform claimed that intensive teacher training programmes should then be developed.

The current movement, which as already mentioned was initiated four years ago, has a very different nature. Schools have been invited to participate by elaborating their own projects of curriculum development while, at a central level, different sorts of working documents are produced, namely draft versions of the "essential competences". These documents are discussed, criticised and modified in a process that takes into account the feedback of the schools and the contributions of universities and professional associations. As I have indicated earlier, a major principle is a large autonomy of schools, in relation both to the various disciplines and the new curricular areas dedicated to support students' projects and periods of personal and group study under teachers' guidance. Meanwhile, together with many formal and informal meetings organised by the Ministry and by the schools themselves, teachers participate in in-service initiatives, namely in the form of workshops and small projects – which are valued and credited for progression in the teachers' career just like traditional courses. The co-operative work among teachers inside the school has become, probably, the hallmark of the movement.

Throughout these last four years, the number of schools joining the movement increased significantly: 10, 33, 92, 184. An interesting result of the process was that teachers leading projects in the former schools began to be more and more invited by colleagues of other schools and meeting organisers to participate in conferences, debates and workshops, a kind of activity traditionally reserved for researchers and teacher educators.

In January 2001, a new law was adopted for curricular organisation. From now on, there are not compulsory uniform regulations about the exact amount of weekly time and the precise topics to be considered year by year in each discipline. Instead of that, schools are invited to make their own decisions about a number of relevant aspects, both at a school level and at a class level. Together with general guidelines focusing on the priority of experimental and practical teaching methods, a new version of the

document stating the essential competences and educational experiences will constitute the main official reference. For each cycle, it is indicated the minimum time to be dedicated to each curricular component (group of disciplines or interdisciplinary area) and the maximum number of hours per day to compulsory activities. About 20% of the total time correspond to periods of work where there are not programmatic prescriptions at all – against the traditional 0%.

This new law includes a number of recommendations that emerged from the experience of the schools involved in the movement – which in any case may be adapted or modified. One of them is the recommendation to organise class activities in periods of 90 minutes, instead of the traditional 50 minutes. The main official arguments invoke better conditions to promote practical and investigative work in the classroom, the use of technology and other materials and the goal of reducing the number of different subject matters in each day.

It should be noted that, although we will enter into a new stage of the process of curriculum innovation, guidelines are far from being completely "ready". For example, the way in which programmes will evolve to constitute working materials for teachers is yet to be determined. The evolution of textbooks is another issue for debate. Refusing a top-down model for development, we do not have a new "system" to be generalised in a precise moment.

In the particular case of mathematics, the present stage of the debate suggests an evolution of the working documents mentioned earlier (section 1.3). The discussions about how we could characterise the mathematical competence for all indicated, for example, that it is necessary to make more explicit the uses of mathematics in relation to other areas and the "real world", and especially the role of mathematics in education for democratic citizenship. Generally speaking, a movement towards crossing the objectives indicated for the various curricular areas and referring them more clearly to common and central aims of the basic education will become a priority.

3. Obstacles and problems

Rather than examining the details, it may be relevant for the international community to discuss major issues and obstacles raised by a movement with the described characteristics. I will concentrate on some of them.

My first observation is that if creating an alternative to the RDD model for curriculum development is a difficult task even in small-scale projects, it becomes much harder in the context of an educational reform at a national level, especially if the tradition is that of a centralised system. The dominant conception of development claims for well-defined and "teacher-proof" curricula carefully tested before generalisation and high quality textbooks as key factors to improve teaching and learning. This seems to be a popular view shared by influential sectors of the scientific community and the society at large.

Public opinion is here a necessary, yet very complex, element to be considered. The strength of a movement based on the interaction between theoretical and practical developments, which is a gradual and long-term process in nature, seems to be at the same time its weakness. At a political level, it is not easy to respond to the accusation of delaying quick and clear answers. Guidelines appearing to be ill defined, as well as the absence of new programmes with exact and precise indications, become a factor of criticism. It is interesting to note that, in this context, the single proposal to give schools the possibility of organising classes in periods of 90 minutes is pointed out almost like a "revolution", provoking unusual public debates about education.

My second observation is that, even inside schools, together with the public pressure mentioned above, it is obviously difficult to deal with uncertainty. If the current movement constituted an opportunity for innovative teachers and school leaders to organise teaching and learning contexts more adequate to their students, for others it is a source of problems. There is a tendency to look for models in the initiatives of "more experienced" schools; however this becomes difficult when there are several different models and there is not an official one.

This tension between autonomy and security is amplified by the emergence of the rhetoric associated to the educational change. This is a common phenomenon in periods of reform, but it is particularly negative when change is a matter of process, not only of content. The tendency of emphasising the "pedagogically correct" and criticising all "deviations", characteristic of all sectors including some educational authorities and researchers, is in fact a force towards the adoption of uniform solutions and contradictory with the goal of a larger autonomy of schools and teachers.

My third observation is related to the concept of competence and, in the case of mathematics, the definition of mathematical competence. Doubts and criticism on the presented proposal showed that a broad concept is difficult to be widely accepted. Terms like *disposition* (to think mathematically), *pleasure* (in developing intellectual activities) or *tendency* (to look for the abstract structure) have been especially criticised with the argument that it is very difficult to make such things "operational". This seems to reflect the difficulty in getting the understanding or the acceptance of the idea that integration of cognitive and non-cognitive components is essential to the concept of competence.

Obviously, this is not a new problem, caused by the adoption of a terminology based on the concept of competence. Similar discussions tend to occur, regardless of the terms in which we base our definitions. Proposals aligned with using and applying mathematics in schools (de Lange, 1996), valuing mathematical investigations (Ernest, 1991) or adhering to the "rebirth" of project teaching (Bishop, 1995), which are consistent with the development of mathematical competence in a broad sense, are often accepted as complementary methods or a sort of applications but not necessarily as the essence of the curriculum. Clearly, the problem is the resistance to

question and abandon the technique-oriented curriculum. A central aspect of this problem has to do with assessment and control, leading to my last observation.

Several authors have pointed out that conceptions and practices about assessment did not evolve to match developments in conceptions and practices about other curricular components. For example, Niss (1993) refers to "an increasing mismatch and tension between the state of mathematics education and current assessment practices" (p. 4). Assessment of the development of mathematical competence requires observation in different situations and confidence in the teacher's professional judgements, while the central role of standardised tests and exams may become a strong obstacle to flexibility, adequacy and diversity.

It is possible that, in the last years, a wider range of assessment modes and instruments – for example students' written productions – has begun to be increasingly accepted and used. However, reinforcing the dominance of tests and exams, the recent influence of the way in which international comparative studies tend to be interpreted and used has a powerful effect against educational change.

These studies could be relevant to provide information about important aspects of mathematical competence. However, presenting scores as indicators of curriculum achievement, and tending to view curriculum as unproblematic, context-free and culture-free (Keitel and Kilpatrick, 1998), the use of these studies, namely the emphasis on rankings, constitutes a serious obstacle to new conceptions and practices of curriculum development.

The problem is well known. Keitel and Kilpatrick (1998) show how, in the USA and in Germany, lower scores in the TIMSS test in comparison with Asian countries are used as an argument to urge teachers to return to a curriculum based on 'core knowledge' or to claim for funding to develop more sophisticated instruments for measuring students' performance. In the UK, the Secretary of State for Education and Employment says that "numeracy is an important life skill, but evidence shows that standards of school mathematics have not been high enough to enable us to compete internationally" (DfEE, 1998).

In Portugal, the situation is about the same, with the difference that scores were even lower. Porfírio and Abrantes (2000) have presented a paradigmatic example of popular notions of culture, school and mathematics, taken from a TV programme organised in the sequence of the publication of the international rankings. When a mathematics educator tried to introduce an example, the moderator immediately commented: "About mathematics we don't understand anything beyond the Pythagoras theorem". However, all evening, the moderator and two other opinion-makers criticised the school for the low scores of students in mathematics tests, while tried to proof the "lack of culture" of our youth by asking some questions about facts related to poetry, history and geography to some students present in the studio.

> These people showed that their level of mathematical ignorance was deeper than they even could realise. (...) They view mathematics as a 'building' and assume that they can only

remember some pieces of that building. They don't have any idea about the nature of mathematical activity or about the way in which mathematical ideas are generated, develop and relate to other ideas. For them, however, this fact is not relevant in cultural terms. (Porfírio and Abrantes, 2000, p.278)

Presently, in Portugal, while the movement of curriculum innovation tries to emphasise flexibility and adequacy of teaching methods to students' characteristics and consideration of their social and cultural backgrounds, the "societal" values of competitiveness and standardisation – of guidelines, methods and "objective" results – tend to favour the reinforcement of a technique-oriented curriculum. The Ministry of Education is strongly criticised for not publicising rankings of schools based on students' scores in national tests. A popular argument is that everybody has the right to know what are the "best schools", the "best teachers" and the "best teaching methods". The need to compete with other countries is generally added as well, together with the argument of "globalisation". As Keitel (2000) observes, this concept is ambiguous; it has frequently a connotation opposite to the values of cross-country collaboration, interaction and co-operation at different levels.

4. Final remarks

In these last decades, much work has been done in the field of mathematics education. Generally the research focus is on the child and relates to learning processes or students' conceptions. In some cases there is concern about the evolution of these processes and conceptions in contexts of curriculum innovation, as well as about models of curriculum development. However, the remark of Burkhardt (1989) that the study of curriculum change on a large scale is neglected, "partly for practical reasons but mainly because of a lack of attention to system issues" (p. 9) seems to continue valid.

There is also a considerable work on teachers' professional development but, again, the emphasis is not generally in collective and social processes relating this development to the dynamics of curriculum change, except maybe in the context of innovative projects.

A major obstacle to develop promising approaches to curriculum innovation may be probably found in political and social issues, namely in "popular" conceptions about education and educational change. In particular, public conceptions about mathematics and mathematics learning in schools seem to play a central role in favouring the perpetuation of a technique-oriented curriculum. However, this influence is seldom studied. When discussing the factors that cause students' (and teachers') conceptions of mathematics, the literature has almost always pointed out the way in which mathematics is presented in school and the dominant use of scores on standardised tests as measures of academic success. There is no doubt about this strong and direct influence. But this is not a story of teachers and students only. What is the role of the society at large and how does it work? What about the role of the scientific community?

We can find a few references in the literature, revealing this concern. Borasi (1990) admits that "social stereotypes (...) may certainly play a role in shaping students' conceptions" (p. 177). As I have pointed out above, Freudenthal (1991) includes "opinion shaping" in the set of actions needed in a process of educational development. However, the recent evolution in Portuguese educational system strongly suggests that we need to know much more about these issues.

Finally, I would like to observe that the frequent shifts in my text between mathematics education and educational change at large reflect the impossibility of isolating the mathematics curriculum from the school curriculum as a whole – especially when the basic education is the context. Similarly, the shifts between a descriptive/analytic perspective and a normative one (Niss, 1996) result from the impossibility of ignoring personal values and options when the goals of mathematics education are concerned. These two aspects should not be neglected whenever research and debate focus on actual change at a national level.

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