

PHYSICAL AND NATURAL SCIENCES CURRICULUM AND TEACHERS' PROFESSIONAL CULTURE: CONCEPTIONS AND PRACTICES

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ABSTRACT

The Basic School Curriculum Reorganization Process in Portugal and its implication on the concept of curriculum concept and on its organization (defined and organized in terms of the development of pupils' competences, namely those specific for physical and natural sciences) has caused in the educational arena several discussions and perplexities. Indeed, the concepts of *curriculum*, *competence* and *teachers' collaboration* have assumed an unquestionable centrality in the educational context. Consequently, their appropriation by the educational actors, namely the teachers, is crucial for the success of the implementation process referred to above.

Nóvoa (1999), for example, mentions that the weakness of collaborative practices may have large negative consequences for the teaching profession. This is one of the reasons pointed out by the author why it urges to find new meanings for the collective professional's concept and to implement routines of work, ways of decision making and pedagogical practices which calls for the enhancement of teachers' co-responsibility and the sharing of their practices.

However, the new curriculum approach, based on competences and the finding of new meanings for the new collective professional's concept are, in reality, still fragile and weak in Portugal. This means that there are still confusions and uncertainties which become evident through the existing difficulties on the curriculum management process, namely in the area of physical and natural sciences teaching and learning process.

Recent researches on the topic, Abelha (2005) and Martins (2005), and despite the fact of the recognition of the existence of some successful cases, conclude that, at the level of the practices, curriculum changes are still few, both on the way teachers work and on the promotion of significant pupils' learning outcomes based on the development of competences.

Keywords: Curriculum, Curriculum Management, Competence, Collaborative Culture, Science Teaching

1. INTRODUCTION

The rapid technological changes and the market globalization require educated individuals in several subjects, capable to demonstrate flexibility, communicative skills and an attitude of openness to long life learning. The competences that our society requires today may be developed through a teaching process in which, for example, science is presented in an integrated and holistic way and in which the learning experiences are associated with pupils' realities and their socio-cultural environment.

However, and at least in Portugal, there is evidence that in the past decades science teaching does not have the desirable effect on pupils' learning. On the contrary, the evidence shows a growing disarticulation between what pupils learn while they are in school, namely at the level of compulsory education, and what society expects from them. Those expectations, at the curricular level, are focused on the development of competences in which individuals, when faced with uncertainty, show that they are able to act effectively, and to readapt themselves to the every present challenges of every day life. Galvão *et al.*, reflecting about this issue, state that *"the rapid technological change and the market globalization require individuals with a wide education background and a capacity to learn through their lives. These competences, however, are not compatible with a teaching process where science is presented in a fragmented way and with contents which are far away from reality, that is without a really global and integrated dimension"* (2001: 129).

The official curriculum document, called *"Currículo Nacional do Ensino Básico – Competências Essenciais¹"* (DEB, 2001), organized in terms of competences to be developed by pupils in the different disciplines, defines, for the area of Physical and Natural Sciences, a set of specific competences which reveals the use of a know how which enable students to confront and interpret the complexity and uncertainty which characterizes our society today. Therefore, and in order to achieve a better quality in the teaching process, the official curriculum documents have defined some principles which should guide the curriculum management process. Among others: a curriculum

concept which promotes science teaching practices based on the development of pupils' competences and which challenges the teachers to change their perspectives concerning their role while educators and in relation with the way they work with their peers. That is, perspectives which enable science teachers to take more effective decisions at the level of management, planning and organization of the curriculum, namely in relation to the disciplines of the Physical and Natural Science area².

Taking as a starting point that scientific knowledge is not constructed only through the daily experience and that teachers have the responsibility, respecting the age level and the social-cultural contexts of the pupils, to fit and to systemize the learning process, it has been established, in the scope of the purposes of science education, three important challenges: *"to enhance the taste for science; to increase the scientific literacy of all the citizens and to prepare for the continuation of the studies"* (Galvão, 2002: 8). However, this author reinforces the idea that the conciliation of these requirements may present some difficulties and also that those challenges may be only acquired if the curriculum concept overcomes the meaning of the sum up of isolated and fragmented disciplines. In other words, when it is assumed that the curriculum refers *"always to a set of learning experiences considered as necessary in a given context and time as well as to the organization and sequence adopted to materialize or to develop it. This set of learning outcomes does not result of an addition of parts. What modify a set of learning outcomes into a curriculum is its finalization, intentionality, coherent structure and organized sequence."* (Roldão, 1999: 43).

The curriculum, in a theoretical and macro perspective, is a political proposal that systemizes the fundamental options in relation to the pupils' learning outcomes. However, in practice, the curriculum is assumed as a project when, through the intervention of different actors, *"it is constructed and (re)constructed in function of different curricular perspectives that guarantee the adequacy and the integration of the realities of each context in particular"* (Martins, 2005: 40).

¹ National Curriculum for Basic Education – Fundamental Competences.

² In the Portuguese educational organization, and at the level of schooling of pupils of 13 to 15 years old science teaching is developed in the scope of two different disciplines, namely, "Natural Sciences" and "Physics and Chemistry Sciences", and therefore taught by two different teachers. Both disciplines, however, belong to the same curriculum area: Physical and Natural Sciences.

Relating the curricular theory with the project perspective, Zabalza argues that the design of a curriculum implies the establishment of “*an educational project to be developed by the whole team of teachers in a school*” (1992: 90). Roldão, conceptualizing about the curriculum concept as a project, also argues that it includes “*the particular form as, in each context, the curriculum is (re)constructed and appropriated taking into account a given real situation, by defining proper options and intentionalities and by constructing specific ways of curriculum organization and management, adjusted to the achievement of the learning outcomes that integrate the curriculum for the concrete pupils of that context*” (1999: 44).

The process of curriculum management, that is, the orientation and justification of the curricular options taken and the attitude “*to think other forms of doing that may be more successful*” (Roldão, 2001: 65) allow the construction and the development of integrated curricular projects. However, the assumption of this curricular practice is possible only if, on one hand, the teachers and the pupils assume their role of researchers and curriculum’ builders and, on the other hand, the process of curriculum development is a collaborative, rigorous, justified, spontaneous and pleasant act, assuming itself as “*a gradual and continuous process, involving observation, reflection and adjustment of the orientations and the pedagogical practices*” (Abrantes, 2001: 42).

Being a common framework, the National Curriculum for Basic Education intends to assure the equity and the achievement of the learning outcomes by all pupils. The option for a competence approach is, so to speak, one way to give meaning to the curricular diversity that, in each particular context, can be developed, either in the scope of the curricular projects, or in the context of its organizations and managements. Following Roldão, competences “*become the reference axle of this process [...] [and] they are instituted as a guaranty of a common appropriation of knowledge, in order to become knowledge in use, mobilized, active - and not inert, fragmentized, encyclopaedic in formats of intellectual and social immobility*” (2004: 181).

This curricular perspective intends to contribute for an integral formation of the pupils, leading, in the future, to the success and personal accomplishment of each individual in the social-cultural context of the plurality of the societies and the heterogeneity of the citizens. Its realization, in practice, assumes that teachers,

while decision-makers and curriculum builders, develop, collaboratively, pedagogical and differentiated strategies that mobilize attitudes, values, knowledge, experiences and other personal, cultural and social components of the contexts and life of pupils. Indeed, in the scope of the development of the specific competences of the area of Physical and Natural Sciences, it is suggested the promotion of educative experiences that fit in a Science, Technology and Society perspective (CTS) and are based on problem solving situations, give the pupils the possibility to analyze the social role of science and technology, making them become accessible, and facilitating the public participation and the decision-making related with scientific and technological aspects.

The presence of such perspectives in the Physical and Natural Sciences curriculum assumes, on one hand, greater rates of collaborative work among teachers and, on the other hand, that the emphasis should be in the promotion of more demanding educative experiences, in order to make possible that the pupils “*point out the learning experiences in the context of scientific process and the nature of science*” (Galvão & Freire, 2004: 32, quoting NRC, 1996). However, this challenge will only occur if teachers would change their conceptual frameworks and attitudes so that their practices can be characterized by the presence of more collaborative ways of work and more effective learning situations with their pupils. Indeed, the studies developed by Abelha (2005) and Martins (2005), under the supervision of the other two authors of this presentation, place themselves in the interface of this problematic and contribute to characterize science teachers’ dynamics of work and curriculum practices, in the scope of the implementation process of Curricular Reorganization for Basic Education.

2. RESEARCH PROBLEMS AND METHODOLOGY

The publication of the Portuguese Law n.º 6/2001, of 18th of January, containing the general guidelines of the Curriculum Reorganization Process for Basic Education³, has defined a new

³ Basic Education in Portugal is constituted by three cycles: 1st, with four years (pupils aged from 6 to 9 years old); 2nd, with two years (pupils aged from 10 to 12 years old) and 3^d, with

understanding for the concept of curriculum and has established a new curricular organization. The effect of this law started in the school year of 2001/2002 for all school years of the 1st and 2nd cycle of Elementary Education. Pupils of the 3^d cycle were integrated, per each year of schooling, in the three following school years.

With the promulgation of the above mentioned Law, the Ministry of Education intended to start a long process of change in Basic Education. Thus, facing to a centralized educational system with an encyclopaedia, normative, prescriptive and transmissible nature, the Ministry aimed to undertake a significant transformation, which main changes have been focused at the levels and at the actors of the decision-making and at the abandonment of a curricular management logic centred, conceived and monodirected by the central administration and fulfilled by the schools and the teachers. In other words, this change process aimed at the abandonment of a *logic of pure rationality technique* [...] [and] *the introduction of a logic of a bipartite management, or in bionomic*" (Roldão, 2004: 180). Thus, in order to guarantee the equity and the achievement of a common learning framework for all pupils, it has been defined, at the central level, the National Curriculum, which appropriation and (re)conceptualization must occur at each School level, through the development of school curricular projects, which on the basis of the specificities of each group/classroom should be adjusted and contextualized in each classroom curricular project.

However, the changing processes are not either linear or immediate. They result from learning processes and appropriations that are translated on personal (re)conceptualizations and (re)constructions, based, necessarily, in formative, monitored and evaluated processes, both at the attained performances level and at the own changing process.

The study presented in this paper intends to assume itself as a contribution to the understanding of the impact of the implementation process of Curriculum Reorganisation for Basic Education. More specifically it aims to contribute to the understanding of changes that may have occurred at the level of curricular practices as well as at the dynamic of the working process among teachers. Notice that the theoretical framework and the results to be presented had its origin in the

three years (pupils aged from 13 to 15 years old). Theses nine years of school correspond to compulsory education.

development of two master research projects, in the context of the Master in Curricular Management, at the University of Aveiro. These two research projects have the following references: "Competences in Physical and Natural Sciences - Conceptions and Practices of Elementary School Teachers" (Martins, 2005) and "Teaching Culture at the level of Science Department: a case study" (Abelha, 2005).

The research project, which has been developed by Martins (2005), had as its central question the following problem:

"How are teachers, at 1st cycle and 4th group of 2nd cycle⁴, appropriating the actual curricular approach based in the development of competences, in particular those defined for the Physical and Natural Sciences curricular area?"

Underlying the statement of this problem some research questions had been defined as well as the following four central aims: 1) To identify 1st and 2nd cycle teachers' conceptions about the concept competence; 2) To characterize possible changes in their practices while promoting a teaching process based on the development of pupils' competences; 3) To identify eventual reasons which restrain their practices in the context of the development of pupils' competences in the field of Physical and Natural Sciences; 4) To propose guidelines for teachers' professional development capable to promote an attitude towards life long learning and the continuous formation, namely at the level of Physical and Natural Sciences curriculum management.

The empirical study underlying this research was developed at two distinct moments and had, essentially, a quantitative approach. However, and in order to further understand the object under study, the research was complemented by a qualitative study. In the first moment, the most significant of the study, a questionnaire was designed and administrated, in the district of Aveiro, to a total of 2 384 1st cycle teachers and to 526 2nd cycle, and 4th group, teachers. In the second moment, and in order to characterize possible changes on teachers' practices, a group of five teachers, among those who answered the questionnaire and showed their availability to

⁴ While at the 1st cycle teachers are generalist and so do not belong to any particular disciplinary group, teachers at the 2nd cycle teach specific disciplines and so belong to different disciplinary group. 4th group includes teachers who teach Mathematics and Natural Sciences.

collaborate in the study, were selected on the basis of criterion of good practices. To those teachers, three of 1st cycle and two of 2nd cycle, a semi-structured interview had been carried out aiming to collect data for a more detailed characterization of their conceptions and practices at the level of their appropriation of the current curricular approach for Elementary Education, of the teaching practices they say to promote with their pupils, while answering the questionnaire, and the selection and justification of pedagogical materials they use in their classrooms for developing pupils' competences in the Physical and Natural Sciences area. The data was collected between the months of January and May of 2005 and, in accordance with its nature, analysed with statistical and content analysis techniques.

The research project developed by Abelha (2005) was focused on the professional culture of the teachers in the context of the Science Curriculum Department of a given School. The research problem was formulated in terms of two interrelated questions, namely:

“What kind of Professional Culture is promoted at the Science Curricular Department?” and “What suggestions can be made in order to promote a professional culture in accordance to up-to-date theoretical frameworks?”

This research problem was unfolded into several questions which originated the following central aims of the study: 1) To identify science teachers' conceptions, belonging to the same Curricular Department, relatively to the concept of Collaboration; 2) To understand the potentialities and the constraints of the way the Curriculum Department is structured in order to promote a collaborative way of work among teachers; 3) To characterize the way teachers manage the science curriculum, at the departmental level, and; 4) To propose guidelines for the promotion of a Professional Teaching Culture, in the context of a Curricular Department, in accordance with up-to-date perspectives on teaching professionalization in general, and on science teachers in particular.

Given the purpose of this study, which included the comprehension of a given phenomenon in its natural context, the empirical study carried out had a predominantly qualitative approach. The empirical methodological design chosen was the Case Study. The Case was the Science Curricular of a Secondary, with 3^d cycle, School located at the district of Aveiro. The data was collected

during the school year of 2004/2005 and the main techniques used were: Inquiry through Questionnaire, administered to the twelve teachers of the Department; Inquiry through Interview, of a semi-structured format, conducted with the Coordinator of the Department and, also, with two teachers who taught the same scholar year; Documental Analysis and Observation. The techniques used to analyse the data were statistical and content analysis.

3. MAIN RESULTS

The curricular approach, defined in the Law n.º 6/2001, of 18th of January, is based on the curricular autonomy of teachers and schools and perspectives the development of competences on and with the pupils. However, it is our understanding, that this curricular approach implies a set of changes on the teaching action, the organization and dynamics of teacher's way of working as well as on the role they play in school and in classroom. The results of the studies mentioned above have been organized in the three following levels: I) Conceptual Appropriation; II) Changes in Practices and III) Implications for Curriculum Management.

I) Conceptual Appropriation

As we have already mentioned the concepts of “Curriculum”, “Competence” and “Collaboration” assume a particular relevance in the context of the implementation process of the Curricular Reorganization of Basic Education, reason why we have considered as important to identify to what extent they have been appropriated by teachers, as well as the meaning they attributed to them. The results of the application of the questionnaire and interview allow us to say that, for the majority of the participant teachers, the “Curriculum” concept is not restricted to the program and to the set of normative rules that they have to fulfil in their classrooms. More than 65.0% of the inquired teachers had agreed with the statement: *“The curriculum is a project that it is constructed and it (re)constructed in function of the intervention and the intencionalities of the different actors”*.

The concept of “Competence” is, however, still very diffuse and far from being appropriated correctly for the generality of the respondent teachers as well as to those with whom they work.

Despite the fact of that teachers stated that they had felt the need to search and reflect on this new concept. Effectively, the crossing of the data obtained from the questionnaire and the interviews allows to verify the existence of difficulties in distinguishing the concept of “Competence” from the concepts of “Aims”. The emerged interpretation is that *“the concept of “Competence”, and despite the fact the it already exists in the lexical discourse of the teachers, is still confined to the speech politically correct and to the terminology to be used in the official documents”* (Martins, 2005: 209).

In what concerns the concept of “Collaboration” the results show that it’s meaning, according to the teachers, is *“as a personal will that results from a conscious and felt effort and not as a set of inflexible obligations that only lead to a false collaboration”* (Abelha, 2005: 164-165). In the context of the Curricular Department, all the inquired teachers stated the existence of collaboration, being this situation a result of the good established interpersonal relationships among all of them. However, the collaborative situations occurred, mainly, at the level of the sub-groups of work (constituted by teachers who taught the same discipline and the same school year) *“(…) where the development of the annual and short/medium planning, done on the basis of the distribution of the contents of the disciplines, are the mote which generates the effective discussion and sharing of opinions among the teachers of the related sub-groups of work. However, rarely, there is a debate and a sharing of experiences among all teachers of the Department”* (Ibid.: 165). Given this result, we tend to state that we are, inside the Department, in the presence of what Hargreaves calls the balkanized culture. This interpretation results from the fact that the data collected show the existence of concerns in establishing articulations among the teachers belonging to the same sub-working group, and not among teachers belonging to different sub- working groups. We, therefore, believe to be in the presence of what Hargreaves (1998) designated by *“reduced permeability”* which hide the true collaboration culture.

II) Changes in Practices

The implementation process of Curricular Reorganization of Basic Education has not induced the majority of the respondent teachers to introduce changes in their practices. However, we point out that in the logic of the current curricular

approach *“the competence institutes itself as the guarantee of a common appropriation of knowledge, which turn itself in knowledge in use, mobilized, acting - and not inert, fragmented, encyclopaedic, hidden in formats of intellectual and social immobility”* (Roldão, 2004: 181). Thus, this meaning of competence implies transformations in practices and, consequently, the introduction of changes. Therefore, we consider that if the generality of the respondent teachers did not feel the need to introduce alterations in their practices this is because they have not yet appropriate themselves the correct meaning of competence. *“This not existing appropriation may be a result of a set of factors associated with the professional culture and the consequent passive position of many teachers; to the insufficient domain of the theoretical meaning of the concept; to the way schools function as an organization marked by “utilitarian” logics and to the absence of an effective evaluation of the teaching performance and its consequences in the educative success/ failure of the pupils”* (Martins, 2005: 211).

This consideration is supported by the results emerged in relation to the frequency that the respondent teachers affirmed to use some of the learning experiences suggested by the document “Currículo Nacional do Ensino Básico – Competências Essenciais” (DEB, 2001), to promote the development of competences in the area of the Physical and Natural Sciences Curriculum, on and with the pupils. Effectively, one of the learning situations suggested on the official curricular document is outdoor activities, such as field work involving the observation of the natural environment. However, the results show that only a relatively small percentage of respondent teacher affirm to carry out such teaching approach (less than 50.0%). Another experience, which is also suggested, is experimental work and, in this case, the majority of the 1st cycle teachers (70.0%) affirmed to use such approach. However, only one minority of 2nd cycle teachers (18.0%) declared to carry experimental activities with their pupils.

From these results some considerations should be made. Namely, the fact that the use of experimental work has not been considered a priority formative experience and a common practice for the development of specific competences in the Physical and Natural Sciences Curriculum area. Such result may mean that those teachers’ practices have, in general, a theoretical and expositive dimension, which is not in

accordance with the actual Science Education trends. Namely it differs from the perspective of "Teaching through Research" and from the Science/Technology/Society (CTS) approach. It differs, also, from the suggested curricular orientations for the development, on and with the pupils, of the specific competences of the Physical and Natural Sciences curricular and, in particular, those referring to the promotion of scientific literacy. The crossing of the data with that resulted from the analysis of the interviewed teachers allow us to conclude that, effectively, *"the generality of the respondent teachers did not modify substantially their practices, as the interviewed teachers had pointed out that the program and the textbook are still very valued by the generality of their peers and that this process of change is quite slow as it opposes the installed routine and the naturalized practices"* (Martins, 2005: 213).

Not relegating the nature of these results and the inferences that emerge from them, the implementation process of Curricular Reorganization of Basic Education presents some added-values, namely the promotion of collaborative ways of work among teachers, fact corroborated by the generality of the respondent teachers. Effectively, the interviewed teachers stated that the initial phase of the implementation process of Curricular Reorganization was characterized for *"a peak of collaborative work"* (I1 Teacher) and that, at that moment, the collaboration among peers was quite common. They affirmed, however, that, in reality, the results of such collaborations are still few, both at the level of the teaching and learning processes and at the level of pupils' academic success.

The study developed by Abelha (2005) is in accordance with the above described situation, as it shows that the implementation process of Curricular Reorganization of Basic Education, that suggests that the Natural Sciences teachers should work collaboratively with the Physical and Chemical Sciences teachers, has not changed the organization of the Curricular Department Organization under study. Indeed this Department only includes Natural Sciences teachers. And despite the fact that it has been requested in a joint meeting of the two departments that the teachers who were teaching the curricular area of Physical and Natural Sciences should meet regularly in order to work collaboratively in the promotion of a more effective management of the Physical and Natural Science Curriculum, the truth is that the so called *"meetings work"* had occurred only

twice and that the teachers continue "to manage" the curriculum in an isolated and independent way. Such fact was explained by the Coordinator of the Science Department as being a feature of the *"formation and culture of the teachers"*.

However, we consider that the fact that similar disciplines are aggregated in the same department may enhance the development of collaborative work, but we think that the not inclusion of these disciplines in the same department should not justify the absence of collaborative work among teachers.

Having into consideration that in schools the curricular departments are the intermediate management structure that congregates teachers who teach similar disciplines, it requires the importance to analyze its organization and work dynamic. The study developed by Abelha (2005) allows to know that, inside the Curricular Department, the levels of collaboration occurred mainly among teachers who taught the same discipline and school year, that is, it occurred at the level of the sub-groups of work which criterion of formation was exactly to be constituted by the teachers in such professional situations. The results also show that the collaboration was concerned with *"the sharing of planes and pedagogical materials; the clarification of eventual doubts; the planning of experimental activities and of study visits; the elaboration and resolution of work sheets; the conception of pedagogical models and the exchange of experiences and strategies"* (Abelha, 2005: 165-166).

Assuming as reference the results of this study, the main potentialities designated by the teachers who developed collaborative practices were seen as covering aspects such as: the *"identification and resolution of common difficulties, situations that diminishes anxiety, fear and uncertainty feelings"*; the *"enhance of creativity promoted by the exchange of ideas and discussions"* and the *"improvement of pedagogical practices"*. Although, following the respondents' opinions, these improvements take place mainly in extra classroom activities, such as study visits, clubs, among others. The improvement of the quality of the experimental work in classroom situations was also, however, mentioned.

Relatively to the promotional conditions of collaborative work, and with exception of the good interpersonal relationship, the teachers emphasized situations external to themselves, such as: *"compatibility of schedules"*; *"physical*

conditions of the working rooms” and *“stability of the staff”*. In our understanding the prevalence of external conditions denotes the absence of compromised and responsibility attitudes with respect to the true concept of “Collaboration”. This idea is strengthened by the kind of aspects that were pointed as the main constraints towards the development of collaborative work, namely: the *“absence of an available and adequate physical space”*; the *“scarce availability on the part of the teachers”*; *“the big number of requests due to the performance of other pedagogical functions”* and *“the exaggerated number of meetings that show to be tiring and not productive”*.

Despite the difference in the approach and the scope of the two studies under reference (Abelha, 2005 and Martins, 2005), and that the above mentioned results reflect the particular situation of a group of professors who, in the school year of 2004/2005, constitute the Science Curricular Department of a given School, it is possible to establish transversal dimensions between the results of both studies. Effectively, the results from the study developed by Martins (2005) showed, in the same trend, that the generality of the respondent teachers reported to external reasons, when questioned about eventual constraints of their practices in what concerns the development of pupils’ specific competences of the Physical and Natural Sciences Curriculum. In a decreasing order, the main constraints had been: *“extreme teaching mobility”*, the *“lack of coherence, clarity and continuity on educational policies”*, the *“existence of an inadequate structure and organization in the schools”* and the *“reduced coordination and articulation among teachers”*. Talking about these constraints, the interviewed teachers referred also to the *“difficulty in carrying out study visits”*, the *“lack of time to reflect upon the situations”*, the *“physical and material constraints”* and the *“common tendency to judge the others for what happens”*.

Effectively, if we analyze the nature of the referred constraints we verify that, in its generality, they refer to external situations, emerging from that an image of impotence and incapacity to deal and/or to overcome adverse conditions and situations. However, we believe that many of the constraints to the development of practices in accordance with the actual curricular perspective are located at the personal level and at the level of the existing and dominant professional and organizational culture. In other words, they

are due, at some extent, as a result of a scarce auto-implication of the teachers and in the distance of their practices with respect to the concept of teaching, that is, *“to make that somebody learns”* (Roldão, 1999, 2003).

If we establish a parallelism with the results presented at the level of the “Conceptual Appropriation”, we consider that the generality of the respondent teachers did not yet overcome the level of the underlying appropriation to the politically correct speech and to the normative culture, predominating still with an extreme concern with the fulfilment of the program and the textbook, in detriment of a critical analysis and questioning, both at the personal level and among peers. Despite the intrinsic risk and uncertainty of any process of change, from the results found *“emerges the idea that the change is not actually so necessary or welcome, as it causes (re)conceptualizations, an increased work and effort and that, as such, it is easier to avoid the changes or to delay them as much as we can. Such idea comes, also, from the lack of visibility of the utility and effectiveness of the change, always invoked as ideologically good, but, rarely, evaluated in what concerns its need and effectiveness”* (Martins, 2005: 214).

III) Implications for Curriculum Management

The concept of “Curriculum Management” assumes the decision of *“what to teach and why, and, when, with what that priorities, with what that means, with what organization and results”* (Roldão, 1999: 25). Also, the present concept of “Curriculum” represents, on one hand, a permanent construction of practices, involving cultural and social meanings and, on the other hand, an instrument that aims to help the analysis and the improvement of the educational decisions.

The official curricular document *“Currículo Nacional do Ensino Básico – Competências Essenciais”* (DEB, 2001), trying to establish a unit and correlations between the learning outcomes throughout basic education, privileges a cycle of study organization and on curricular disciplinary areas. Thus, in the area of Physical and Natural Sciences the learning outcomes to be achieved are together in a discipline “Study of the Environment”, at the level of 1st cycle; of “Natural Sciences”, at the level of 2nd cycle and of “Natural Sciences” and “Physics and Chemistry”, at the level of 3^d cycle. Such reorganization of the learning experiences by itself, assumes a new perspective for the understanding of the

curriculum in Basic Education and, therefore, the need of a coherent and effective curricular management of the learning experiences to develop on and with the pupils. From this one can see an increased reinforcement of the competences of the Curricular Department, while intermediate curricular structure that congregates teachers who teach several discipline that are included in the curricular area of Physical and Natural Sciences.

Focusing her study on the professional culture within a Science Curricular Department, the results of the study developed by Abelha (2005) indicated that in the department under analysis, the management of the science curriculum was, essentially, done vertically. For Alonso (2002), a type of predominantly vertical/disciplinary curricular management causes some limitations to the development of pupils' learning outcomes, in particular: absence of contextualization of the learning experiences and problems with the meaning of the learning outcomes to be achieved, generating, therefore, a lack of motivation and the predomination of a simplistic vision, fragmented and not dynamic of the reality, caused by pupils' difficulties in establishing connections among the different learning experiences.

The analysis of the results of this study has brought evidence that teachers organize themselves in sub-groups according to the school level and the disciplines that they are teaching. Therefore the supremacy was given to the disciplines contributing, in this way, to the fragmentation of teaching. Joining themselves informally in the teachers' room, according to the availability of the members of the working teams, *"the purposes of these sub-groups of work [...], in accordance with the opinion of the interviewed, [were]: to clarify doubts and to change experiences; to find strategies about how to develop certain contents; elaboration and resolution of work sheets; common planning and searching"* (Abelha, 2005: 170). On the other hand, the articulations among contents and strategies established among teachers were one common practice at the level of the sub-groups of work. However, little common discussed occurred among teachers of distinct working sub-groups and practically inexistent discussions occurred among teachers of different departments, as can be seen by the following statement: *"Sincerely it is not my concern to articulate contents and activities with my Colleagues of the department who taught disciplines different from mine (...)"* (I B).

In summary, an effective management of the Physical and Natural Sciences curriculum assumes bigger rates of collaboration among teachers, not only at the intradepartmental level, but also at the interdepartmental level. Actually, an effective culture of collaboration among teachers seem to be a possible and efficient way to brake the borders between the learning experiences of the different disciplines, enabling, also, pupils' appropriation of knowledge in the perspective of *"a wide discipline"* and not as an addition of disciplinary knowledge, isolated and with strong barriers.

Reflecting upon science education and assuming the present random and chaotic nature that characterizes the relation among Science/Technology/Society/ Development, Veiga (2003) considers that Science Education (and for the Science) is one of the better located area to promote in pupils the construction of a theory of comprehensibility for action. However, the results of the studies described above seem to indicate that, beyond a scarce culture of collaboration, the participant teachers show, as well, a lack of formation and of co-commitment what makes it difficult for them to appropriate the present curricular perspective and, therefore, the management of the Physical and Natural Sciences Curriculum, in order that their practices promote on pupils the construction of the desirable theory of comprehensibility for action.

In this way, we think that to the present initial and continuous teacher education systems should be imposed the need to define guidelines which make the science future teachers, and the teachers, become more aware of the relation among Science/Technology/Society/ Development. It should also be stated that the teachers' educators should have *"the duty to imagine and to explore new possibilities of educating future teachers [and in-service teachers], through the development of projects that can contribute to the reconstruction of values of solidarity, freedom, responsibility and human dignity, in an "unquite" and not "stable" style of the emergency of an emancipator knowledge"* (Veiga, 2003: 15).

4. FINAL COMMENTS

The official document, *"Currículo Nacional do Ensino Básico – Competências Essenciais"* (DEB, 2001), is the educational national framework for compulsory education and which has been

designed aiming to promote better educational performances, in a context of equality and equity, so that pupils can achieve, through diverse and contextualized school experiences, a solid appropriation of a set of efficient and usable learning outcomes. This aim is deeply articulated with a teaching process based on the development of pupils' competences. In fact, the curriculum design that is being proposed presents and constitutes an opportunity for the development of pupils' competences through more significant learning experiences which may promote the *knowing how* when they are facing complex and opened situations that characterize our society.

The effective appropriation of the concepts of "Curriculum", "Competence" and "Collaboration" assume a crucial relevance for the success of the implementation process of Curricular Reorganization for Basic Education in Portugal. One notices that the competence "*functions as the way to give meanings to a possible and desirable curricular diversity, given the diversities of the contexts, the organizations and the managements that the school projects have (or should have), in the real curriculum of the different schools and situations*" (Roldão, 2004: 181).

However, and although the generalization of the Process of Curricular Reorganization of Basic Education was initiated in the school year of the 2001/2002, results emerging from several empirical studies allow us to affirm that the appropriation of the concept of "Competence" still is in an embryonic phase, with some confusions and uncertainties. Which, considering the answers of the teachers involved in these studies, are evident in their difficulties in managing the Physical and Natural Sciences curriculum; in the scarce levels of collaboration among them; in the weakness of the changes introduced in their practices which, in general, only occur at the level of their speech as well as on the lack of information, auto-implication, evaluation and formation that still persist.

The results also show that the concern of the generality of the respondent teachers is, still, at the level of the political correct speech and at the normative culture. Therefore, one still has at the school level: an individual way of work among teachers; the fulfilment of the "official curriculum", whose visible face is the textbook, and the fulfilling of institutionalized and uniform documents, conceived with the intention to answer to what is politically correct. Therefore, the analysis and the critical questioning do not

seem to be a common practice among teachers, both at the level of their conceptual appropriations and at the level of the impact on the curriculum management process and on their practices.

The changing processes are continuously interactive and dialectic and they count on the auto-implication of all the actors involved. Despite the fact the one of results emerged from the empirical studies was, in the teachers' discourse, the increasing of the rates of collaborative ways of work among teachers, one has noticed that this has not been translated in effective changes in teachers' practices, in promoting but also on the development of significant pupils' learning experiences. In fact, the relation that the majority of the teachers establish with the collaborative process is not much deep, perhaps because it is "*difficult to work in teams or to invest in a collective dynamics of the school project*" (Perrenoud, 2002: 98). Therefore, one considers that to be a teacher in a Science Curricular Department that enhances a collaborative way of work demands a strong relation of belonging among all teachers as well as the sharing of values, beliefs and educational purposes. In fact, and despite the unquestionable indicators that point out to the need of higher rates of collaborative ways of work among teachers, the generality of the respondents is nor still aware of the added value that collaboration may have. However, Fullan and Hargreaves are quite strong when they affirm that "*nobody is an island. [...] If our workplaces include people who are important for us and that belong to our "other meanings", they will have one enormous capacity - positive or negative - to affect the kind of person we are and, therefore, the kind of teacher we become*" (2001: 71).

Lastly, the studies have shown that the lack of a collaborative culture makes impracticable an effective management of the Science Curriculum and that, on the other hand, can justify both the difficulties of the appropriation of conceptual changes inherent to the Process of Curricular Reorganization of Basic Education and to the development pupils' competences in Physical and Natural Sciences. On the basis of all these results one concludes that in order to contribute to the effective improvement of the quality of education and of the social and cultural progress, it urges the need "*to help teachers to work more effectively, in cultures of collaboration characterized by the sharing of learning, the positive risk and the continuous improvement*" (Hargreaves, 1998: 290). Definitely, "*the central question is not,*

therefore, to know what it is missing so that teachers can collaborate more, but what can be done so that teachers collaborate, when they wish and in a way that is professionally more rewarding and with more positive impact on their pupils” (Lima, 2002: 184).

It is desirable that teachers and schools are able to answer to the diversity and complexity of the needs of today’s society through the promotion of the development of responsible, critical, active citizens and, also citizens with scientific literacy. For such to happen, one considers urgent to differentiate, positively, and to value teachers who have embraced the changing process that underlies the appropriation of the actual curriculum approach, investing in the schools, mainly in formative projects centred on teachers’ needs. These projects, having as starting points both the results obtained in teachers’ curricular practices and on reflective processes, are assumed as potential ways to promote the necessary reflection, (re) adaptation and evaluation of the strategies to be adopted having into consideration the real contexts.

Indeed, the appropriation of the desired conceptual changes do not occur through official legislation, but it is a learning process that, supported by permanent auto-discoveries and creativity, arises from continuous constructions based on knowledge and collaborative work whose consequence, in every-day-life, is translated at the level of personal (re)constructions and (re)conceptualizations necessarily based, both on formation processes and on the production of knowledge. It is important also to note that changing process is not only to move from what it is, but to create and to (re)create something beyond what already exists. Indeed, the appropriation of the actual curriculum approach, based on the development of competences, depends, largely, on the teachers, as “*it continues to belong to the teacher an irreplaceable role, being the teacher one of the most important agents of change*” (Costa, Praia & Marques, 1999: 306). It emerges, thus, the need of a consistent effort that congregates perspectives of analysis and a coherent action from the Educational Central Administration, the Institutions of Formation, the Schools and the generality of the Teachers.

REFERENCES

- ABELHA, M. (2005). *Cultura Docente ao nível do Departamento Curricular das Ciências: um estudo de caso* (Dissertação de Mestrado). Aveiro: Universidade de Aveiro.
- ABRANTES, P. (2001). *Reorganização Curricular do Ensino Básico – Princípios, Medidas e Implicações*. Lisboa: Ministério da Educação – Departamento da Educação Básica.
- ALONSO, L. (2002). Para uma teoria compreensiva sobre integração curricular. *Infância e Educação – Investigação e Práticas*. Revista do GEDEI, 5, pp. 62-87.
- COSTA, N., PRAIA, J. & MARQUES, L. (1999). Educação em Ciência: Binómio Investigação – Formação. In V. Trindade, I. Fazenda, C. Linhares (Org.). *Os Lugares dos Sujeitos na Pesquisa Educacional*. Campo Grande: UFMS Editora, pp. 305-323.
- DEB (2001). *Currículo Nacional do Ensino Básico – Competências essenciais*. Lisboa: Ministério da Educação – Departamento da Educação Básica.
- FULLAN, M. & HARGREAVES, A. (2001). *Por que é que vale a pena lutar? O trabalho de equipa na escola*. Porto: Porto Editora.
- GALVÃO, C. (2002). O ensino das Ciências Físicas e Naturais no contexto da Reorganização Curricular. *Boletim da APPBG*, 17, pp. 7-15.
- GALVÃO, C. et al. (2001). Ciências Físicas e Naturais. In: *Currículo nacional do ensino básico – Competências essenciais*, pp. 127-146. Lisboa: Ministério da Educação – Departamento da Educação Básica.
- GALVÃO, C., FREIRE, A. (2004). A perspectiva CTS no currículo das Ciências Físicas e Naturais em Portugal. In: *Perspectivas Ciência-Tecnologia-Sociedade na inovação da educação em Ciência*. Martins, I. et al., pp. 31-38. Aveiro: Universidade de Aveiro.
- HARGREAVES, A. (1998). *Os Professores em Tempos de Mudança – O Trabalho e a cultura dos Professores na Idade Pós-Moderna*. Lisboa: McGraw-Hill.
- LIMA, J. (2002). *As Culturas Colaborativas nas Escolas*. Porto: Porto Editora.
- MARTINS, I. (2005). *Competências em Ciências Físicas e Naturais – Conceções e Práticas de Professores do Ensino Básico* (Dissertação de Mestrado). Aveiro: Universidade de Aveiro.

NÓVOA, A. (1999). *Os Professores na virada do milénio: do excesso dos discursos à pobreza das práticas*.

http://www.bibvirt.futuro.usp.br/textos/hemerotec/a/edp/edp25/edp25n1_01.pdf (consulta a 17 de Março de 2004).

PERRENOUD, Ph. (2002). *Aprender a negociar a mudança em educação: novas estratégias de inovação*. Porto: ASA Editores.

ROLDÃO, M. C. (1999). *Gestão Curricular: Fundamentos e Práticas*. Lisboa: Ministério da Educação – Departamento da Educação Básica.

ROLDÃO, M. C. (2001). Currículo e políticas educativas: Tendências e sentidos de mudança. In C. Freitas *et al.* *Gestão Flexível do Currículo – Contributos para uma reflexão crítica*. Lisboa: Texto Editora, pp. 59-68.

ROLDÃO, M. C. (2003). *Gestão do Currículo e Avaliação de Competências – As questões dos professores*. Lisboa: Editorial Presença.

ROLDÃO, M. C. (2004). Competências na Cultura de Escolas do 1º Ciclo. In A. Cachapuz, I. Sá-Chaves, F. Paixão. *Saberes Básicos de todos os cidadãos no séc. XXI*. Lisboa: Conselho Nacional de Educação – Ministério da Educação, pp. 177-197.

VEIGA, L. (2003). Formar para um conhecimento emancipatório pela via da Educação em Ciências. In L. Veiga (Coord.). *Formar para a Educação em Ciências pré-escolar e no 1º Ciclo do Ensino Básico*. Coimbra: Instituto Politécnico de Coimbra, pp. 13-29.

ZABALZA, M. (1992). Do currículo ao projecto de escola. In R. Canário (Org.). *Inovação e Projecto Educativo de Escola*. Lisboa: Educa, pp. 87-107.

Legislative References

Decreto-Lei n.º 6/2001, de 18 de Janeiro – Princípios orientadores da organização e da gestão curricular do ensino básico.