The *what* and the *how* of teaching and learning:
Going deeper into sociological analysis and intervention

Ana Morais
Isabel Neves
Delmina Pires
Department of Education & Centre for Educational Research
School of Science University of Lisbon

Revised personal version of the final text of the article published:
In J. Muller, B. Davies & A. Morais (Eds.), Thinking with Bernstein, working with Bernstein. London: Routledge (2004).
Routledge homepage: http://www.routledge.com/

THE *WHAT* AND THE *HOW* OF TEACHING AND LEARNING: GOING DEEPER INTO SOCIOLOGICAL ANALYSIS AND INTERVENTION

ANA MORAIS, ISABEL NEVES AND DELMINA PIRES

Introduction

This paper presents a study focused on primary school science learning contexts and addresses one of the major research areas of the ESSA Group, the characteristics of pedagogic practices most favourable to the acquisition of scientific knowledge and competences by students of different social backgrounds. It is based on Bernstein's theory of pedagogic discourse and Vygotsky's social constructivism and asks which modalities of pedagogic practice are more favourable to the acquisition of scientific knowledge and competences by *all* children. Our studies have shown that the effect of pedagogic practice can overcome the effect of children's social background and suggest a mixed pedagogy for successful scientific, social and affective learning (Morais and Neves 2001) and indicated how teachers' conceptual demand[1] with respect to scientific knowledge and investigative competences, is influenced by the social context of the school (Domingos 1989b; Miranda and Morais, 1994).

The study starts from these results and goes deeper into classroom analysis in order to search for a more comprehensive and detailed picture of the relative importance of each characteristic of pedagogic practice and their interplay for effective learning. We attempt to distinguish the characteristics of a practice as a whole and separately. With this objective in mind we have considered the:

a) sociological characteristics of pedagogic practices that lead to the success of *all* children;
b) interaction between children's social background, pedagogic practice and scientific learning; and
c) interactions between the distinct characteristics of a pedagogic practice that make for better scientific learning.

The first and the second questions require consideration not only of the *how* of teaching and learning (classroom social contexts) but also the *what* (scientific knowledge and investigative competences) distinguished by degree of conceptual demand and status. For that reason *the what of learning* was taken as a sociological characteristic. Teachers can variously recontextualize the same scientific subjects not only on the basis of epistemological and psychological but also sociological assumptions. They can implement pedagogic practices with low levels of conceptual demand, promoting fundamentally terminological and factual learning and appealing to low level investigative competences, limiting children to acquisition of simple cognitive competences that privilege memorising and low level understanding and observation. Teachers can also seek to implement pedagogic practices involving high levels of conceptual demand when they promote learning processes based on conceptualising and applying knowledge and developing of competences with investigative potential, such as in problem solving. Such practices promote the development of complex cognitive competences and access of *all* children to texts more highly valued by the scientific community and society. The *what* considered in our studies is, therefore, not related to the scientific themes to be learned but to the conceptual level at which they are intended to be learned.

In our third research question, we wanted to achieve deeper understanding of the extent to which some characteristics of the social classroom context, highlighted in earlier studies, constitute limiting factors to others and the relative importance of each. In particular, we sought to understand how conceptual demand, in terms of scientific knowledge and investigative competences, the *what* of learning, may be a limiting factor for characteristics of the classroom social context, the *how* of learning. A complete description of the research is available in Pires (2001).

Theoretical Framework

The study is based on Vygotsky's ideas (1978, 1992) about the child as an active learner and of the role of the teacher as creator of social contexts that enhance

learning. It is particularly focused on Bernstein's theory of pedagogic discourse (Bernstein 1990, 2000) in defining those contexts, the interactions which occur in them and in analysing the influence they may have on children's scientific learning.

For Vygotsky, learning involves the social construction of knowledge for which the nature of the social interaction the teacher promotes in the classroom context is fundamental. For that learning to be meaningful and allow the development of the total cognitive potential of children, teachers must promote learning processes which go beyond children's actual to exploring their potential development through the creation of the zone of proximal development.[2] This requires teaching-learning processes that are not based on low level conceptual demand and implies that children learn in contexts which allow dialogue and interaction with others.

According to Bernstein, the nature of social interaction that characterises given teaching-learning contexts at the micro-level of the classroom is a consequence of power and control relations between subjects, discourses and spaces. Classification (power) and framing (control) are conceptual instruments used to characterise the *how* of pedagogic practice, both instructionally and regulatively. In instructional contexts, discursive rules of selection, sequence, pacing and evaluation define teacher-child relations using distinct values of framing. Stronger values characterise theories of instruction more centred on the transmitter and weaker ones those more centred on the acquirer. Intra-disciplinary, inter-disciplinary and academic/non-academic relations between discourses are characterised by distinct values of classification. Strong classification of intra-disciplinary relations entails clear boundaries between various scientific contents to be learned within disciplines and weak classification entails blurred boundaries. These lead to smaller or greater conceptual articulation between the various contents of a discipline. Strong classification of inter-disciplinary relations and between academic and non-academic knowledges indicates higher status given to knowledge of a discipline, relative to that of others in the curriculum and to academic knowledge, relative to the non-academic knowledge, respectively. Whenever knowledge from other disciplines and non-academic knowledge is allowed to enter

subject classrooms, classification between them becomes more blurred. In the regulative context of pedagogic practice, hierarchical rules that define communicative relations between teachers and children and children themselves can be characterised according to distinct framing values. Strong framing shows communication with heightened control by teachers and children of higher social status, respectively and weak framing of communication where all children, including those of lower social status, have some form of control. Relations between spaces also have distinct classification values. Teachers' and children's spaces and those of children of distinct socio-cultural backgrounds, gender and achievement may be strongly classified and bounded or have weak or blurred boundaries.

Methodology

The study took two years and followed a rather unusual action research methodology, rejecting both analysis of the empirical without an underlying theoretical basis and uses of theory which do not allow for its transformation on the basis of the empirical. Rather, we have used an external language of description, as advocated by Bernstein (2000), whereby the theoretical and empirical are viewed dialectically. Researchers and teachers were always strongly classified, with the possibility of varying control relations (see Afonso 2002; Neves, Morais and Afonso 2004, in this volume).

Sample

The sample was made up of four female teachers in four fourth year (age 9–10) primary school classes, in schools located in two country towns. They taught 91 children (39 boys and 52 girls) from families differing by socio-economic level in terms of fathers' and mothers' academic qualifications and occupations.[3] They were grouped in three categories: working class (WC), lower middle class (MC^-) and higher middle class (MC^+).[4]

Figure 6.1 here.

Methodological procedures

The first year of the research was dedicated to intensive teacher training involving learning about scientific content and processes and pedagogical contents, particularly Bernstein's theory and related research. It was also dedicated to the piloting of one teaching unit by each teacher and the construction of instruments to characterise teachers' pedagogic practice in terms of Bernstein's concepts of classification and framing. Two teaching units and relevant materials were constructed and delivered during the second year of the study.

Instruments were devised to analyse teachers' practices during the first and second stages of the study in terms of the relations between subjects (teachers, children), discourses (intra-disciplinary, inter-disciplinary, academic/non-academic) and spaces (teacher's space, children's spaces) present in the classroom context. They guided teachers' actions in their classrooms and were used to characterise the pedagogic practices that took place. Each relation analysed had several indicators measured on a four point scale of classification and framing, from very strong to very weak (C^{++}, C^{+}, C^{-}, C^{--}; F^{++}, F^{+}, F^{-}, F^{--}). The number and type of indicators for each relation varied according to the instructional and regulative context under analysis. The results obtained made it possible to characterise the pedagogic practice of each teacher in relation to the characteristics of the theoretical profile of the practice that they were intended to implement. These characteristics had been suggested by former studies as having the potential to promote favourable learning by all children (Morais and Neves, 2001).

Our methodology was based on a dialectical relation between the theoretical and the empirical. We developed an external language of description so that the notion of Bernstein's internal language of description could guide observation and the empirical data obtained provided a basis to define indicators more adequate to the relations

under analysis. Thus, the instruments contain textual indicators of the specific characteristics of the contexts under study.

Figure 6.2 exemplifies an extract from the instrument used to characterise the instructional context of the pedagogic practice with respect of the discursive rule sequence and one of the indicators used in the analysis of this rule. This is followed by transcripts, obtained from classroom observation which show two values of framing on a four point scale.

Figure 6.2 here.

Having characterised each teacher's actual pedagogic practice over two teaching units, we determined its degree of approximation to the theoretical profile previously planned, on a four point scale, for both instructional and the regulative contexts, over twelve characteristics in all.[5] The value 4 was given whenever a teacher's practice was similar to the theoretical profile with respect to the characteristic under analysis and 1 was given whenever practice was distant from the theoretical profile.[6] The total of points possible for each teacher on all twelve characteristics of the practice, like the total of points for the theoretical profile, was 12 x 4 = 48. Their juxtaposition gave us a profile of teachers' pedagogic practice in relation to the theoretical profile of effective teaching that we had derived from past research, in terms of the *how* of learning.

We also characterised practice in terms of the *what* of learning (teacher's scientific competence) using data obtained from classroom observation and other data collected in the course of the teachers' training process. This characterisation considered both scientific knowledge and investigative competences. For each, a 4-points scale was again constructed, where higher values of the scale (2x4, maximum of 8) represented higher teacher scientific competence and lower values (minimum of 2) represented lower competence. In all modalities of pedagogic practice power relations between teachers and children were strongly classified; teachers having higher status in the

pedagogic relation and determining both organizational and communicational features of the teaching-learning context.

Figure 6.3 shows the position of each teacher in terms of the *what* and the *how* of their pedagogic practice in delivering the two teaching units. The table also shows, for their pedagogic practices as a whole, the percentage of the theoretical practice achieved by each teacher and its classification.

Figure 6.3 here.

Children's degree of scientific learning[7] was estimated by tests containing questions to evaluate the development of both simple and complex cognitive competences.[8] For each set of competences, children's marks were transformed on a 4-point scale where: 0–24 per cent=1; 25–49 per cent=2: 50–74 per cent=3; 75–100 per cent=4.

The relation between teacher's pedagogic practice as a whole and children's achievement was measured through analysis of variance (One-way Anova), followed by a Post Hoc Test (Multiple Comparisons) whenever the value given by the variance analysis was significant. This statistical treatment was also used to analyse the same relation in terms of children's socio-economic level. To express the relative weight of each one of the characteristics of pedagogic practice on children's learning, we used stepwise regression, considering the *what* and *how* of pedagogic practice and the characteristics of instructional and regulative contexts separately.

Data Analysis

We analysed the relation between teachers' pedagogic practice and children's scientific achievement by considering the characteristics of their practices as a whole and separately. Following earlier studies (e.g. Domingos 1989a; Morais, Neves, Medeiros, Peneda, Fontinhas and Antunes 1993; Neves and Morais 2004; Morais, Neves et al 2000[9]) that showed family socio-economic background to be a variable

influencing students' scientific achievement, we focused on the interaction between children's social background, pedagogic practice and scientific learning, taking the level attained by children in complex cognitive competences as a measure of achievement. Studies by Domingos (1989a, b) and Morais, Peneda, Neves and Cardoso (1992) had shown that differences in scientific achievement related to family's socio-economic background were particularly marked when the level of conceptual demand was higher.

Interaction between pedagogic practice, family socio-economic background and achievement in sciences

Analysis of variance was carried out, where the dependent variable was children's achievement in complex cognitive competences (CC), the independent variable was pedagogic practice (Pp) and the mediating variable was family's socio-economic level (FSEL). Achievement was measured in a 1–4 scale, where level 1 indicates very low achievement and level 4 very high achievement in CC. Teachers' pedagogic practice was measured in a 1–5 scale, where 1 indicates the practice most distanced and 5 the nearest to the pedagogic practice which previous studies had shown to be favourable to the scientific learning of all children (see Figure 6.3). Family socio-economic level was measured on a 1–3 scale: 1 working class; 2 lower middle class; and 3 higher middle class.

The analysis was carried out for all children in the sample at the same two points when their teachers' pedagogic practice was characterised. However, the analysis presented here concerns only results from two teachers and their children after delivery of the second teaching unit when not only teachers changed practices but children's progress should have been most evident. To highlight the relation between pedagogic practice and achievement, as mediated by family socio-economic level, we selected the two teachers (A and C) who showed greatest contrast in their pedagogic practice and whose children's science results were significantly different at the point of delivery of both teaching units. At the same time, their pupils were the most evenly

distributed in terms of social class levels. Figure 6.4 shows the results of the analysis. The percentages on the vertical dimension refer to the distribution of children, by social group and achievement level.

Figure 6.4 here.

The data shows that teacher C, with pedagogic practice nearer to the characteristics shown to be favourable to children's achievement, got the best results: the percentage of children with low achievement (2 or less) is lower than 50 per cent for any social group. Teacher A, whose pedagogic practice is furthest away from the characteristics favourable to children's achievement, has more than 50 per cent of children in all social groups showing low achievement. Indeed, a high percentage of teacher A's children in all social groups show very low achievement (level 1) and level 4 is only achieved by socially advantaged children (FSEL 3). In contrast, the percentage of teacher C's children with very low achievement is very small and the highest achievement is not restricted to socially advantaged children. These results support the conclusions of our earlier studies that show that pedagogic practice can overcome the effect of children's social background (e.g. Morais, Fontinhas and Neves 1992; Fontinhas, Morais and Neves 1995; Morais and Miranda 1996; Morais et al 1993; Morais, Neves et al 2000).

The influence of different characteristics of pedagogic practice on scientific development

To provide a more comprehensive and detailed picture of the relative importance of each of the various characteristics of pedagogic practice and their interplay for effective learning, we undertook a stepwise regression analysis to estimate the contribution of each characteristic of pedagogic practice for children's success in complex cognitive competences. The results showed that differences in scientific achievement were mainly explained by the *what* of the pedagogic practice, explaining 25.8 per cent of the variation of children's results after delivery of the first unit and 24

per cent after the second. When only the *how* of pedagogic practice was considered, by analysing each of the sociological characteristics which defined its instructional context, intra-disciplinary relations and evaluation criteria emerged as those with higher explanation value of children's results after the first unit, together explaining 26 per cent of the variance (15.8 per cent and 10.2 per cent respectively). After the second unit, evaluation criteria again came out as the characteristic of the instructional context having greater influence on children's results, explaining 23.3 per cent of the variation.

When we analyzed the relation between the sociological characteristics which define the regulative context of pedagogic practice and children's results in complex cognitive competences, regression analysis indicated the relation between teachers' and children's space and child-child hierarchical rules as those with highest influence on achievement after the first unit, together explaining 23.4 per cent of the variance (20.1 per cent and 3.3 per cent respectively). After the second unit, teachers'-children's space relation came out again as the characteristic of the regulative context with greatest influence on children's achievement, explaining 24 per cent of the variance.

These results support the idea that an important condition of children's success in complex cognitive competences is the scientific competence of teachers: their knowledge proficiency and command of the investigative competences to be developed. However, this *what* is a necessary but not a sufficient condition. The explicating of evaluation criteria (strong framing of this discursive rule) and the blurring of boundaries between teachers' and children's spaces (weak classification) are further crucial conditions for children's success. Statistically, the blurring of boundaries between knowledges of a discipline (weak classification of intra-disciplinary relations) and the existence of open and intense communication between various children (weak framing of child/child hierarchical rules) were also important.

This statistical analysis complements the results of the earlier ones, revealing which practices contributed most to differential scientific achievement among children. When there is a poor pedagogic practice at the level of the *what* and it is characterised, at the level of the *how*, by weak framing of evaluation criteria, strong classification of teacher and child spaces and of intra-disciplinary relations and strong framing of child/child hierarchical rules, there is a low level of scientific learning and high differential achievement between children. In contrast, when there is good pedagogic practice at the level of the *what* and it is characterised at the level of the *how* by strong framing of evaluation criteria, weak classification between teacher and child space and intra-disciplinary relations and a weak framing of child/child hierarchical rules, there is a high level of scientific learning and low differential achievement between children.

The characteristics of the pedagogic practice highlighted by this analysis must be seen in the context of the results obtained by the whole group of teachers who were part of the study. Some of the characteristics showed teachers to be similar or having little difference between them, as in the case of pacing, so that it is understandable why they did not come out as explaining differential results. However, it must be borne in mind that similarity between some teachers in the present study was engendered partly, at least, by the training they received in the course of the action-research process. This suggests the importance of developing further research involving teachers whose pedagogic practices are more markedly distinct in terms of those characteristics (see Afonso 2002; Neves, Morais and Afonso 2004, in this volume).

Interplay between various characteristics of pedagogic practice and the relation between children's achievement and practice

The statistical results of previous analyses indicate that there is a relation between pedagogic practice and children's differential achievement and that some characteristics are more important in that relation. But what is the extent to which the interplay of the various characteristics of the practice explains the relations suggested

by the results? We must look at the interplay between the characteristics which came out as fundamental factors for children's differentiated achievement in order to understand the reason why they perform a crucial role in the pedagogic practice as a whole. We should also look at the interplay between those characteristics and other characteristics of the pedagogic practice in order to obtain a more comprehensive picture about the relation practice-achievement.

If explicating the evaluation criteria (strong framing) is a crucial condition for efficient scientific learning, that explicating will be more successful when communication relations between subjects in interaction are more open. In order for the text that children are expected to produce to be explicit, it should be constructed (with the teacher' support) by children in interaction with other children. This requires a weak framing of hierarchical rules so that children can intervene in discussions and that all children feel their opinions are valued. Moreover, the classification between teacher's and children's spaces should be weak so that there are open teacher-children communication relations. Furthermore, in order that the text to be made explicit to children represents a high level of scientific conceptualisation, a condition for the success at the level of complex cognitive competences, the blurring of boundaries between the various subjects of the discipline is needed. This requires a weak classification at the level of intra-disciplinary relations, an aspect that previous analysis showed to be an important condition for that success. On the other hand, if a crucial condition for efficient learning is high scientific competence on the part of teachers, the explicating of evaluation criteria will only lead to efficient learning when that competence exists.

We are led to think that effecting all these aspects of pedagogic practice requires weak framing of pacing if time restrictions are not to prevent the whole process. For text to be acquired by children to be made explicit, in detail and with rigour and articulation of distinct knowledges of a discipline to be systematically achieved and frequent open communication between teacher and children and between children themselves to occur, time is needed. However, contrary to what is believed, it is possible to weaken

the framing of pacing without significantly increasing the amount of time school has to offer to children. If efficient intra-disciplinary relations require time, they may, in turn, increase time for learning. When returning systematically to scientific knowledge already explored in order to relate it to new content to be learned, teachers increase learning time for the former.

Detailed analysis of the pedagogic practice of teachers A and C shows that they differed in terms of evaluation criteria (teacher A with weak and teacher C with strong framing), child-child hierarchical rules (more weakly framed for teacher C than for teacher A) and the relation between teacher and child spaces (teacher A with strong and teacher C with weak classification). Teacher A also had very strong classification at the level of children's power relations, stronger classification of academic-non/academic relations and strong framing of the teacher-children hierarchical rules. Teacher C had very weak classification at the level of children's power relations, relatively weaker classification at the level of academic-non/academic relations and very weak framing of teacher-children hierarchical rules. Pacing and children's space were more weakly framed and classified for teacher C than for teacher A. These differences could also account for differences in their children's achievement. They also lead us to contend that learning time cannot itself be a sufficient reason to explain children's differential achievement. For example, the lesser attention given by teacher A than teacher C to the relation between academic and non-academic knowledge and to teacher-children communication might be seen in terms of differences in learning time. However, since framing of pacing for teacher A is also weak, it is not the most relevant difference between their practices: it is possible to think that teacher A did not use the time to put into practice that which ostensibly distinguished her from teacher C. This illustrates the complexity of the relations between the various characteristics which define a pedagogic practice and help us to understand how these relations may explain its influence as a whole on school achievement.

Conclusions

The present and earlier studies reveal that the pedagogic practice which promotes a high level of scientific development in primary school children is *mixed*, with: (a) weak boundaries between teachers' and children's spaces; (b) open communication relations between teacher-children and child-child; (c) explicit evaluation criteria; (d) weak pacing of learning; (e) strong intra-disciplinary relations; (f) high level of conceptual demand; and (g) high level of investigative proficiency. Primary school children are able to develop scientific knowledge and investigative competences provided their teachers possess sound scientific and pedagogic competences. As in Morais *et al* (1993), Morais, Neves *et al* (2000) and Morais and Neves (2001), we show that pedagogic practice can overcome students' social background, even in developing complex cognitive competences, where the disadvantaged, tend to show greater difficulty. This implies that there is no need to lower the level of conceptual demand in order for *all* children can succeed at school. Raising the level of conceptual demand is, indeed, a crucial step in order that all may have access to a higher level of scientific literacy valued by both the scientific community and society at large.

A pedagogic practice which makes possible attainment of a good level of school science success, even when the level of conceptual demand is raised, creates conditions for working in the zone of proximal development of given groups of children, exploring all their potential levels of development, as suggested by Vygotsky when he said that 'pedagogy should be directed not to the yesterday but to the tomorrow of child's development' (Davydov 1995: 18). Vygotsky contends that learning precedes development, 'that an adequately organised instruction leads to mental development' (Wertsch 1991: 72) so that good learning goes beyond actual development; if it does not it is not learning. The level of conceptual demand we provide for children should be somewhat higher than what their actual development suggests that they are able to do. Learning is a complex social process in which knowledge is socially constructed in interaction with others; that social, inter-psychological processes precede subject, intra-psychological processes will be of

extreme relevance to the characteristics of the social context which define a given pedagogic practice.

The primary condition for children's success in complex cognitive competences is the scientific competence of teachers. Making evaluation criteria explicit and arranging weakly classified teacher-child space are also crucial, while the blurring of boundaries between distinct scientific contents, with open and intense communication between children whose opinions of all are equally valued, is important. Marked weakening of pacing, blurring of boundaries between children's spaces, an open relation of communication between teacher and children and between academic and non-academic knowledge also characterised the arrangements of the teacher whose pedagogic practice was closest to our theoretical profile and whose children were relatively the most successful. Bernstein's and Vygotsky's ideas clearly give meaning to these linkages, synthesised in Figure 6.5.

Figure 6.5 here.

Once more we underline that although teacher's scientific competence is a necessary condition for learning, it is not a sufficient. The other characteristics presented in the diagram are also fundamental to the success of *all* children, their interplay in the creation of a learning context favourable to *all* children permits understanding of the extent to which their mutual interdependence explains children's school performances.

This study is able to explain with greater rigour why pedagogic practice plays so important a role in children's level of scientific development and the meaning of the interdependence of its various characteristics. Methodologically we have now attained a better model of an efficient pedagogic practice and can now go further in seeing the extent to which this model adapts to multiple schooling situations, increasing the precision of our knowledge of the conditions of effectiveness of the characteristics indicated by our model.

Acknowledgments

We acknowledge the financial support of the Gulbenkian Foundation and the Institute for Educational Innovation for the project of which this study is part.

References

Afonso, M. (2002) 'Os professores e a educação científica no primeiro ciclo do ensino básico: Desenvolvimento de processos de formação', Doctoral thesis, School of Science University of Lisbon (unpublished).

Bernstein, B. (1990) *Class, Codes and Control, Vol IV: The structuring of pedagogic discourse,* London: Routledge.

Bernstein, B. (2000) *Pedagogy, Symbolic Control and Identity: theory, research, critique,* (rev. edition), London: Rowman & Littlefield.

Davydov, V. (1995) 'The influence of L.S. Vygotsky on education, theory, research and practice', *Educational Researcher,* 24(3), 12–21.

Domingos, A.M. (now Morais) (1989a) 'Conceptual demand of science courses and social class', in P. Adey (ed.) *Adolescent Development and Social Science,* London: Falmer Press.

Domingos, A. M. (now Morais) (1989b) 'Influence of the social context of the school on the teacher's pedagogic practice', *British Journal of Sociology of Education,* 10(3), 351–66.

Fontinhas, F., Morais, A.M. and Neves, I.P. (1995) Students' coding orientation and school socialising context in their relation with students' scientific achievement', *Journal of Research in Science Teaching,* 32(5): 445–62.

Miranda, C. and Morais, A.M. (1994) 'O contexto social na relação entre a exigência conceptual dos professores e o desenvolvimento científico dos alunos', *Aprender* (17): 55–70.

Morais, A.M., Fontinhas, F. and Neves, I.P. (1992) 'Recognition and realization rules in acquiring school science: the contribution of pedagogy and social background of students', *British Journal of Sociology of Education,* 13(2): 247–70.

Morais, A.M., Peneda, D., Neves, I.P. and Cardoso, L. (1992) *Socialização primária e prática pedagógica: Vol. 1,* Lisbon: Gulbenkian Foundation.

Morais, A.M., Neves, I.P., Medeiros, A., Peneda, D., Fontinhas, F. and Antunes, H. (1993) *Socialização primária e prática pedagógica: Vol. 2, Análise de aprendizagens na família e na escola,* Lisbon: Gulbenkian Foundation.

Morais, A.M. and Miranda, C. (1996) 'Understanding teachers' evaluation criteria: a condition for success in science classes', *Journal of Research in Science Teaching,* 33(6): 601–24.

Morais, A.M., Neves, I.P. *et al* (2000) *Estudos para uma sociologia da aprendizagem,* Lisbon: Institute for Educational Innovation and Centre for Educational Research of FCUL.

Morais, A.M. and Neves, I.P. (2001) 'Pedagogic social contexts: studies for a sociology of learning', in A. Morais, I. Neves, B. Davies and H. Daniels (eds), *Towards a Sociology of Pedagogy: the contribution of Basil Bernstein to research*, New York: Peter Lang.

Neves, I.P. and Morais, A.M. (2004) 'Pedagogic practices in the family socialising context and children's school achievement', *British Journal of Sociology of Education* (submitted for publication).

Neves, I., Morais, A. and Afonso, M. (2004) 'Teacher training contexts: study of specific sociological characteristics', in J. Muller, B. Davies and A. Morais (eds), *Thinking with Bernstein, Working with Bernstein*, London: Routledge.

Pires, D. (2001) 'Práticas pedagógicas inovadoras em educação científica: Estudo no primeiro ciclo do ensino básico', Doctoral thesis, School of Science University of Lisbon (unpublished).

Vygotsky, L. (1978) *Mind in Society: the development of higher psychological processes*, Ed. M. Cole, V. John-Steiner, S. Scribner and E. Souberman, Cambridge, MA: Harvard University Press.

Vygotsky, L. (1992) *Educational Psychology*, Winter Park, FL: PMD Publications.

Wertsch, J.V. (1991) *Voices of the Mind: a socio-cultural approach to mediated action*, London: Harvester Wheats.

---

[1] Teacher's level of conceptual demand is related to the nature of the cognitive competences to be developed by children. When there is a low level of conceptual demand, these competences involve a low level of abstraction (memorization and understanding at a simple level); when there is a high level of conceptual demand, the competences involve a high level of abstraction (understanding at a high level, application, synthesis and evaluation).

[2] According to Vygotsky (1978: 86), the zone of proximal development 'is the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers'.

[3] The FSEL was obtained from a composite index based on fathers' and mothers' occupations and academic qualifications, each scored 1–6. Their sum was then converted to a percentage and this percentage was scaled (1: ≤ 58 per cent; 2: 59–83 per cent; 3: 84–100 per cent).

[4] Social class should be here understood as a nominal concept.

[5] *Instructional context*: selection, sequence, pacing, evaluation criteria, intra-disciplinary relations, inter-disciplinary relations, relations between academic and non-academic knowledges.
Regulative context: hierarchical rules teacher-children, power relations child-child, hierarchical rules child-child, teacher-children spaces, children's spaces.

[6] For example, according to the theoretical profile, pacing would be characterized by very weak framing (F^{--}) and the evaluation criteria by a very strong framing (F^{++}). In the case of pacing, the value 4 was given to pedagogic practice F^{--}, 3 to practice F^{-}, v 2 to practice F^{+} and 1 to practice F^{++}. On the contrary, in the case of the evaluation criteria, the value 4 was given to pedagogic practice F^{++}, 3 to practice F^{+}, 2 to practice F^{-} and 1 to practice F^{--}.

[7] Children's scientific learning was also measured (Pires, 2001) in relation to their possession of recognition and realization rules in relation to knowledge and competences. This analysis will be the object of another article.

[8] An example of a question to measure the development of complex cognitive competences and of two answers given by children was:
Question - You have probably seen that when we stir the wood in a fire-place we rekindle the embers. Explain this.

Child A – This happens because when the embers are stirred the ashes are taken away letting oxygen in, which is the air component responsible for making the materials burn, light up.
Child B – Because the embers which were beneath went up when we stirred them, and they could again consume the oxygen which is in the room.

[9] Morais, Neves *et al* (2000) also contains studies carried out by Afonso, Câmara, Morais, Neves and Pires focused on family contexts.

	FAMILY SOCIO-ECONOMIC LEVEL		
TEACHERS	WC	MC^-	MC^+
A	7	9	8
B	4	3	12
C	10	10	10
D	3	8	7

WC - Working Class; MC^- - Lower Middle Class; MC^+ - Higher Middle Class

Figure 6.1. Social composition of the four school classes

Example of indicator

INDICATOR	F^{++}	F^+	F^-	F^{--}
Exploring/ discussing themes under study	The teacher explores contents according to a rigid order which is never altered even when children intervene	The teacher explores contents according to a given order but accepts children's interventions at the level of the micro-sequence	The teacher explores contents altering the micro-sequence, and occasionally the macro-sequence, as a result of children's interventions	The teacher explores the contents, even changing the macro-sequence, as a result of children's interventions

Examples of transcripts

F^{++} Ronaldo reads aloud the material needed to the realisation of an experiment plannified by his group. David, who is part of another group, wants to ask a question.
- No, sorry, we are letting doubts to the end – Teacher

F^{--} Children made a variety of experiments about several state changes of various substances. The description of the experiences and the presentation of the results is done according to an order chosen by children.
Teacher's questions intend to clarify some aspects referred by children, but do not suggest any sequence to work presentation.

Figure 6.2. Extract of the instrument for analysis of the discursive rule sequence and respective examples of transcripts.

PEDAGOGIC PRACTICE	TEACHER A		TEACHER B		TEACHER C		TEACHER D	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
The *how*	28/48	32/48	42/48	38.5/48	40/48	43/48	29.5/48	35/48
The *what*	2/8	2/8	6/8	8/8	8/8	8/8	8/8	8/8
Total	30/56	34/56	48/56	46.5/56	48/56	51/56	37.5/56	43/56
	53.6%	60.7%	85.7%	83%	85.7%	91.1%	67%	76.7%
Modality of pedagogic practice	*Pp1*	*Pp2*	*Pp4*	*Pp4*	*Pp4*	*Pp5*	*Pp2*	*Pp3*

1st - First unit; 2nd - Second unit

Figure 6.3. Teacher's pedagogic practices when teaching the first and second units

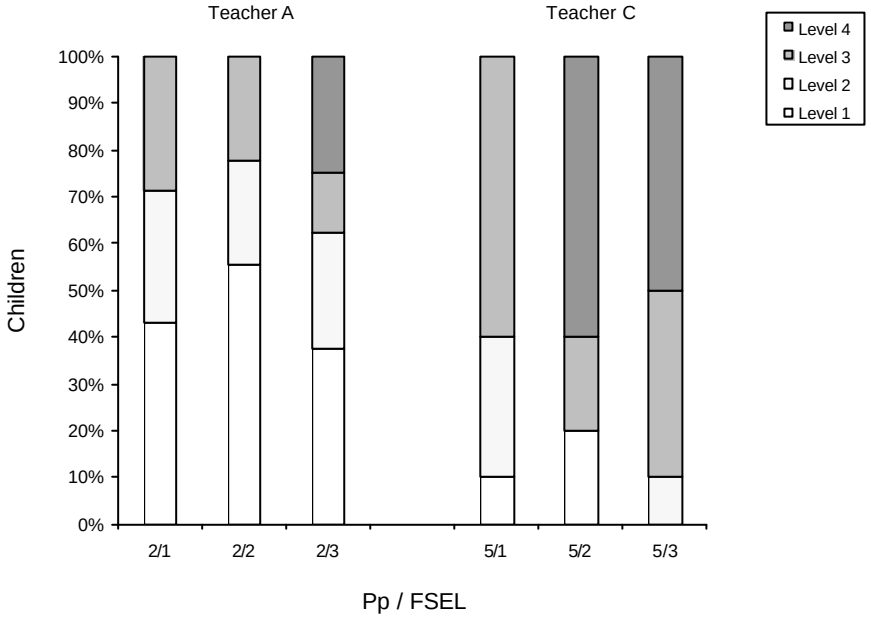

Figure 6.4. Interaction between pedagogic practice, family socio-economic level and achievement in sciences – second stage of research

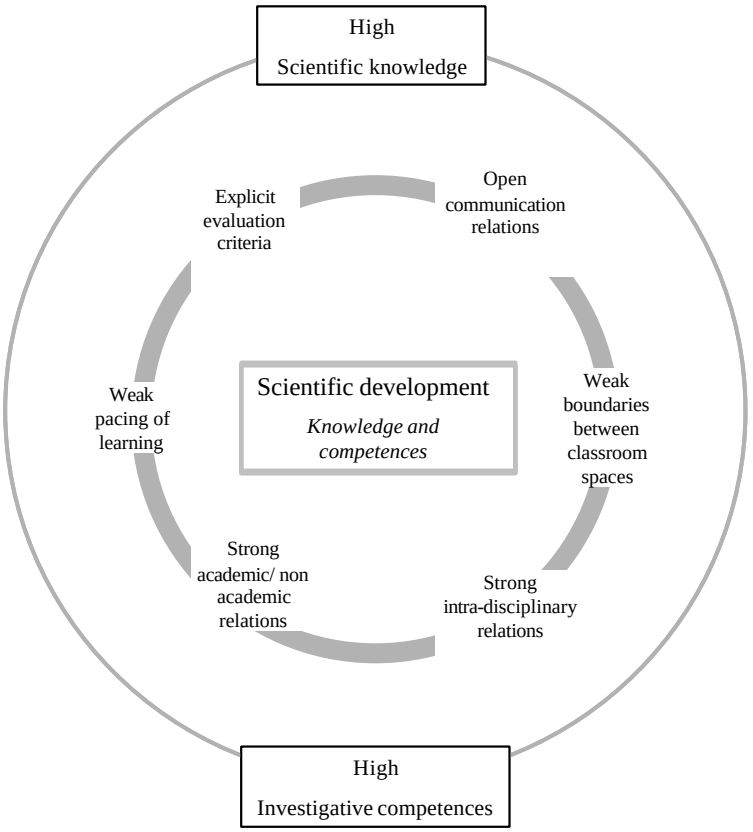

Figure 6.5. Inter-relations between the characteristics of the pedagogic practice and scientific development.