Conceptual demand of science courses and social class

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INTRODUCTION AND OBJECTIVES

The study[1] is within a line of research which aims at relating the underachievement in sciences with sociological factors. The central argument is that the new paradigm for science education emphasized the understanding and application of general scientific principles through the use of pedagogic theories emphasizing 'learning by discovery' and 'learning the structure of the subject'. Such new curricula and pedagogic theories, stressing the active involvement of the child in his/her acquisition, were expected to increase the understanding of all children at a *higher* level of scientific literacy.

Essentially, the new paradigms have their origin in psychology, more specifically in theories of child development (Piaget and Bruner) especially concerned with cognitive development and in theories of the ordering and teaching of subjects in school (Gagne). Both of these groups of theories abstract the child from his/her institutional and cultural context and the school/teacher from the social context regulating the processes of transmission and acquisition. My view is that the failure of the new paradigm to recognize the sociological context of learning in school may well have affected the success of this paradigm in improving the achievements of large numbers of pupils in school, more specifically of children of working-class backgrounds.

The study started with a broad problem arising out of the current underachievement in the science classrooms of secondary schools in Portugal. The questions addressed were related to the division between two groups of children with respect to achievement in sciences; a group constituted by those children who have high levels of success and another group constituted by those who show high levels of failure. Before I started my research I had been led to believe that the introduction of new methods and new contents in science education was at least partially accountable for this sharp division between two groups of children. Modern contents and methods in science teaching seemed to have pushed the 'brightest' children to a greater development of higher

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competencies and, although this kind of teaching fulfilled its goals, it appeared to do less for the 'less bright' children, who seemed to me to have fallen behind.

I initially believed that this failure was caused by the high level of conceptual demand entailed in the modern science teaching and based on Bernstein[2] I was led to believe that the working-class children who tended to be failures at school, failed within its present pedagogic regime because of the high level of abstraction entailed in modern science courses.

Based on Bernstein's theory and on the results of a pilot investigation[3], I devised a detailed empirical study in which I tried to unveil possible relations between social class and achievement in different types of competencies in the sciences. I aimed at understanding the complex of interrelations I felt existed behind children's underachievement in the sciences, and possibly in other school subjects. I extended the research to include the consideration of a number of other sociological factors besides the direct indicators of nominal social class (father and mother's educational qualifications and occupations). Thus, variables more associated with the family (gender, siblings, etc.) and more associated with the school (teacher, type and area of school, etc..) were introduced in the research.

The theoretical fundaments of the study are in Bernstein, his model of cultural reproduction through education having been used to interpret the results and to explore the possibilities of increasing the efficiency of pedagogic practice. The aim of this paper is to give a short account of *some* aspects of that study.

GENERAL PROCEDURE AND SAMPLE

In essence, my research is composed of three interrelated investigations which I considered were essential if I was to obtain a globality in the results and their interpretation. In the main study I tried to find relations between the sociological variables and achievement in two types of competencies, those which require a low level of abstraction (A - Acquisition of Knowledge) and those which require a high level of abstraction (U - Use of Knowledge). This study was supplemented by two other studies, a second study in which I intended to characterize the pedagogic practice

of the teacher and a third one which intended to establish patterns of achievement in A and *U* competencies.

The sample was constituted by 1300 pupils of middle and upper secondary school, eleven teachers and eight schools. The schools were located in big cities and in towns in the country, they were all comprehensive and had either a predominantly working-class population (referred as working-class schools) or a mixed class population (referred as middle-class schools). The teachers were all female.

For the main study the data were obtained through questionnaires to pupils and parents and through tests made by teachers[4] and in which A and *U* competencies were clearly distinguished.

The characterization of teachers' pedagogic practice was made in joint work with them, using materials developed by themselves and the researcher. It was mainly intended to determine their degree of conceptual demand and the ability to bring pupils to attain the level they had established to their courses. The measures I carried out were supplemented by more qualitative assessments.

For the establishment of patterns of achievement in different competencies, I started from the selection of a limited number of objectives to which a special attention was paid in the transmission-acquisition process. These patterns were used to appreciate the ability of the teacher to bring the pupils to achieve a given level, thus making the characterizing of the pedagogic practice more complete. They were also used to appreciate the results of a change in that practice.

RESULTS AND INTERPRETATION

For the first search of predictive variables of pupils' achievement, the practice of using stepwise regression was followed.[5] The analyses showed the teacher as the most striking influence, followed by the parents' education and occupation, area and type of school, gender and repeating. It pointed out clearly the dominant influences of family and teacher/school. It also showed that the quantitative results for stepwise regression cannot be taken as definitely conclusive in a quantitative sense because of balancing influences among some variables. Using this form of analysis, the exact

nature of the relationships between the different factors could not be pursued in the depth required. In order to obtain a more delicate understanding of the complexity of the interactions I proceeded with a different form of analyses[6] which entailed the use of both quantitative and qualitative forms of data study.

The results showed that the achievement in sciences is much lower in working-class pupils, both in middle and upper school, and that such difference is mainly due to a high differential achievement in *U* competencies. Thus, a course with a low level of conceptual demand will originate a reduced differential achievement and a course with a high level of conceptual demand will produce the opposite effect. This seems to confirm the initial hypothesis. However, the results also showed that the picture is much more complex.

Although I found a pattern of differential achievement related to social class for most teachers, such differential achievement is not equal to all of them and for some of them is even non-existent. On the other hand, I see that a teacher pedagogically very competent,[7] produces classes of pupils which exhibit a pattern of class regulated differential achievement. Thus, such differential achievement is difficult to attribute entirely to the lack of pedagogic competence of the teacher and may well be, in part, a function of the high level performances required by *U* competencies which perhaps working-class pupils are less likely to acquire under particular pedagogic regimes.

The conclusions I reached leaves some discrepant cases and differences between teachers' sub-samples of pupils to be explained. Many hypotheses can be put forward to explain the discrepancies and I am going to explore the likeliest ones on the basis of the date I possess. First I shall deal with each hypothesis separately, then I shall examine them together.

The Mediation of Gender

I was able to see[8] that differential achievement is related to gender: lower working-class girls attending working-class schools perform worse than boys of the same social class, especially in *U* competencies. I have also seen that when the sample is divided in two groups, boys and girls, the relationship between social class and differential

achievement is much more marked and well defined for girls than boys. Thus, there are gender differences *within* social class position which affect girls' achievement within the working-class.

From this point of view I may think that that part of the comparative underachievement of the lowest social groups in working-class schools is more due to the underachievement of girls than to the underachievement of boys. If in such schools boys outnumber girls, differential achievement related to social class should be less evident. If girls outnumber boys differential achievement related to social class should be more evident,. i.e.., whenever the lower working-class is fundamentally represented by girls, differential achievement will tend to be greater. The more the lower working-class predominates in the school population the more that effect should be important.

The Mediation of Repetition

Trying to find whether or not the relation between repetition and achievement is influenced by a third variable, social class, I was able to see[9] that: (a) non-repeaters are in general better than repeaters especially in the case of *U* competencies; (b) for *U* competencies the pattern of differential achievement between different social groups is strongly marked for repeaters.

These findings are strong support for the hypothesis that there is a relation between social class, repetition and differential achievement.

The relative underachievement of the lowest social groups is more due to the underachievement of repeaters than to the underachievement of non-repeaters. If non-repeaters outnumber repeaters differential achievement related to social class will be less marked. However, if repeaters outnumber non-repeaters, differential achievement related to social class will be more marked, i.e.., whenever the lowest social groups are mainly represented by repeaters differential achievement will tend to be the greatest. The more the lowest social groups predominate in the school population the more that effect will be evident.

In order for there to be an interrelation between social class, repetition and achievement then the school classes must contain representatives from both middle-

class and working-class. Some teachers do not have the full social class range represented among their pupils and, as a consequence, although they have a high percentage of repeaters and a high proportion of low social class pupils, the social class/repetition/achievement relation does not hold for these teachers. On the basis of my argument I would expect the class/ repetition/achievement effect to be most strongly marked for teachers who have a social hierarchy among their pupils and both a high percentage of repeaters and a high proportion of low social class pupils., The class/repetition/ achievement effect should be least marked in the case of teachers who have a low percentage of repeaters and a high proportion of middle-class pupils.

The Mediation of the Teacher's Pedagogical Practice

I was able to see[10] that the teacher's pedagogical practice is strongly influenced by the social composition of the school: teachers in schools with a low social composition tend to lower their level of conceptual demand and therefore the level of abstraction elicited by their courses tends to be low.

From this, it can he deduced that the focus of transmission will be more directed to the pupils of the social class which predominates in the school. In such circumstances, where a relation exists between social class and achievement, a working-class child in a working-class school will tend to show higher achievement when compared to a middle-class child than if he/she were in a middle class school. Therefore, differential achievement between different social groups will tend to be greater in middle class schools.

The focus of transmission is likely to be more directed to the middle class pupil with teachers who have taught (or had usually taught) in middle class schools and more directed to the working-class pupil with teachers who have taught in working class schools.[11]

The above appears to indicate that part of the differential achievement in relation to social class can be due to the influence of this factor, in schools where a social class hierarchy exists among the pupils.

I must stress that the differential achievement between social groups due to the effect

described above is directly related to the teacher's pedagogical practice but is indirectly related to the social class composition of the school.

The above appears to indicate that there is a complex interaction between social class, differential achievement, social composition of the school class and focus or orientation of the teacher's pedagogic practice.[12]

According to my conclusions, teachers with a high degree of conceptual demand will tend to sharpen the division between different groups of pupils. Thus, part of the differential achievement between social groups may be due to the influence of this factor, affecting teachers who were found to be in the category of high conceptual demand.

Differences in Differential Achievement

I have now considered a number of hypotheses and carried out a series of analyses to explore the reasons for the differences in achievement in the sub-samples of pupils.

CONCLUSION - INTRODUCTION OF A THEORETICAL MODEL

The above shows that in accounting for social class effects upon differences in differential achievement, both the influences of family and teacher/school factors must be considered. Some variables are more closely associated with the influence of the family (gender, parents' occupation and education) some are more closely associated with the influence of the teacher/school (pedagogic practice, type of school, repetition) but all relate to both the family and the teacher/school. However, the crucial variable which produces differences in differential achievement appears to be, from this analysis of our data, the teacher.

The pedagogic practice of the teacher is strongly related to the school context where she teaches.[13] It is that social context which makes teachers develop courses with a low or a high level of abstraction to match what they consider (consciously or unconsciously) to be attributes of the school population they teach. A working-class school and/or a school in the country acts selectively on the conceptual level of the teaching so as to produce a

reduced conceptual demand and focus of the pedagogic practice. This means that the achievement of some groups of pupils is dependent upon the context in which they are taught and/or the experience of the teacher. Although a superficial analysis may indicate that all pupils are equally affected by the lower level of teaching as all receive this kind of teaching, it is the working-class group of children which is most affected. They are the children who are less likely to develop competencies of a relatively high level of abstraction, because *both* sites of acquisition (family and school) are less likely to provide them with the opportunity to develop these kind of competencies. For middle-class children, the family will help them to a lesser or greater extent in the development of relatively high level abstract pedagogic competencies, whether or not the school carries out this function.

What was said above makes clear that when marked differential achievement between groups of children (social class, gender) does not exist at school in our study it is *not* because all children are achieving a high conceptual level of scientific understanding, but because they are *all* being provided with a low conceptual focus. I would argue that teachers who make a very low level of conceptual demand have failed to understand the sociological implications of the transmission-acquisition process they are promoting. Children who enter the school disadvantaged will leave it still more disadvantaged.

As has been seen, the causes which lie behind differential achievement in the sciences are of a very complex nature but the causes which eye have explored are directly and indirectly related to social class, which acts directly in the family and indirectly in the school. To summarize I would say that between social class and achievement in the sciences lies the invisible regulation of the social context of the school class which acts selectively upon the conceptual focus of the teacher and upon the ability of the teacher to enable pupils to attain required levels.

Although teachers of higher competence and high conceptual demand increased, in general, the gap between two groups of children (in terms of social class, gender), both of them attained higher levels, including the most disadvantaged group. [14] On the other hand, the results of the study on patterns of achievement in different types of competencies,[15] and which corresponded to an explicitness of sequencing rules and criteria and a weakening of pacing, suggested that differential achievement may decrease when there is a change in the pedagogic practice. It seems possible,

therefore, that teachers with a good knowledge of psychology of education and methodology of the subject and who provide a structured teaching can introduce an improvement in learning, provided the teaching conditions allow for the use of such competencies and *provided* those teachers are aware of the implications of the sociological context of education in school.

I shall now try to develop a theoretical model, drawing on Bernstein, which allows, me to offer a more general interpretation of my findings. Figure 10.3.1 summarizes the main relations in this model.

Bernstein argues that the school rewires an elaborated :orientation to meanings where there is an indirect relation to a local material base, i.e.. an orientation to universalistic meanings, independent of the context. However, *the realization* of these meanings is regulated by the classification and framing procedures of the school. Thus, from this point of view, the school requires of the pupil an orientation to its orders of meaning *and* an orientation to the contexts, contents and rhythms it creates for their realization in a given pedagogic practice.

Whereas the socialization of some children in the family allows them to acquire an elaborated orientation, some other children are limited to a restricted orientation, i.e.. an orientation to context dependent particularistic meanings. Middle class children tend to be found in the first position and working class children, especially lower-working class children, are likely to be found in the second.

Bernstein argues that restricted orientations arise out of the forms of solidarity based upon a simple division of labour, whereas elaborated orientations are more likely to arise out of the forms of solidarity based upon a complex division of labour. From this point of view, class relations broadly distribute elaborated and restricted orientations, according to whether the conditions of work in which individuals find themselves approximate either to a simple or complex division of labour. Bernstein points out that restricted orientations may be transformed by work itself through the activity of agencies of defense, challenge, opposition, for example, trade unions, political parties.

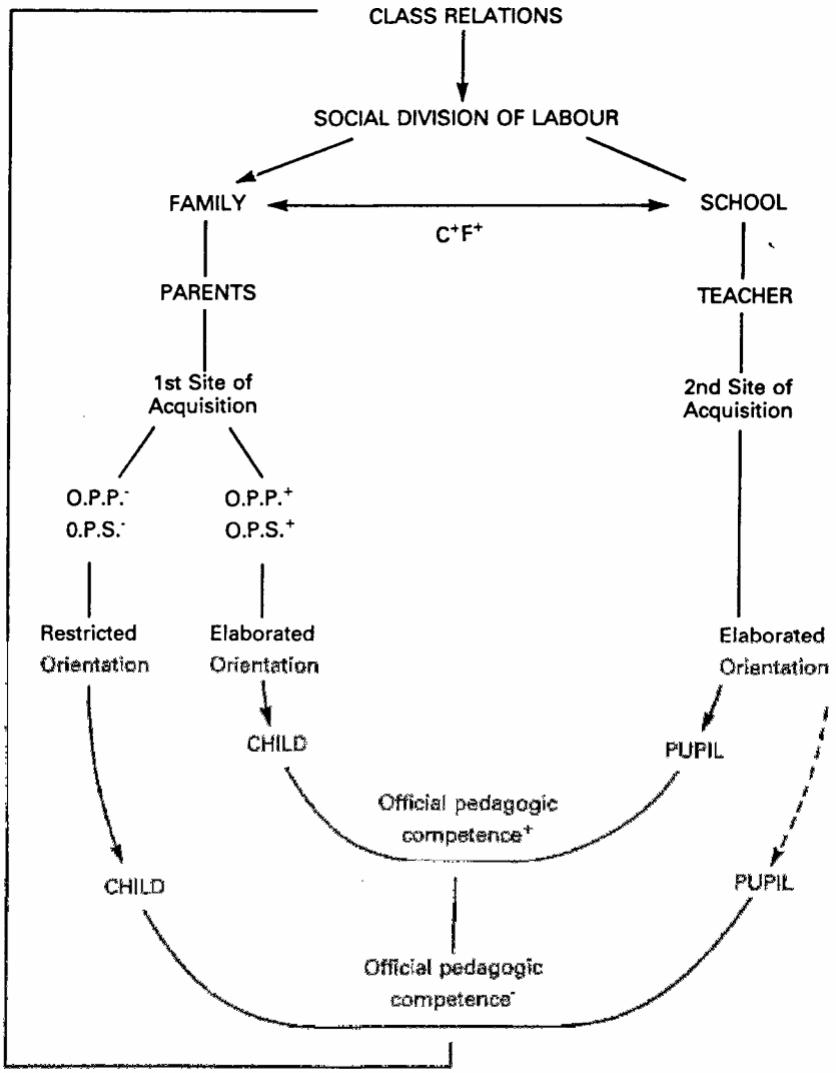

Figure 10.3.1 – *Social class and pedagogic practice*

It has been seen how there is little difference between the pupils with reference to the achievement of A competencies; the crucial differences arise out of differential acquisition of *U* competencies. The fact that working class children arrive at school without an elaborated orientation may explain their underachievement in the *U* competencies, because these are the competencies which require a high level of

abstraction. It also explains why differential achievement is higher where the conceptual demand of the courses is higher. The fact that these pupils can be successful with teachers who make a low level of conceptual demand (teachers whose pedagogic practice is selectively focused upon A competencies) does not mean that this kind of teaching requires a restricted orientation: the orientation of the school is always elaborated. Rather it means how *measured* achievement can give us a measure of memorised knowledge in A competencies and not necessarily an understanding of that knowledge, which would require and elaborated orientation.

How the school creates the contents, contexts and rhythms of elaborated orientations may well affect crucially those who acquire the modality of its elaborated codes.

If the school insulates itself strongly from the family, that is if there is a strong classification between the home and the school, then in the case of working-class families their practices, relations and orders of relevance and language variety are less likely to be seen as legitimate and encouraged by the school. In this case there is a double disadvantage entailed in the school's pedagogic practice. In the first place, the orientation to elaborated meanings required by the school may not be encouraged in the family and in the second place the contexts, contents and rhythms of the school are not related to the contexts, contents and rhythms of the family's local pedagogic practice.

It is true that a decontextualizing of knowledge and local practices acquired at home always, to some extent, occur at school to children of all social classes. The school selects, refocuses and abstracts from the knowledge and practices the child brings to it and this decontextualizing process is followed at the same time by a recontextualizing of the child into the official pedagogic practice of the school. Given that this practice is much nearer to the middleclass because the official pedagogic practice of the school is imbedded in, and perhaps dominates, their local pedagogic practice, then the twin processes of decontextualizing and recontextualizing will favour the middle-class child and place the working-class child under a crucial disadvantage. It is likely in Portugal, especially in the country, that working-class families are less likely to incorporate in their local pedagogic practice the official pedagogic practice and the specialized space it requires.

I saw that[16] pacing seems to be important for, when it is reduced, there is time available for explicating both the sequencing rules of learning and its criteria. This would seem to be necessary because the working-class children in my study, especially those in the country, are less prepared in their homes to meet the rules and orientation of the transmission regulating the teaching practice. A strongly paced transmission in the school requires a second site of pedagogic acquisition, i.e.. the home.

That second site of acquisition, the home, must be capable of creating what I can call an official pedagogic space. The distinguishing features of this space depend upon the context of acquisition in the school. If this context requires silence, isolated learning, relatively context independent texts acquired in competitive relations with others there is good reason for believing that social class regulates the distribution of such contexts in the family.

I can distinguish families in terms of those who have imbedded in their practices an official pedagogic space from those families who do not create such a space. Such an official pedagogic space in the home creates the context of acquisition of the school's pedagogic performances. For example, if it is not possible to provide in the home a space for the child as *pupil*, that is a space where noise is excluded, which is isolated, where material conditions for learning exist, then acquisition is more difficult. In working-class homes such a space is less likely to be found. Indeed the presence of such an isolated space for solitary learning could well be antithetic to the more communal and supportive practices often found in such homes, especially in the country in Portugal. Furthermore, the independence of children often valued in these homes is not so much based upon the independence in the learning encouraged by the school but an independence of the parents so that the child can leave the parents free and assist both in the home and as a wage earner.

The school constitutes an individual called pupil; the family an individual called child. Pupil and child overlap in the middle-class. They are more likely to be sharply separated in the Portuguese working-class and a double-life, one at home and another different one at school may be created. There is in this case a strong classification between the two agencies of pedagogic transmission as boundaries and practices between them are sharp indeed. For the middle-class this classification is weaker.

The pedagogic competence of the individual is a result of a complex of interactions between the child who conies from the social institution called the family and the pupil who attends the social institution called school. Thus, for the working-class child, the official pedagogic competence will be less developed and for the middle-class child will be more developed. In fact, the school maintains and emphasizes the competencies brought into it by the middle-class children and *hid* omission it also maintains and reinforces the competencies brought by working-class children. In other words, little is changed by the school; on contrary, differential reproduction is maintained and legitimised. In such conditions, each child follows separate ways under the same roof of the comprehensive mixed classes and mixed sex school.

This model is liable to be challenged because it appears to entail a deficit approach: working-class children lack the competencies middle-class children possess. In fact, according to this model, working-class children as we have defined this group in this study, relative to middle-class children, are more likely to lack the pedagogic competence to achieve *U* competencies *with respect to the pedagogic regime of the school.* However, because the working-class children in my sample perform differently than the middle-class children it does not mean they do not have the same potential to acquire the modality of the elaborated code demanded by the school. Indeed, it may well be that, if the modality of the school's elaborated code was changed (its classification and framing strengths) so that the contexts, contents and rhythms of the school's pedagogic practice had greater relevance to the contexts, contents and rhythms of the children's family and community culture, the acquisition of crucial *U* competencies would be facilitated. The pedagogic practice shown by the most competent teachers in this study and also the change in pedagogic practice occurred in the sub-study, on patterns of achievement in different types of competencies, support this suggestion. In fact, such practices correspond, in some aspects, to a new modality of code. To seek new forms of institutionalizing the elaborated code of the school, i.e.. to develop a new modality of code seems to be a promising direction for future research.

Whilst it is indisputable that working-class children possess a valid competence and this competence should be respected and incorporated into the pedagogic practice of the school, it appears from our findings that working-class children do not have the

same facility in acquiring the *U* competencies of science. The acquisition of these competencies, however, would not necessarily make the children middle-class in their cultural practice. Neither should the understanding of scientific concepts and principles, and the competence to use this knowledge in solving new problems and in understanding and criticizing the world, be a preserve of a socially selected few. Scientific literacy is a necessary condition for equal access to the discourse and decisions of power. To defend the culture of the working-class does not entail that the children should be deprived of scientific literacy nor that such literacy entails the adoption of what are considered to be middle-class values and practices and the loss of their own values and practices.

We can use the general form of our model to analyze differential gender achievement in the acquisition of *U* competencies. We suggest that, as in the total school population working-class pupils are disadvantaged as compared to middle-class pupils, so *some* girls are disadvantaged compared to boys. These are the girls from families where different patterns of male and female behaviour are expected and which, in Portugal, occur mainly in working-class families in the country. In Portugal, the school, its ethos and teachers do not have a bias against girls. I argued" that the difference in achievement arises from gender differences in the upbringing of the children so that boys and girls are socialized into different values, aspirations, practices and competencies. In Portugal, this occurs mainly in the working-class in the country. where very strong patriarchal values and practices dominate the family, and it is in the country that differential gender achievements are to be found in my research. Clearly in societies where the school holds different expectations, attitudes for boys and for girls and where the curriculum offers the possibility of gender differentiated subjects, then we would expect a compounding of school and family influences to produce differential achievement in science.

If I had to sum up and point to the major issue raised by my argument, it would be the following. At the moment, the curriculum and pedagogic practice in science education in Portuguese secondary schools through the direct and indirect effect of social class is producing a stratification of knowledge broadly parallel to the hierarchy of social class. On the whole, working-class children particularly lower-working class are restricted to a level of understanding of science which denies to

these pupils what is available to the middle-class children: the ability to understand, develop and apply the principles of science. We could consider that A competencies represent the vocabulary of science, whereas *U* competencies represent the syntax. From this point of view, working-class children are acquiring the vocabulary without the syntax. In a sense, it may even be the case that working-class pupils are over-socialized into A competencies and under-socialized into *U* competencies by the school. And this has many implications. Working-class pupils are confined within a very limited conception of science, science as definitions, elementary procedural rules, rather the science as an imaginative exploration and explanation of the physical world. From this point of view they are likely to be cut off from the power of its discourse. I can say that, from this perspective, the school is institutionalizing inequalities in the acquisition of the power of discourse. However, from another point of view, particularly in developing societies such as Portugal, working-class pupils have unequal access not only to the power of discourse but also unequal access to the discourses of power and their dominant agencies and practices in society.

NOTES

1 See Domingos *(1984)* for a complete description *of* the study.

2 For Bernstein's theory see, for example, Bernstein *(1977, 1981* and *1985);* and Domingos *et al, (1986).*

3 Domingos *(1984) op. cit., p 55.*

4 *Ibid,* see sample of tests in appendix *IV.*

5 *Ibid,* see a *full* description of the stepwise regression treatment in chapter *5* on 'Quantitative analysis *of* sociological variables and achievement'.

6 *Ibid,* see chapters *6* and *7* on 'Gender and achievement' and 'Social class and achievement'.

7 *Ibid,* see chapter *4* on 'Teacher's pedagogic practice.'

8 *Mid,* see chapter *6* 'Gender and achievement'.

9 *Ibid,* see chapter *7* on 'Social class and achievement'.

10 Mid, see chapter *4* on 'Teacher's pedagogic practice'.

10 Ibid.

12 Ibid, see chapters *4, 6* and *7,* on 'Teacher's pedagogic practice,' 'Gender and achievement' and 'Social

class and achievement'.

13 Ibid, see chapter *4* on 'Teacher's pedagogic practice'.

14 Ibid, see chapters *4, 6* and *7* on 'Teacher's pedagogic practice', 'Gender and achievement' and 'Social class and achievement'.

15 *Ibid,* see chapter 3.

16 *Ibid,* see chapters 6 and *7. 17 Ibid,* see chapter 6.

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