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# STUDYING THE RECONTEXTUALISATION OF SCIENCE IN PRE-SCHOOL CLASSROOMS: DRAWING ON BERNSTEIN'S INSIGHTS INTO TEACHING AND LEARNING PRACTICES

ABSTRACT. This paper explores pre-school pedagogic practices related to science, and argues for the relevance of sociology of education for such exploration. It also argues that this approach has a wider applicability in analysing the effects of changes in education policy on (pre)school practice. A basic characteristic of pre-school organization in many western societies for many decades has been its play-like activity. This has required teachers to structure the experiences of young children by acting upon the contexts of learning rather than the content. However, current policy initiatives and developments in a number of countries in the 1990s, including Greece, demand that teachers make systematic use of specialised content from science, mathematics and other subjects to structure pre-school curriculum activities.In order to analyse pedagogical practice in a systematic way, and to explore issues such trends in policy might raise, we have obtained data by video-recording school science activities in a nursery classroom, and have developed a tool of analysis based on Bernstein's conceptual framework. In demonstrating the usefulness of the analytical tool, we provide evidence to support developing concerns that the emerging discourse of pre-school teaching and learning of specialised content is in tension with dominant pre-school pedagogical practices, and that the contradictory demands placed upon teachers might lead to a narrowing of the view of learning in pre-school classrooms.

KEY WORDS: boundary, classification and framing of knowledge, early childhood science teaching and learning, recontextualization of knowledge, sociological analysis of school practice, visible and invisible pedagogical practice

Is science learning important in early schooling contexts? Today, in addition to policy makers (Grieshaber, 2000), many science educators would argue for its absolute relevance, and the growing interest in teaching specialised content (science, language, mathematics) is reflected in publications, specialised conferences and courses, and, in the Greek context, in Pre-school Science Education, a distinct area of research and teaching in Education Departments.

But what could sociologists say about pre-school science? We wish to argue that sociology of education can play a major role in addressing critical issues in science education research and furthermore it can help bridge the gap between different research specialisms in education studies by providing a framework for interdisciplinary work.

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Traditionally, science education research has drawn on psychology as a framework through which to address issues of teaching and learning, against the background of a discipline, which carries respectability as well as a whole bank of 'tried and tested' research methods and procedures, with some claim to scientific 'certainty.' What psychology has not enabled science and other educators to address is how and why success and failure is distributed in a systematic way in schools and classrooms (Lerman & Tsatsaroni, 1998). Only recently, however, have psycho-social, social-cultural and sociological theories attracted the interest of science education researchers. The reasons for and implications of the rapid growth in recent years in the number of these approaches, not only in science education but also in the various specialisms of educational studies are multiple; and a sociological account of this trend goes beyond the scope of this paper (see Tsatsaroni, Lerman & Xu, 2003). One can mention the implications of the internal critique of Piagetian theories of constructivism, the debates over radical and social constructivist approaches, the rediscovery and the different readings of Vygotsky's theory in an effort to construct a convincing account of the socio-genesis of individual consciousness. Suffice here to recall that Vygotsky's central claim has been that higher mental functions in the individual have their origins in social life; and that a full account of them must be based on an understanding of the way in which psychological tools (symbolic artefacts such as signs and symbols) act in the mediation of social factors. Subsequent developments of this original theory seek to combine semiotic and activity-based accounts of the effects of the social on the individual. These theoretical developments provide the potential for investigating the development of cognition in context, and for understanding cultural and social factors as they impact upon learning (Daniels, 2001). Still, in Lave's words "without a theoretical conception of the social world one cannot analyse activity *in situ*" (1996, p. 7, quoted in Daniels, 2001, p. 102). Hence the suggestion that ". . . in order to try and understand why people act in particular ways we should study thinking, feeling, and communication in the context of specific forms of institutional organisation and practice" (p. 99). There is, therefore, a requirement for a structural description of social settings, which provides principles for distinguishing between social practices; and for a sociological theory that makes such descriptions possible.

Theoretical developments such as those described above have served to dissipate the view of researchers working in various curriculum specialist areas that sociology was only addressing educational issues at the macro level, or merely the social, as opposed to the cognitive, aspects of schools and classrooms. But we argue that mainstream science and mathematics

education research is still to be convinced as to the vital role of sociology in addressing issues to do with teaching and learning in schools. As Morais (2001, p. 32) also remarks: "In general, they [science educators] tend to feel that sociology is very 'loose,' poorly conceptualized and unable to help them with their research and practice . . . ."

In what follows, then, we shall first argue that Bernstein's work (1990, 1996, 2000) provides a perspective that allows the sociology of education to demonstrate its relevance for specialist areas of curriculum research. This argument is developed in the context of early childhood science education, an area which has not received as much attention as other levels of education. We shall also provide the key elements of Bernstein's theoretical account.

In the remaining parts of the paper we shall illustrate our position by describing in turn:

- The aims and method of a small pilot study, carried out in a spirit of co-operation between science education, and sociology of education researchers, and which involved a teacher developing science activities in her nursery class.
- A preliminary analysis of the pedagogic discourse constructed, followed by a description and analysis of data obtained from the classroom practice.
- Our provisional conclusions, together with a brief elaboration of some aspects which, although indicated by related approaches, could not have been established so systematically and clearly, as to their consequences.

## EARLY CHILDHOOD SCIENCE EDUCATION AND SOCIOLOGY OF EDUCATION

### *Stability and Change in Pre-school Provision of Science*

There are certain features in early childhood education provision that have been stable for several decades internationally. In the 1970s, Bernstein (1977, p. 511) refers to the dominant pre-school/infant school pedagogy in terms of the following characteristics (cf. Alloway, 1995):

- The control of the teacher over the child is implicit rather than explicit;
- ideally, the teacher arranges the context which the child is expected to re-arrange and explore;

- within the arranged context, the child apparently has wide powers over what he/she selects, over how he/she structures, and over the time scale of his/her activities;
- the child apparently regulates his/her own movements and social relationships;
- there is a reduced emphasis upon the transmission and acquisition of specific skills;
- the criteria for evaluating the pedagogy are multiple and diffuse.

Bernstein argues that this creates an *invisible* form of pedagogy where the criteria for knowledge transmission, being multiple and diffuse, are transmitted through *inter-personal* forms of control. This contrasts with visible forms of pedagogy, characterised by explicit criteria of evaluation transmitted through explicit hierarchical relationships between teacher and pupil. On the other hand, the aspects of the child that have high visibility for the teacher in pre-school pedagogy are described by the concepts of *readiness* and *busyness*. The former points to the inferences the teacher makes about the developmental stage of the child, from the child's ongoing behaviour, in accordance with Piagetian theory. The second prescribes that children should be busy doing things and that the child's present activity reveals his/her state of readiness. Furthermore, Bernstein notes that the fundamental concept underlying the concepts of readiness and busyness is that of *play*. Play-like activity is the dominant form of pedagogy in early childhood education (and, one could argue, in those types of school which provide for less able children).

Bernstein notes, however, that not all forms of doing are considered as play, and are as legitimate in the nursery classroom; furthermore, play does not merely describe an activity but also contains an evaluation of that activity, as in productive and unproductive play, solitary and social play. What remain invisible in this form of pedagogy are the teacher's theories. In particular, the concepts just referred to entail a theory from which interpretation, evaluation and diagnosis are derived. The theory covers nearly all the child's doing and not doing, and, as a consequence, it gives rise to a total – but invisible – surveillance of the child.

Bernstein also argues that, as with all pedagogic theories, this form of pedagogy and the theories supporting it are not ideologically neutral. Both in terms of how criteria of knowledge are transmitted, and in terms of its form of social control, invisible pedagogy has its origins in the new middle class (Bernstein, 1990). This implies that the power and control relations governing pedagogic discourse position children in lower social classes in a disadvantaged relation to the acquisition of school knowledge (Singh, 2001). For instance, there is a difference between working class

and middle class children concerning their attitudes towards work and play. For the former, work and play are distinct and separate activities, while for certain strata of the middle class, there is no strict line separating them. This is likely to affect their relations to school knowledge (Cooper & Dunne, 2000).

It is of interest to note that twenty five years after Bernstein's aforementioned paper there is still at present a wide consensus, at least among teachers, teacher educators and education researchers, if not necessarily among policy makers, regarding child-centred pedagogies in pre-school classrooms (File & Gullo, 2002; Riksaasen, 2002). This justifies an approach to the teaching of science where the 'child acts as a scientist.'

But here we also note a paradox. There is a parallel tendency, which appears to conflict with the one just mentioned. If we take the case of Greece, since the mid 1980s the training of both pre-school and primary school teachers was moved from colleges of education to university departments. But the more the early childhood education departments established and organised themselves in universities, the more they followed similar moves to those of primary education departments such as, for example, the provision of specialised courses that aim to structure pre-school teachers' frameworks about science. The double pressure upon pre-school education departments to differentiate themselves from primary education departments and simultaneously to specialise their teaching certainly had diverse consequences; but one of these is the emphasis put on the *necessity for a more systematic use of specialised content* from science (and other subjects) to structure pre-school curricular activities. This apparent paradox of simultaneously emphasising play and arguing for the systematic use of specialised content is currently becoming more prevalent, at least in certain countries, because of factors outlined next.

There is a general move to restructuring (Ball, 2001; Broadfoot, 1998) at all levels of education which in many countries took place in the 1990s – with the implementation of national curricula, setting of teaching and learning targets, national assessment tests, new inspection procedures, and the whole discourse of performativity. Thus the emphasis on assessment, in particular, which in other levels of education has become the dominant discourse, might have consequences for nursery classes as well. For example, we can probably assume that the national test for assessing pupils' knowledge at the age of 7 in England will have direct effects on the content and pedagogy of nursery education (Tunstall, 2001).

The emerging 'learning society' discourse might also affect educational provision in nursery classes. At the level of rhetoric, at least, there is already a call for intensifying learning processes at all levels of the education

system, including or rather paying particular attention to early ages of schooling. Thus in Greece, for example, there is talk about the need for compulsory nursery attendance (and/or provision) and more systematic ways of organizing knowledge, demands which in fact create a lot of confusion. Therefore, one can hypothesise that the more emphasis is put on systematic provision in nursery classes, the more nursery school teachers will be pressed to introduce activities with more specialised content, especially from science, mathematics, and possibly computer science, which arguably underpin 'the knowledge society' in the 'information age.'

If with these developments education continues to be (or becomes more) central to the knowledge base of society, groups and individuals, then, we argue, specialist curriculum research does need the sociology of education to understand the effects of the changes. For, as Bernstein (2000, p. xix) remarks, "... we must have an analysis of the social biases in education. These biases lie deep within the very structure of the educational system's processes of transmission and acquisition and their social assumptions."

### *The Relevance of Sociology and of Bernstein's Work for Early Childhood Science Education: Possibilities of the Theory*

In one of his essays in the influential collection '*Knowledge and control*,' Young (1971) observes that sociologists in colleges, institutes, and departments of education tended for years to neglect the study of curriculum. He suggests that a fear of 'boundary disputes' with philosophers of education and curriculum specialists led sociologists of education to shy away from an analysis of the content of schooling. In an equally important and well-known volume of sociological work, Karabel and Halsey (1977) remark on Young's point that this was true. There was also the problem that "... the ill-defined character of the available methodologies [in the sociology of education] seemed incompatible with the development of a rigorously empirical, scientific discipline" (p. 51).

Since the 1970s there have been significant changes in the field of the sociology of education, as well as many changes in the way knowledge is produced and in the relations among sub-fields in the field of knowledge production, which necessarily affect educational research communities and relationships among these communities. One consequence, we believe, as argued earlier, has been the growing interest in sociology, particularly among educators and researchers who would traditionally have ignored this field.

In this paper, we wish to show that Bernstein's theory is a crucial element in a 'policy' and practice of educational research that starts from the view that sociology of education can and must play a central role

in the exploration of pedagogical and instructional issues. It provides a conceptual framework with great power in describing the empirical. Further, its systematic and elegant character as a theory should have special appeal to science (and mathematics) educators and researchers (Bernstein, 2001; Morais, 2001). Concerning its first feature, Bernstein's theory provides tools for analysing and describing educational processes at all levels: classroom interactions and the form interactions take, depending on the type of practice dominant in the process of knowledge transmission; the construction of knowledge and its transformation into a school form of knowledge; the analysis of the different fields and sub-fields, agencies and agents within an education system; and, in his most recent work, the analysis of the field and sub-fields of knowledge production (Bernstein, 1999). His aim has been to develop models and what he has called a language of description of the empirical (Bernstein, 2000; Moore, 2001a, 2001b).

Among the key ideas and essential elements constituting Bernstein's theory, we shall mention here those that underpin the rationale, design and development of our study.

Over four decades of research, Bernstein (1990, 1996, 1999, 2000) focused on the institution of the modern school arguing that this has been designed to transmit two kinds of knowledge: knowledge pertaining to abstract concepts and skills and knowledge pertaining to moral conduct. Bernstein suggested that these two modes of knowledge are transmitted principally via specialised, pedagogic discourses. Thus pedagogic discourse is a single discourse, created by the embedding of an *instructional* (i.e., knowledge and skills and their relations to each other) into a *regulative* discourse (principles of social order, relation and identity). *Recontextualising* agents, such as syllabus writers and classroom teachers, select, organise and define "in evaluative criteria" knowledges to create an instructional discourse for the purposes of teaching and learning (Singh, 2001, p. 253). The regulative discourse establishes the order within the instructional discourse. It generates principles of selection, organisation, sequencing, pacing and criteria of evaluation. It also "mobilises theories of instruction" (Singh, 2001, p. 253) and thus contains a model of the learner and of the teacher, as well as their relationship (Bernstein, 1990, 1996). Thus the specialised interaction practices between teacher and student are constituted by the regulative discourses, and the form that instructional discourse takes has important regulative features. For example, the more highly controlled the instructional discourse, the more likely it is that regulative discourse is constituted by imperative and positional modes. When learners have more apparent control over instructional practice regulative discourse is likely to take more personal modes. The more implicit is the

hierarchy, the more the control will inhere in interpersonal communication. Therefore, for Bernstein regulative discourses perform a crucial ideological function because they conceal the relations of power and control generating the arbitrary internal ordering of school knowledge (Bernstein, 2000; Singh, 2001, 2002).

Instructional and regulative aspects of the discourse, described in terms of distribution of power and principles of control, can generate a variety of pedagogic structures, distinguished according to their organising principles.

*Power* relations refer to the strength of the insulation of the boundaries between categories of agents, pedagogic discourses and institutional contexts. "Power relations . . . create boundaries, legitimise boundaries, reproduce boundaries, between different categories of groups, gender, class, different categories of discourse, different categories of agents" (Bernstein, 1996, p. 19). Power relations establish and legitimise relations of social order.

Relations of *symbolic control* refer to the legitimate relations of communication appropriate to the different categories of agents (i.e. teacher–pupil, different categories of pupils), discourses (different categories of knowledge), and contexts (spaces within the school). Principles of control carry the boundary relations of power and socialise individuals into these relationships. These principles carry both the power of reproduction and the potential of its change.

In other words, Bernstein's theory allows us to focus on two levels: a structural level and an interactional level (Daniels, 2001). The former is analysed in terms of the division of labour it creates and this is in turn analysed with respect to the degree of specialisation of its categories. Structures are distinguished in terms of their category relations, and the key concept at the structural level is that of *classification*, which refers to the degree of maintenance of boundaries between categories. The interactional level is analysed in terms of the form of social relations it creates. It focuses on the regulation of the transmission and acquisition relations between teacher and pupil. The key concept at this level is that of *framing* which refers to the control over the selection, sequence, pacing and evaluation criteria; that is, the discursive rules which regulate instructional practice and the hierarchical rules which regulate norms of social conduct. Power relations generate *recognition rules* – rules for distinguishing between contexts. Control is the communicative realisation of these relations and manifests itself in pedagogic communication governed by *realisation rules* – rules for the creation of specialised texts within contexts (Bernstein, 1990, 2000).

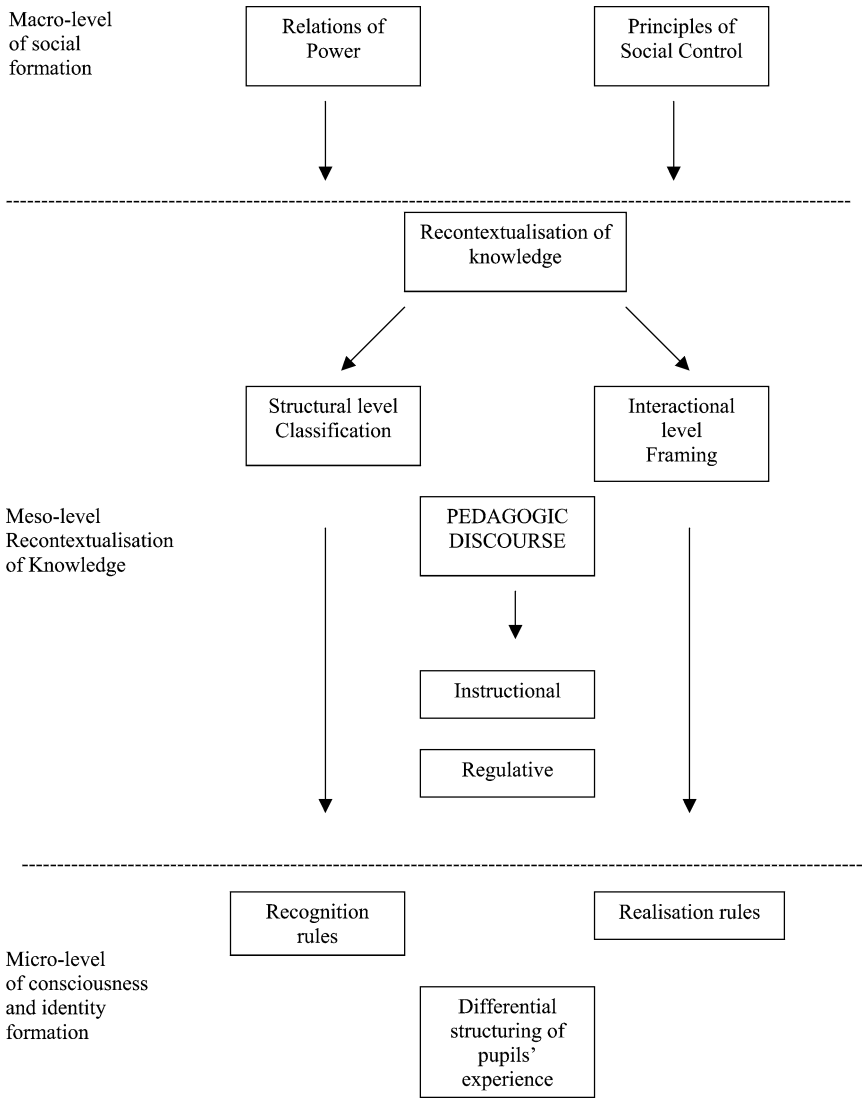


*Figure 1.* Key elements of Bernstein's theory: the construction of pedagogic discourse.

Figure 1 presents together the essential elements of Bernstein's theory referred to above, and we shall now draw on school science to illustrate these theoretical terms.

First, we should point out that distinctions such as research and teaching practice, and teaching of specialised or non-specialised pedagogical scientific contents, are expressions of more fundamental structural differences in the distribution of material and symbolic resources in a given society. Therefore it is always important to examine how given distinctions are

created, how they are maintained and how they help to reproduce more fundamental distinctions. This, in essence, means that from the sociological perspective, and from Bernstein's perspective in particular, the selection, transmission, acquisition and evaluation of pedagogical scientific knowledge are not neutral procedures, i.e. products of rational decision-making (e.g., distributed according to age). Rather, they are socially determined, in the sense that they are fundamental mechanisms for the reproduction of structured inequalities. Figure 1 shows three levels of this process: macro, meso and micro levels.

The dominant *power and control relations* operating in a given society can be traced in the way that '*school physics*,' on the one hand, and '*science related activities*,' on the other, are constructed and placed in a secondary and in a nursery school curriculum, respectively; as well as in the way in which a hierarchical structure connecting these two levels of schooling (and their respective agents, such as teachers) is created and reproduced over time (see the section "The empirical study and its context" and the sub-section "Background analysis of available teacher-positions in the discourse" below). Furthermore, we have to examine both their internal constructions as school subjects, and their relations to other pedagogical contents in the curriculum. That is to say, we have to analyse the actual processes of *recontextualisation* of scientific knowledge and the *classification* and *framing* rules, structuring the respective pedagogic discourses, at the *structural* and *interactional* levels. Thus, usually, specialized science textbooks (or forms of specialialised instruction and communication in the classroom) tend to prevail in upper secondary education, with strong boundaries separating school science (and the teachers of science) from other pedagogical content (and teachers of other subjects). In contrast, in nursery classrooms, usually, there are texts (and most usually, non-specialised oral pedagogical communications in the classroom) with activities related to science topics, integrating different kinds of school and out-of-school knowledge. An expression of different classificatory principles in the structuring of the curriculum is the teaching (learning and evaluating) of electromagnetic forces in upper secondary education, as opposed to magnetic properties in the nursery classroom. At the interactional level, the framing rules structuring the pedagogic communication in a school physics classroom tend to be explicit and visible, while usually in a nursery classroom interpersonal and invisible rules of pedagogic communication tend to prevail. At this level, we need to examine both the *instructional* and *the regulative* aspects of the pedagogic discourse. To explain these terms we use episode 57 from our empirical data, cited below (see section on "Analysis of data"). The episode displays the interaction

between the teacher and the nursery school children in the course of an activity aiming to assess children's ability to distinguish materials susceptible and not susceptible to magnetic forces. Thus *evaluation* of taught content is the prevalent aspect or element of instructional discourse, and given that this activity has been chosen by the teacher in advance, there is no doubt that power relations are, indeed, in place in this classroom. However, we can note immediately that within the frame of this activity, a pupil called Christina, proposes and introduces elements of another discourse, the discourse of counting, and furthermore that this is not only accepted by the teacher, becoming a legitimate content of pedagogic communication, but is accepted in a form of interpersonal communication which hides from view the existing power relations: "Do you want us to count where there are more?" (line 819). This means that the rules for the *selection of pedagogic content*, another element of instructional discourse, appear to be under the pupils' control. The invisibility of power relations is more evident in the elements of discourse which most clearly belong to the regulative aspects of pedagogic discourse. As mentioned, Christina *initiates* (line 818) and also *closes* (line 827) this episode. As the teacher responds positively to Christina's suggestions, the hierarchy structuring the pedagogic relation remains invisible. However, during the course of interaction, the teacher attempts to *state* her power and control over the activity and the pupils, by making reference to the evaluation criteria of the practice, the main element of instructional discourse in this conjuncture: "The ones that attract each other, that's the one that won, isn't it?" (line 826); as well as to have the final word, that of evaluator, in the discourse: "Fine, well done" (line 826). Christina's challenge of the teacher's power through her successful attempt to impose her definition of the activity as a competitive game with winners and losers in the closing line of the episode (line 827) 'distracts' the teacher from asking questions which would help to make unambiguous and explicit the criteria for assessing the deeper understanding of relevant pedagogic content. Christina herself might or might not have understood the activity as both a science related activity and a competitive game, but it is always important to examine how the social and cultural background of individual pupils impinge upon their ability to do so, i.e. upon their *recognition* and *realization rules* structuring the cognitive, emotional and behavioral aspects of their response in this and similar situations. At the same time, her 'missing' the opportunity to act as a transmitter and evaluator of specialized knowledge, and her apparent willingness to act as a provider of context-specific, and often action-orientated and play-like activities, noticed in many instances of our empirical data, are (symbolic) means through which this *teacher's identity* is constructed as different

from, say, a teacher of physics in upper secondary education, responsible for teaching and assessing physics, as one of the most specialized and highly valued subjects in the school curriculum.

In one of his last pieces of writing Bernstein intimates that the tacit metaphor driving the conceptual language of his theory is that of 'boundary.' He writes:

> I have been concerned with how distributions of power are realised in various, and often silent, punctuations of social space which construct boundaries. I have been equally concerned with how these boundaries are relayed by various pedagogic processes so as to distribute, shape, position and opposition forms of consciousness (Bernstein, 2000, p. xiii).

The theoretical models developed from this conceptual framework help one ask how concepts relate to each other and to the organising rules and principles. They help to raise questions in a systematic way about the research problem under consideration. For example, when he distinguishes between open and closed schools, in his early work, the distinction was based on the principles of "boundary rules: things must be kept apart: things must be put together" (Bernstein, 2000, p. 123). The question was how things (i.e., categories at the level of: values, curriculum, teaching groups) are kept apart and how things are put together, and the research question was to find the model, i.e. the organising principle, for generating a range of forms of school organisation, knowledge transmission, acquisition and evaluation. This also led to further questions such as: in whose interests is the apartness of things? Whose power is maintained by such boundaries?

Research questions generated in other theoretical frameworks can benefit from the application of Bernstein's theory (Morgan, Tsatsaroni & Lerman, 2002). In particular, the systematic description facilitated by the theory can help science educators to raise the following important questions regarding policy issues, processes of knowledge provision and effects on equality and justice:

- Whether a change in policy (or an innovation) in schools changes the way teachers and pupils relate to each other, between and within groups;
- which group's social assumptions, values and norms are promoted and underlined, and therefore presented as general;
- which social category of pupils is likely to benefit from an innovation or change in arrangements;
- whether an innovation is a change, or a version of the same, that is, whether it ameliorates or reproduces social inequalities.

To repeat, the most important contribution of Bernstein's theory to educational research relates to its capacity to hold together in one picture the

macro- and micro-levels of analysis: the wider social structure and changes in that structure, issues of state educational policy, the everyday activities of pupils and teachers in the classrooms and their short and long-term effects on the educational careers of pupils (and teachers). It requires and facilitates at once the study of rules of knowledge distribution, that is, relations of power, and the conditions under which students acquire evaluation criteria, that is, principles of control and identity formation. This is to say that, in essence, the weak or strong boundaries separating school science from other subjects in the curriculum and from the everyday world of the pupils, and especially the explicitness or implicitness of the criteria for what constitutes a legitimate response to teachers' questions in a science lesson, are the symbolic means through which pupils' identities are differentially structured. In this sense, among sociological theories, Bernstein's work is particularly useful because it describes and helps to clarify what sociology in general can bring into the field of science, or other specialised areas of the curriculum, namely the idea of *the socially constructed* nature of school knowledge and practices (Cooper & Dunne, 2000; Dowling, 1998; Morgan, Evans & Tsatsaroni, 2002), and a sustained application of this idea. Furthermore, it allows us to investigate pedagogic practices in relation both to the official curriculum discourses and to those produced by the specialised research activities of the relevant educational research communities. This permits us to study better the positions, practices and values available to teachers as well as to (different categories of) pupils.

We thus believe that in the politics of educational research, Bernstein's theory, inspired by the view that "the elegance of the formulation and the generative power of the concept for empirical description are equally important" (Bernstein, 2001, p. 372), might play the role of the catalyst in relations between the sociology of education and other fields such as science and mathematics education. In particular the latter are likely to appreciate the striving for the (common) value of elegance, systematicity and generative power of highly powerful concepts.

## THE EMPIRICAL STUDY AND ITS CONTEXT

The project[1] starts with Bernstein's concept of recontextualization which suggests that any specialised discourse becomes pedagogic through a process of selection, simplification, condensation, repositioning and refocusing of the contents that transform the discourse and the social relationships (Bernstein, 1990, p. 191–192). It thus aims to describe how the contents of science are recontextualised in the everyday activities of nursery classrooms, to analyse the type(s) of pedagogical practice and the form(s) of

pedagogical relationship constructed, and to investigate the social consequences for the infants and nursery school teachers.

In the pilot study, in particular, we focused on the recontextualisation of science and the production of the 'science-related activities in early childhood classes' as well as on the type of pedagogy and forms of social relations in the realization of these activities in the nursery classroom. We also considered the positions available to the teacher in the discourse constructed.

The study was designed by the research team, comprising the authors of this paper and a secondary school teacher with experience as an advisor of nursery school teachers concerning science teaching and evaluation.

Initially the research team chose the scientific topic, namely 'magnetic properties,' specified the learning objectives, developed a set of ten activities, and organised them into a written 'plan of work.' Given the emphasis on developing tools for recording and analysing data it was also decided that only one nursery school teacher with her class should be invited to participate in the study at the pilot stage, and the 'plan of work' was meant to direct and assist her in carrying out the teaching of the chosen topic.

We chose the topic of magnets and their properties because one of the research team members had previously done some systematic preparatory work in developing and trying out relevant activities for children of preschool age (Ravanis, 1994, 1996, 2000). These studies, which were based on both quantitative and qualitative analyses, showed that children of this age were able to satisfy the demands of activities aimed at discovering magnetic properties. Nursery school teachers, on the other hand, had the opportunity to develop a range of strategies in realising these activities. Both of these findings were relevant to the present study.

The learning objectives were defined as follows:

(a) Children to experiment with and learn about the magnetic attraction of certain materials, and to distinguish material susceptible to such attraction from materials not susceptible.
(b) Children to experiment and learn about the mutual attractive and repulsive properties of the magnets.

The activities proposed in the 'plan of work' were of three kinds:

- Free experimentation with magnets and objects attracted and not attracted by magnets, and free experimentation of mutual attraction and repulsion of magnets of different shapes.
- More organised activities, where children were asked specifically to use magnets to attract metallic staples without touching them. In this category we include play-like activities, such as a role-playing game

where two children take the role of magnets and the rest the role of objects, with music to co-ordinate the playing of the game.

- Activities that would help systematise the knowledge acquired and/or evaluate whether the learning objectives were achieved. In this category are included activities such as asking children to classify objects according to whether they are attracted or not by magnets.

Given that pre-school classrooms usually consist of two age groups, in the 'plan of work' 5 to 6 year-old children were recommended. The time that could be devoted to each learning objective was indicated: 30 minutes for the first, 20 minutes for the second and 15–20 minutes for evaluation activities.

The teacher who carried out the activity of the pilot study had 15 years of teaching experience and agreed to participate, prepare the material needed, and modify the activities designed by the research team to fit her own teaching purposes. Like most nursery school teachers, she has no specialist training in science. When the teacher met with the research team, it was made explicit to her that the designed activities were meant to assist her and that she could make as many changes as she thought necessary.

Two weeks were considered enough for the preparation of the activity by the nursery school teacher. No other directions were given to her apart from the activities proposed.

The teacher realized the project in two consecutive days, carrying out each of the activities within the time period set, and with nine pupils participating from the age group recommended. Activities were videotaped. The transcript of the video as well as the written teaching plan prepared in advance were the main sources for constructing the research data. The field-notes kept during the whole process were also used.

*Background Analysis of Available Teacher-Positions in the Discourse*

We referred earlier to the practices in the transmission and acquisition of science knowledge in nursery classes that are current in Greece and other countries, noting in particular the paradox whereby play-like activity as the dominant mode co-exists with an increasing emphasis on the necessity of systematic provision of scientific content (concepts, skills and attitudes). As already argued, this has been created by recent developments – notably by the curious combination of an expansion in the relevant research field, and changes in policy and the wider context.

This line of thinking helped to refine our research aims and questions as to how science is recontextualised in nursery classrooms, and the effects of this recontextualisation on the pedagogical relations and outcomes. The aforementioned paradox required that in investigating these research ques-

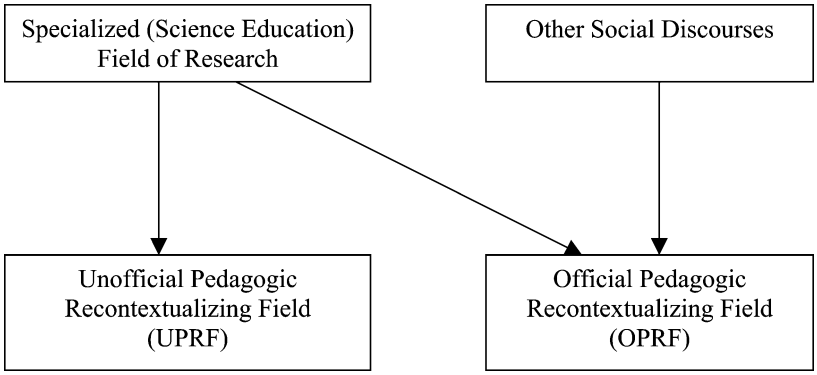


*Figure 2.* Fields and sub-fields in the production of discourses on pre-school science provision.

tions we should also analyse the discourse within which teachers make their decisions and deploy their actions. Previous analyses (Bernstein, 1996; Makrynioti, 1999) showed that there had been a convergence of views between official policy agents, on the one hand, and teacher trainers and researchers, on the other, regarding dominant practices in pre-school settings, which was expressed, sustained and reproduced through the idea of play-like activity as the proper form for nursery classes. If one cannot assume that a discourse is ever unitary, one can still expect that such convergence of views was less likely to create tensions and contradictions in the discourses teachers drew on to shape their pedagogic practice. In contrast, the emerging discourse might create different teacher-positions that will create tensions and pose contradictory demands upon the teacher of the nursery class.

As implied, we take the view that pedagogic discourse is not unitary but consists of an official and other unofficial discourses (see Figure 2). The official discourse is produced by recontextualizing agents, operating in the *Official Pedagogic Recontextualizing Field* (OPRF) (Bernstein, 1996), that is, government departments and agencies. To produce this discourse, official pedagogic agents draw on a set of discourses and practices, available within the field of recontextualization, and subsume them under their aims and purposes. Among such discourses are those produced in the field of production of knowledge by the activities and practices of pre-school (science) education research, and circulated within the *Unofficial Pedagogic Recontextualizing Field* (UPRF), such as teacher training courses. Elements of these are appropriated by official agents, often constituting central elements of the official discourse. Elements of discourses produced by other educational communities and circulated within the UPRF such as discourses on continuity between levels of schooling, or school effective-

ness might also become elements of the official discourse. We can, then, say that the official discourse consists of a variety of elements drawn from heterogeneous discourses, some of which form unofficial, sometimes oppositional educational discourses. The official discourse, constituted in the OPRF from various discursive resources and expressed in the pre-school curriculum, has, for a long time, in many western countries, institutionalised and sustained one dominant type of practice, *invisible pedagogy*: a modality of pedagogic practice with weak framing values whereby "the rules of regulative and instructional discourse are implicit, and largely unknown to the acquirer" (Bernstein, 2000, p. 14). Here the acquirers apparently have a great measure of control over the selection, sequencing, and pacing rules, and the criteria of evaluation of instructional discourse are likely to be implicit and diffuse. This makes available to the pre-school teacher the position of *facilitator* and constitutes the pupil as a self-regulating acquirer.

A second aspect of the production of the discourse is that among its constitutive elements are theories, evidence, arguments, in short projections of practice produced by agents operating in the *Specialised Education Fields of Research*. As argued, these become resources that the official discourse draws on to prescribe forms of action, though they are subject to recontextualizations and multiple transformations. They can also relay different and, at times, oppositional voices (Morgan, Tsatsaroni & Lerman, 2002). We can see that the initial 'plan of work' was prepared by the 'research team;' it was a product of agents operating in the field of research. More concretely:

- The 'plan of work' for the pre-school science activities, designed by the secondary school science teacher on the team, was ultimately the product of co-operation among the members of the research team. The latter aimed at formulating a research programme that would bring together the concerns of a specialist in science education and a sociologist of school knowledge. Given the theoretical and practical limitations of the dominant idea of the teacher as researcher (Foster, 1999; Hammersley, 1993; Solomon & Tsatsaroni, 2001), the research team had made the decision that the best way to communicate these research concerns to the teacher who was to realise the activities in the nursery class was through designing and explaining the plan of work. It could, therefore, be argued that this plan of work contained research objectives which, in the process of their translation into explicit teaching objectives, remained, to a great extent, implicit to the teacher.

- The topic of magnetic properties was chosen by the research team – and did not emerge from everyday school practice, as is usually the case in pre-school classes. Furthermore, the reasons for choosing such a topic which have to do with, among other things, the need to consider issues from different theoretical perspectives was the main concern of the research group, and not necessarily the teacher who probably was unaware of such research literature.
- The rationale for the teaching objectives was complex, hence difficult to communicate to the teacher. In particular the selection of sequencing rules – the order for the unfolding of the activity (Bernstein, 1990) – and the criteria of evaluation of pedagogic activity were based on empirical, sociologically informed research findings (Cooper & Dunne, 2000; Morais, Fontinhas & Neves, 1992), and the concerns of the sociologist in the group with issues of equality in knowledge provision. These theoretical and political concerns remained, to a great extent, implicit.

This description makes clear that the explicit teaching objectives, guidelines as to the sequencing rules, and activities of evaluation serve the purpose of creating a more visible form of pedagogy: a modality of pedagogy formed by explicit rules of instructional and regulative discourse. This pedagogy privileges certain aspects and contents of science, and also serves to regulate the actions of the nursery class teacher: for the teacher who adopts this position, the origins of the principles that regulate the practice, i.e. the specialised education theories and research practices – perhaps more than the origins of the principles of invisible pedagogy that is dominant – operate as an invisible control, providing criteria to evaluate her practice. We can refer to this position available to the teacher as that of '*transmitter of specialised knowledge*.'

A third important aspect of the discourse is how it is deployed in practice. In order to examine the deployment of the discourse in practice, we must analyse teachers' positions within it, that is to say their position vis-à-vis the official discourse, the resources on which they draw and the practices, i.e. the criteria used, and their orientation to the task (Morgan, Tsatsaroni & Lerman, 2002). What affects the recontextualization at this level is a crucial question. What are the resources teachers use to construct their position and deploy 'appropriate' practice? We have already indicated that both the official discourse (including elements of specialised education research discourses), and the specialised education research field, independently available within UPRF, provide resources to teachers. But in addition, the strategies teachers deploy in doing their task and in justifying their practices depend on how they interpret their own schoolwork activ-

ity. Strategies might be drawn from specialised, which Bernstein (1999) calls vertical discourses, but also from horizontal discourses, i.e., forms of knowledge usually typified as everyday or common sense, from other local contexts in which teachers live and act. Such discourses, which we can call *social discourses* (see Figure 2), are additional resources for teachers. In the pilot project, structurally, there were two points of 'entry' for the teacher to influence the process of recontextualization. In addition to changes that she could make and indeed did make (see below) in the *Recontextualizing Field* of the nursery class, the research team had invited her to make her own teaching plan. Changes introduced by the teacher at these two stages can be treated as analytically distinct in order to analyse her actual positioning in the practice. Consequently, we argue that the preceding background analysis is a necessary stage in the research process, for it helps us to identify the subject-positions, here the position of 'facilitator' and of 'transmitter of specialised knowledge.' It also helps us to see that these positions are differently resourced, they prescribe different forms of action and they are linked to different, opposing forms of pedagogy – an invisible, and a more visible form, respectively.

Here a couple of methodological points are in order. The approach to the research problem just described, first, suggests that the systematic analysis of the video-recorded material of the pre-school science classroom, which was the principal object of analysis in the pilot study, can be facilitated by the application of Bernstein's theoretical framework to the analysis of the construction of the discourse and the subject positions that it makes available. Second, it shows the importance of theory in conceptualising a research project, because this background analysis, facilitated by Bernstein's theoretical framework, helped us not only to refine the research questions already posed and make sense of the available information, but also to open up one aspect of the research problem which is of immense importance for understanding the subject-positions in the discourse. This relates to the internal structure of science education as a research field and the kinds of resources that this makes available to teachers. Consequently this aspect has been taken up in the redesigning of our ongoing research project (Bernstein, 2000, p. 155–174; Morgan et al., 2002).

### *Research Questions*

We now turn to the transcript of the video, and the teacher's written teaching plan, that were our main sources of data during the piloting of the project. Here we shall refer to our research questions, and in the subsections that follow we shall describe the research tool, explain the method-

ological steps we have followed to address the transcript, and consider aspects of the analysis and some of the research findings.

Our earlier background analysis sought to identify the positions available in the discourse of school science provision. We identified two opposing positions for nursery school teachers which, in fact, may or may not be occupied by the nursery school teacher in the situation in the transcript. Furthermore the teacher may at various moments in the education process occupy either – or both – of these positions. Also, the resources she draws on to interpret our guidelines and read the plan of work might affect her positioning. Finally, the dynamics of the situation and the interactions between teacher and pupils and pupils themselves might affect the positionings of both the teacher and the pupils, as well as the construction of the message to the nursery class children as to what is (school) science.

Therefore, in addressing the transcript we focused on the form(s) of practice constituted in the nursery class and the kind of social relationships that characterised it, and we sought to identify *the ways in which the teacher and children were positioned or sought to position themselves in the practice*. The research questions we asked at this stage were:

- What contents were privileged?
- What resources did the teacher draw on, i.e. what educational theories and pedagogical models?
- What form of practice was introduced?
- What form of control regulated the pedagogical relationships?

### *The Research Tool*

The core of our research tool consists of the set of questions that were used to address the transcript and identify the form of practice constructed from the teacher's recontextualisation of school science activities. These questions follow from the concepts of classification and framing, provided to describe the construction of school forms of knowledge and practice.

From the concept of *classification* come the first two questions mentioned in the previous section:

- What sorts of changes are introduced in the content, both during the redesigning of the activities and in its realization in the classroom? To record information relevant to this question we considered whether the teacher had added any new material (e.g., a paint-brush), new activities (e.g., constructions made of paper), or whether she omitted material and activities suggested to her in the 'plan of work;' added elements that emphasise the pedagogical character of the activ-

ity (e.g., formulating conclusions) or elements that are seen to imply the scientific character of the activity (e.g., scientific terminology).
- From what contexts does the teacher draw resources in making the changes? Here we considered three kinds of contexts, the scientific, the school and the everyday, in order to understand how the teacher understands the relationship between everyday and scientific domains.

From the concept of *framing* derive the other two questions introduced above:

- What is the form of practice constituted in the nursery classroom?
- What form do the social relations between teacher and children (and among children) take?

These questions in their operationalisation were grouped together according to different framing rules (Bernstein, 1990):

- Who initiates the opening and closing of episodes of each activity and what is the form of intervention adopted by the teacher?
- Who controls the pacing of the activity, and
- Who formulates – or controls – the conclusions during and in completing the activity (criteria of evaluation)?

The transcript as a whole, containing all the activities that took place in the nursery class in the two days of the realization of the study, is taken as one instructional unit, then divided into 126 episodes. An episode is defined as a segment of a lesson. Criteria for distinguishing between episodes were: changes in the stage of an unfolding activity; changes in stated or implicit demands for pupils' actions raised by the teacher; a question, remark or decision a pupil might make, and other similar ways that might mark a change. Then the two sets of questions derived from the concepts of classification and framing respectively, as presented above, were treated separately. In order to ensure consistency in the coding procedure, data were read first individually and then collectively and agreement was reached as to what information should be coded for each of the dimensions that operationalised the research questions.

We now indicate how we analysed the information in exploring the questions that relate to classification. Because of lack of space we do not deal with the questions that relate to framing, but we give some examples of the kind of analysis done.

*Analysis of Data*

The research team proposed to the teacher ten activities on the topic of magnets and their properties. These activities were of three distinct kinds:

activities of free experimentation; more organised activities, some of which were play-like ones; and a third category aiming to systematise and evaluate the achieving of learning objectives.

The analysis of the coded information corresponding to the two questions that operationalise classification shows that the teacher redesigned and realised the activity, making several important changes to the team's initial recontextualisation of science for teaching purposes.

Concerning the first question the teacher made changes in the content, as follows:

- She added new material such as a paint brush, a hammer, transparent glasses, some of which were functional, while others were chosen to attract the interest of children.
- She introduced new activities to achieve the teaching objectives suggested by the research team. For instance, in the example given below, the teacher introduces an activity which requires children to use their magnets to catch from a bowl fish with metallic staples attached to them. Children are meant to experiment with and learn about magnetic attraction exerted on certain materials. However, the children's and teacher's attention shifts to being able to recognise different kinds of fish.

*Episode 22*

(T: teacher, Ps: several pupils, P1: one, unidentified pupil.)

| | | |
|---|---|---|
| 166 | T: | (*The pupil is trying to catch a fish with his magnet.*) Oop! What did you catch, Konstantine? |
| 167 | Ps: | A fish, and a boot . . . |
| 181 | T: | What did you catch? One little rubbish from the sea water (*the teacher smiles*). |
| 184 | T: | Oop, what did you catch, Foti? |
| 185 | Maria: | A shark. |
| 186 | T: | Is this a shark? |
| 187 | Christina: | No, it is a swordfish. |
| 188 | Fotis: | Swordfish. |
| 189 | T: | Swordfish, come Christina . . . |
| 199 | T: | What did you catch, Maria (*it is noisy, as the pupils are talking to each other*). |
| 200 | Maria: | A crab (*pleased*). |
| 201 | T: | A crab, is it? |
| 202 | Ps: | Yes . . . |

- The teacher also introduced elements from pedagogical-instructional practices, usually met in primary schools, such as summing up what

was taught, and formulating general conclusions; practices such as counting material, classifying objects by size, these performed in a playful way; and also activities drawn from the pedagogical practice of music and movement. The first of the examples that follow is from the latter case. The teacher asks the children, each representing either a negative or a positive pole, indicated by a label stuck on them, to take a position in a circle such that opposite poles stand next to each other, the children holding hands. They are, then, instructed to move round the circle and take turns in walking out and in again to another position between two children of the "opposite charge," whenever she strikes the drum. The activity is meant to be an application of knowledge already acquired on the mutually attractive and repulsive properties of the magnets. But music and movement, expressing the need felt by the teacher to draw on familiar pre-school practices, take precedence over the understanding of the rules structuring the task. In the second example the notion of 'more' is introduced with connotations from both the school and everyday discourses. It is interesting also that the latter is introduced by a pupil. The teacher responds positively, making it a legitimate content of the ongoing pedagogic activity, concerned with assessing children's ability to distinguish materials susceptible to magnetic properties from those which are not, in a context of a competitive game between two groups.

*Episode 59*

914 T: Fine. So, listen, I have something to say to you. I am going to strike the drum . . .
915 Ps: Yes.
916 T: And as I strike, you are going round and round (*the teacher takes the drum and pulls the chairs away*). When the sound of the drum stops and you hear a name, this child will stand out of the circle . . . (*she strikes the drum and the pupils move round the circle*).
921 T: Maria (*Maria stands out of the circle*).
922 T: Maria got out of the circle. Now I want you to walk into the circle again, properly though, as is required, as the magnets are joined together. Not in your previous position, in another position . . .

*Episode 57*

818 Christina: Let's see which column has the most objects.
819 T: Do you want us to count where there are more? Fine.
820 Ps: Yes . . .
823 T: Which group won?
824/5 Ps: The other one. The one (*with objects*) made of iron.
826 T: The ones that attract each other, that's the one that won, isn't it? Fine, well done (*the pupils show it with their hands*).
827 Christina: We did it; we won (*talking to a boy pupil*).

- The final category examined changes introduced by the teacher (or pupils) that are considered to represent the specialised, scientific character of the activity. Both the use of terminology such as North and South Pole, rod-shaped and horseshoe magnets, and of a test tube in which the teacher was placing magnets in attractive or repulsive action were noted.

Concerning the second question, the teacher draws resources from the following contexts:

- Contexts of everyday life that offer familiar fields of reference and practice (e.g., household utensils, simple tools of everyday use, activities such as games that imitate social activities or games that use certain constructions). These contexts might indicate that the teacher, in teaching science in the nursery class, considers the everyday world as the privileged frame of reference.
- Scientific contexts, which offer specialised fields of activity and practice. The use of resources such as specialised instruments, scientific terms, and experiments might indicate that the teacher recognises the demands that stem from the specialised content of science to which the activity belongs.
- The context of pre-school education but also of other levels of education. From these contexts the teacher draws her teaching strategies (e.g., asking the children to count, a familiar school activity, role-playing, but also summing up and systematising) which might indicate that the teacher perceives the activity and wants the children to perceive it as a school activity – as transmission and acquisition of a certain cognitive content and a set of skills.

On the basis of the information recorded on the two questions that operationalise the concept of classification, we observe that the teacher in her own recontextualising made substantial changes to the scheme proposed by the team. These modifications affect the degree of *differentiation* and *specialisation* of the activity, and therefore change its character.

Differentiation refers to the relations of the activity under consideration to other activities of the pre-school programme, that is, the existence of a strong or weak boundary between this activity and other activities in the nursery class. An important role is here played by the context(s) on which the teacher draws to construct the pedagogic activity. Thus, for example, the resources drawn from the context of pre-school education serve to weaken the boundary. The analysis of the information gathered showed that indeed most of the changes introduced by the teacher resulted in an activity with low boundary maintenance. On the other hand, the teacher

used resources drawn from other school levels to organise the activity, such as making concluding statements, and systematising the knowledge. Such resources have served to somehow increase the differentiation of the activity vis-à-vis the usual nursery school practices. We thus conclude that in terms of differentiation the practice introduced and realised in the nursery class potentially creates a tension, as sometimes it resembles ordinary activities in the nursery class and other times, it looks more like the practice that 'normally' organises other levels of schooling. But our data suggests that the degree of differentiation of the constructed practice was, in the main, low.

Specialization, on the other hand, is the result of the principles that organise the content of the activity. To characterise the practice from this point of view, we looked at the modifications in the content, and analysed the categories of the resources used and the contexts they stem from to reconstruct the practice. From the examination of the video-recorded material, we conclude that most of the material added by the teacher came from everyday contexts and the children's experiences, which serves to make the everyday world the privileged frame of reference (Dowling, 1998). It is important to remark here that elevating the everyday world to a privileged frame of reference also legitimises not only the introduction of material from this world, but also the principle of the *segmental structuring* that characterises the acquisition of knowledge and experiences in this world (Bernstein, 1999, 2000). By this we mean pedagogic acts where the information provided by the transmitter is recontextualised and adapted according to the perceived needs of the receiver, and that this information is often exhausted at the point of its consumption. To put it differently, the instruction, drawing on familiar strategies, becomes localised and context dependent, directed towards immediate goals, relevant to the acquirer. Knowledge learnt in segments is related not by integration of their meanings by some coordinating principle, but through the functional relations of the segments to the everyday life. In terms of its mode of acquisition segmental pedagogy is directed to common competence rather than graded performance. On the other hand, the degree of specialisation was affected by the kind of resources that were drawn from the specialised frame of science. Here it is interesting to note that the resources used were specialised instruments or terms, which only at the surface level affect the degree of specialisation. Other categories of resources such as concepts that introduce children to a scientific way of working have contributed to the increase of specialisation of the practice. The examination of the data shows that there were few such cases but, nevertheless, they created conditions where the use of specialised scientific principles to organise the activity

is, to start with, also considered legitimate. This suggests that two contradictory principles were involved in the organisation of the practice. The first principle of segmental structuring of knowledge constructs the relation between everyday discourse and school scientific knowledge in terms of weak boundaries, and elevates the everyday world into a privileged frame of reference. Accordingly, specialised competences tend to be made available in disconnected segments. The second, scientific principle, serves to strengthen the boundary between science and the everyday world, giving rise to a discourse the integration of which is at the level of meanings. This constitutes specialised symbolic structures of explicit knowledge and the social units of its acquisition consists of specialised pedagogical content, structured in space and time by principles of recontextualising and rules of evaluation.

To sum up thus far, the activity that is formed in the recontextualisations initiated by the teacher (and the pupils) appear to have a fairly low degree of differentiation, which is expressed in the weak boundary separating it from 'normal' activities in the nursery classroom. But in terms of its specialisation, the identification of two different principles structuring it, suggests that the practice lacks consistency. This is expressed in the tendency, at times, for the boundary between everyday and school scientific discourse to appear very weak, and other times to appear much stronger; and the tendency to shift between two opposing pedagogic modes: one of context specificity through segmentation, and the other a context specificity through recontextualisation. Combining this finding with the background analysis presented earlier we argue that the teacher's positioning is likely to oscillate between a position of the teacher as provider of knowledge that is a shaped response to the pupils' needs, i.e., as facilitator of context-specific activities that need to be accomplished; and that of the teacher as a transmitter and evaluator of a specialised form of knowledge.

In order to provide a more systematic analysis of how these contradictory practices and positions interact in the discourse under analysis, and how they shape the pedagogic relationship in the nursery class we would need to refer to our analysis of the questions that operationalise the concept of framing. Here we would like to make three points.

First, the teacher appears to have direct control over *opening or closing* of 82 out of 126 episodes comprising the data. The remaining 45 are initiated by pupils. However the teacher has an indirect control on these initiatives as she exercises her authority of accepting (38 times) or rejecting (6 times) them. Further examination of the data reveals that the cases where she rejects pupils' initiatives fall into two categories: those where a pupil's

initiative is not seen as important/relevant, and those which are seen to require time not planned in advance.

Secondly, when data were examined more closely from the point of view of time we noted that in the main it is the teacher who controls the *pacing* rules of the practice. More specifically, it appears that in most activities pacing is fast, becoming faster whenever resources are drawn from specialised, scientific contexts and slowing down when such resources are drawn from normal nursery or school contexts and familiar, everyday contexts (counting, music-dance). Drawing on the theory we can offer a provisional interpretation of this finding. Scientific content is perceived by this teacher as something which she knows and which she has to transmit to those who do not know. This creates a visible form of pedagogy, what often is called traditional, which is a *transmission* mode of practice: the teacher occupies the position of a transmitter of a certain pedagogical content within a given unit of time. The visibility of the power relations affects the principle organising the pedagogical interaction, namely the time dimension. Pupils' definitions of the social situation and how these might affect the pacing rules of the practice will also be considered in the analysis of the data in the main study.

Finally, when examining the practice from the point of view of its *criteria of evaluation* we note that such criteria are often controlled by the teacher and explicitly so: it is the teacher that formulates conclusions, her main strategy being that of repeating the basic meanings that are expected to be acquired by pupils. At other times, as is often observed in primary school classes, the teacher directs pupils towards the 'right' answer. In the episode cited below the teacher asks a question and formulating a half-completed answer, leaves it to the children to fill in the right word(s).

*Episode 7*

| | | |
|---|---|---|
| 381 | T: | Well, so what did we learn today? That the magnets . . . what do they do? |
| 382 | Maria: | They hold near them (*things made of)* iron and steel. |
| 383 | T: | They pull. |
| 384 | Maria: | Things made of iron and steel. |
| 385 | T: | Things made of . . . |
| 386 | P1: | Of iron. |
| 387 | T: | Of iron . . . |
| 388 | Ps: | And of steel. |
| 389 | T: | And of steel, eh? |

The above points, we believe, suggest that when pre-school teachers are asked to draw on specialised content to construct their teaching prac-

tice they are, in fact, positioned in a powerful discourse of transmission. The effects of this discourse, especially in its interaction with the child-centred, invisible forms of pedagogy still dominant in nursery education, might be a narrowing down rather than deepening of pedagogical aims and purposes of pre-schooling; a narrow focus on specialised contents or specific competences; and a time economy which not only might affect who is included in the pedagogical practice, but might also jeopardize the aims of science education *per se*. Put in a schematic form, the indications that such effects are likely to occur are: the omitting of free experimentation from the practice observed in the nursery class, the extending of play-like or action-directed activity, though divorced from any clear instructional aims (Tunstall, 2001, p. 229), and an understanding of evaluation as an ability to recite the appropriate terms and phrases.

## Concluding Remarks

The starting point of this paper was the view that changes in pedagogic practices or new ideas about reforms initiated either by teacher trainers and researchers or by agents of state policy need to be thoroughly examined. We argue that Bernstein's theory can be of great value in carrying out such analyses, and we attempt to exemplify it by applying his basic conceptual framework to produce and analyse data from an exploratory study. Certainly more detailed analysis and a full-fledged study is needed to produce reliable results. We therefore end this paper with two provisional conclusions.

Our first conclusion, drawn from the initial analysis of pedagogic discourse and the analysis of the pedagogy constructed by the teacher and realised in the nursery classroom, is that the emerging discourse of pre-school teaching and learning of specialised (scientific) content is in tension with the still dominant pre-school practices of invisible pedagogy. This creates contradictory positions for pre-school teachers that place contradictory demands upon them. The contradictory demands arise when the teacher uses the resources – including ideological elements – of one discourse or pedagogical model within structures that require strategies that are more consistent with another (Morgan et al., 2002). Thus pre-school teachers might shift between a pedagogy that constructs weak boundaries between specialised school knowledge and everyday knowledge, based on the ideological notions of play and activity as a means of developing the child, and characterised by slow pacing, invisible criteria and interpersonal forms of control; to one which constructs strong boundaries, puts an em-

phasis on 'lesson' as specialised content, and is characterised by strong pacing, and too narrow criteria of evaluation of the practice (and pupils) (File & Gullo, 2002). We suggest – subject to replication and refinement through analysing the whole research sample – that the contrast here is not simply between two opposing pedagogical modes such as visible or invisible, but also between two opposing discourses such as everyday/horizontal and scientific/vertical and their opposing modes of acquisition.

Currently, there is a substantial body of research studies operating within the framework of social constructivism that focuses on the study and transformation of young children's intuitive reasoning about the natural world. These studies link the cognitive achievement of children to different teaching strategies, which create contexts for different forms of social interaction (Inagaki, 1992; Ravanis & Bagakis, 1998; Robbins, 2002). Relevant here also are research and intervention efforts concerning the development of measurement tools for programme evaluation and improvement of pedagogies in pre-school classrooms. Researchers involved with such activities, often drawing on findings from social contructivist approaches, are debating whether curriculum-free quality measures are possible, or whether specific intentional, content-specific steps should be taken to ensure that the requisite development occurs (Dickinson, 2002, 2003; Lambert, 2003). Though tentative, our conclusion suggests that Bernstein's sociological theory, which connects the interactional with the structural level of analysis, can provide systematic and principled descriptions of pedagogic encounters, which can also support appropriate, subject-specific pedagogic interventions. This is because it provides a set of interrelated concepts that can be employed to link the structural features of the pedagogic discourse to the recontextualising arenas, agents and resources which construct it, and to the forms of pedagogic control governing its realisation in the classroom. This is a principled description, we suggest, which helps to reveal and explain the consequences of such practice for children's engagement and achievement, as well as for knowledge reproduction.

The second conclusion is more tentative and also methodological in character. In the current context there is an overemphasis on the importance of academic researchers developing their research in co-operation with teachers in action research projects. Though the research reported here had no such objectives, this fashionable discourse of action research still had some effects on it, somehow implicitly regulating the relationships of the main participants in the pilot study (e.g., inviting the teacher to introduce her own changes and to prepare her own material). This makes us pause to think about the conditions we ourselves as researchers created in our attempt to form the context for carrying out and achieving the research

objectives; for it is clear that the co-operation between the teacher and the research team was conducted in a way that kept implicit the *principles* of the discourse that was privileged by the latter. As a consequence, the teacher was put in a position of 'dependence' vis-à-vis the research team. However, we believe that we did not create this situation, but perhaps amplified it. We could, in fact, argue that what is most characteristic of the general field of educational studies is that discourses constituting it have multiplied but its subfields are becoming more detached and insulated from one another (Ball, 1998; Bernstein, 1996; Tsatsaroni, Lerman & Xu, 2003). This of course has direct implications for teacher education courses and teachers' abilities to reflect upon their practices in a way which makes use of relevant theories and research findings.

This brings us to a final remark, which conveys our experience of trying to bridge the gap between different fields of research specialisms, and between fields of research and the world of teachers' practice. If such co-operations are currently encouraged and sustained by opposing ideologies, we, the research team, feel that they can create conditions for raising challenging questions concerning teaching and learning, and for exploring the socially and discursively organised aspects in the pedagogic mediation of knowledge. If this can be considered at all as evidence that the particular quality and strength of sociology is today recognised in other specialised fields of research, then processes of co-operation in research that builds on such strength might be worth pursuing.

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