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The quest for high-level knowledge in schools: revisiting the concepts of classification and framing**

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ABSTRACT

This article centres on the problem of raising the level of school knowledge, particularly science knowledge, for all. The article describes studies in science education developed in Portugal by Morais and Neves and collaborators. These studies are mainly based on Bernstein's model of pedagogic discourse (PD), and on his theorisation on knowledge structures. The concepts of classification (power) and framing (control) are revisited to highlight their potential to characterise educational code modalities, through an extensive external language of description. Examples of instruments are presented in order to discuss the potential of using classification to analyse the status and the conceptual level of school knowledge (the what of PD) and also of using classification and framing to distinguish power and control relations between subjects, discourses and spaces (the how of PD), in educational texts/contexts. Educational code modalities which encourage school success are discussed in terms of their implications for greater equity.

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Knowledge; classification; framing; code modalities; conceptual demand; science education

1. Introduction

This article is focused on the research in science education which we have developed in the ESSA Group (Sociological Studies of the Classroom)[1] in Portugal. Such research is heavily based on Bernstein's theory of pedagogic discourse. Specifically, the article addresses the research that has led to the creation of what may be called 'multiple educational code modalities'. Bernstein's concepts of classification and framing are revisited here in order to show their potential for defining educational code modalities, not only in terms of the sociological relations present in different pedagogic texts/contexts but also in terms of the conceptual level of school knowledge.

Although several other researchers have referred, or even worked with, Bernstein's concepts of classification and framing in their theoretical or empirical studies (for example, Arnot et al. 2004; Atkinson 1985; Maton 2006; Sadovnik and Semel 2000), these concepts have not always been used in a precise or in a detailed way. For instance, the difference between classification and framing is not always well understood, or is little explored or absent in the

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**The authors wish to dedicate this particular article to the memory of Basil Bernstein, who gave to all of us the theoretical basis for sound research in education.

studies; and, when that difference is present, these concepts are in general limited to their extreme values, according to the two ideal types of pedagogic codes (collection/integration curricula and visible/invisible pedagogies). Furthermore, in educational texts/contexts, classification and framing have mainly been used to characterise the contextual realisations of the elaborated code and not to evaluate the conceptual level of school knowledge.

The main aims of the article are the following: to present the potential of using the concept of classification to analyse the status and the conceptual level of school knowledge and of using classification and framing to distinguish power and control relations in various educational texts/contexts; to show the inter-relations between the epistemic and the pedagogic dimensions of the pedagogic discourse to define educational code modalities; to discuss the importance of school knowledge of high level, and of specific pedagogic characteristics, as essential to ensure effective learning for all students, in other words for socially distinct students; and to highlight the strong grammar of Bernstein's theory and its power to direct research through a rigorous and detailed external language of description.[2]

The article starts by giving a general picture of Bernstein's theory of pedagogic discourse, with special attention to the concepts of classification and framing associated with pedagogic code modalities, and by broadly presenting his theorisation of knowledge structures. This is followed by a description of: some of the instruments constructed, how those instruments have been used to analyse the conceptual level of scientific knowledge taught in school and the sociological characteristics of the educational texts/contexts in which knowledge is to be transmitted/acquired. The inter-relations between the epistemic and the pedagogic dimensions of the pedagogic discourse are presented to clarify the conceptual framework used for constructing those instruments. Finally, the great power of the internal language of description contained in Bernstein's theory will be discussed, in ways that reflect its unique potential for doing sound empirical studies, particularly those centred on those educational code modalities which encourage success in science education.

2. Classification and framing in Bernstein's theory of pedagogic discourse

Focusing on the structure of educational knowledge which he considers to be a distinctive aspect of the field of sociology of education, Bernstein always highlighted (through the successive models he created) the power and control components that underlie the structuring of such knowledge. In order to operationalise these components, Bernstein developed the concepts of classification and framing and, through them, created a highly rigorous means of supporting both macro-level and micro-level analyses and their inter-relations. He also established relations between the theoretical and the empirical. The crucial and innovative distinction Bernstein made between power and control offered new possibilities for research which, if used, would give that research a deeper and more precise character.

As stated by Bernstein (2001), although the article 'On the Classification and Framing of Educational Knowledge' (Bernstein 1971) is one of the benchmarks for the development of his theory, the most important paper was 'Codes, Modalities and the Process of Cultural Reproduction: A Model' (Bernstein 1981). Central to the development of this model is the concept of code which, according to Bernstein, refers to a regulator of the relations between contexts and a generator of guiding principles for the production of the texts, adequate for each context. At an operational level, the code is defined by the relations between the coding orientation and the form in which this orientation is realised, given by the expression: $O^{E/R}/C_{ie}{}^{+/-}F_{ie}{}^{+/-}$. In this formula, $O^{E/R}$ refers to the coding orientations, elaborated or restricted.

By its very nature, the official pedagogic discourse institutionalises an elaborated orientation where meanings are universalistic, and relatively context independent. Within the elaborated orientation, school knowledge may assume lower or higher levels of complexity depending on the schooling level and on specific teaching/learning situations. In any case, school knowledge must always have the high status that should be accorded to knowledge in any pedagogic text/context. The coding orientation may give rise to a large range of realisations which reflects the distribution of power and the principles of control inherent to the social relations present in the pedagogic texts/contexts. In this formula, C and F correspond to the concepts of classification and framing which are used to analyse respectively power and control relations within a given social structure; +/– refer to strong and weak values of classification and framing; i refers to internal relations (i.e. relations within a given context of communication, e.g. school); and e refers to external relations – in other words, relations between distinct communicative contexts (family and school, community and school, school and work). In the analysis of relations between categories (subjects, spaces, discourses), classification refers to the degree of maintenance of boundaries between those categories; it is strong when there is a marked boundary between categories, and it is weak when there is a blurring of boundaries between categories. Classification refers also to the hierarchies across different categories in which each category has a specific status and voice, and therefore a given power. Framing refers to the social relations between categories and is related to the communication between these categories. Framing is strong when the categories with higher status have control in that relationship, and is weak when the categories with lower status also have some control in the relationship. According to this theorisation, a context is defined by considering four components – where, whom, what and how – and its characterisation requires the analysis of spaces, subjects, discourses and communicative relations.

Later, Bernstein developed his model of pedagogic discourse (Bernstein 1990) and focused on the distinctive characteristics which constitute and distinguish the specialised form of communication that is realised by the official pedagogic discourse (which is itself defined by ID/RD, where ID is the instructional discourse and RD is the regulative discourse). Through this model, Bernstein intended to show the multiple relations present in the production and reproduction of the pedagogic discourse. At the level of discourse reproduction, the model contains the possibility of situations where the classification values may not correspond to equivalent framing values and where a varied range of classification and framing values may be present in terms of specific characteristics of the pedagogic practice. This means that, although referring to the dichotomies between two ideal types of educational codes (collection and integration) and pedagogies (visible and invisible), Bernstein's theory predicted that there would be multiple code variations, according to the values of classification and framing and their respective combinations. At the level of discourse production, the model includes the field of symbolic control where knowledge of the various academic disciplines is produced. This knowledge will be recontextualised and reproduced in specific pedagogic contexts.

With respect to the official pedagogic contexts, the concept of classification offers the possibility of evaluating the status of school knowledge and its conceptual level (the what of the pedagogic discourse). Within a given conceptual level of knowledge, adequate to a given schooling level, the concepts of classification and framing suggest the possibility of analysing the forms used in the teaching–learning process (the how of the pedagogic discourse) which lead students to achieve that level of knowledge. In this case, the concept of classification allows for the evaluation of the following relations:

(a) between subjects (teacher–student and student–student);
(b) between discourses (intra-disciplinary and inter-disciplinary relations and relations between academic and non-academic knowledge); and
(c) between spaces (teacher's space–students' space and the spaces of different students).

Within the teacher–student relations, the concept of framing allows for the evaluation of the following:

(a) relations jointly designated by discursive rules (selection of knowledge and skills, sequence of learning, pacing and evaluation criteria, i.e. the criteria that determine the production of the legitimate text); and
(b) relations associated with hierarchical rules.

Discursive rules refer to the control that transmitters and acquirers may have in the process of transmission–acquisition, and hierarchical rules regulate the form of communication between subjects with distinct hierarchical positions (as is the case for the teacher and students) which refer to the control that the subjects in interaction may have upon the norms of social conduct.

By incorporating into his model of pedagogic discourse the field where production of knowledge takes place, Bernstein inter-relates the epistemic and pedagogic dimensions of the pedagogic discourse which is later institutionalised in formal educational contexts, as in the case of schools at the various teaching levels. In its epistemic dimension, the pedagogic discourse is, according to Bernstein's (1999) theorisation on knowledge structures, a vertical discourse. This discourse, referred to as school or official knowledge, presents a coherent and explicit structure distinct from everyday or common-sense knowledge, which he calls the horizontal discourse. This other discourse corresponds to a segmentally organised and differentiated knowledge which tends to be a context-dependent, tacit and multilayered discourse and which is associated with a restricted coding orientation. The vertical discourse may present distinct structures, depending on the nature of the academic disciplines which are the object of transmission/acquisition. Whereas, for example, natural sciences (biology, physics, etc.) have a hierarchical structure, social sciences and humanities (sociology, history) have a horizontal structure. In its pedagogic *dimension*, the pedagogic discourse is a discourse that legitimises the given sociological message which is present in diverse educational texts/contexts (syllabuses, textbooks, pedagogic practices).

Based on this theorisation, it is possible to say that the vertical discourse – the epistemic dimension of knowledge – corresponds in the pedagogic dimension of knowledge to the elaborated code on which school knowledge is predicated. Given the hierarchical structure of natural sciences, we should say that school science knowledge must be a high-level knowledge. Access to this high-level knowledge requires learning contexts with specific characteristics in terms of power and control relations between subjects, discourses and spaces.

3. Classification and framing: defining educational code modalities

3.1. Epistemic and pedagogic dimensions of the pedagogic discourse

Bernstein's model of pedagogic discourse and his theorisation on knowledge structures are taken here as the conceptual basis with which to relate the epistemic and the pedagogic dimensions of the school pedagogic discourse (a vertical discourse) and to define multiple

educational code modalities. Figure 1 shows the various relations which were used for defining these modalities in science educational contexts. At the level of knowledge production – the epistemic dimension – whereas scientific knowledge (the what to be taught) has a hierarchical structure, the pedagogic knowledge (the how it is to be taught)[3] has a horizontal structure. At the level of knowledge transmission – the pedagogic dimension – the what of school pedagogic discourse may correspond to different classification levels and the how may correspond to different classification and framing levels. Classification and framing are crucial concepts in the definition of code modalities, by allowing us to define not only the conceptual level of scientific knowledge (classification) but also the specific characteristics of the official educational contexts under analysis (classification and framing). In this definition, local educational contexts, characterised by a horizontal discourse, have also been considered.

A finer application of this theorisation has led to the development of an extensive external language of description which included the construction and application of several instruments for analysing the conceptual level of school knowledge (what knowledge should be learned) and the characteristics of pedagogic contexts where knowledge is transmitted/acquired (how should knowledge be learned). The instruments contained various indicators[4] which differ according to the text/context under analysis and to the schooling level.

3.2. What should be learned – studying the conceptual level of school knowledge

In our empirical research, since the early 1980s, on different levels of the Portuguese educational system we have demonstrated how science school knowledge has been viewed in terms of what we have called the 'conceptual demand of science education' (see, for example,

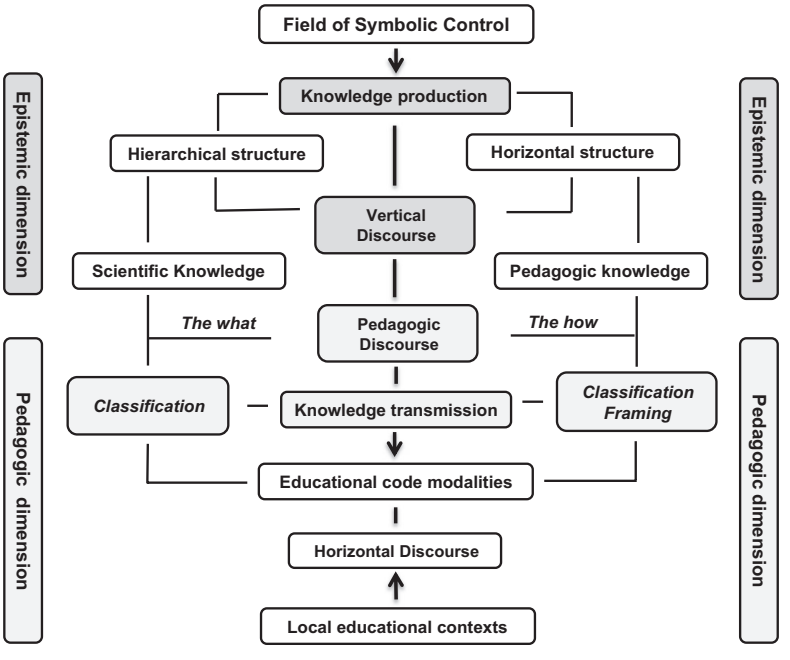

Figure 1. Epistemic and pedagogic dimensions in the definition of code modalities.

Calado, Neves, and Morais 2013; Domingos 1989a, 1989b; Ferreira and Morais 2014; Silva, Morais, and Neves 2013). This construct, first used by Morais (Domingos 1989a, 1989b) to refer to the complexity of cognitive skills, has evolved to also include the complexity of knowledge and of the inter-relations between distinct kinds of knowledge of a same discipline. We now define it in the following way:

> Conceptual demand is the level of complexity of science education as given by the complexity of scientific knowledge and of the relations between distinct knowledge of a scientific discipline and also by the complexity of cognitive skills. (Morais and Neves 2016, 177)

Although the what could be studied in terms of the status given to disciplines/subject matters (e.g. within sciences giving more status to biology than to geology), this has not been questioned in our research. That should not be understood as neglecting the importance of studying the type of knowledge in terms of 'subject matter' and its relevance. Instead, it means that, in our studies, priority has been given to the conceptual level at which any knowledge selected is the object of the teaching–learning process. We maintain that the conceptual level at which a given scientific 'subject matter' is explored represents a crucial dimension, if not the most important, of the teaching–learning process. This is mainly because students need to access the hierarchical structure that characterises the vertical discourse, in science educational contexts.

Crucial importance must be given to knowledge in school learning, when the focus is placed on the 'conceptual demand of science education'. When this aspect was formerly discussed by Morais (for example, Domingos 1989a, 1989b) it was theoretically grounded on Bernstein's theory and also on concepts from psychology of education (for example, Vygotsky 1978), as shown in the following quotation:

> […] At the moment, the curriculum and pedagogic practice in science education in Portuguese secondary schools [ages 13–17] through the direct and indirect effect of social class is producing a stratification of knowledge broadly parallel to the hierarchy of social class. […] working-class children, particularly lower working class […] is restricted to a level of science which denies to them what is available to the middle-class children: the ability to understand, develop and apply the principles of science. […] Working-class pupils are confined within a very limited conception of science, science as definitions, elementary procedural rules, rather than science as an imaginative exploration and explanation of the physical world. From this point of view […], the school is institutionalizing inequalities in the acquisition of the power of discourse […] but [working-class pupils] have also unequal access to the discourses of power and their dominant agencies and practices in society. (Domingos 1989a, 222)

Some other authors (for example, Maton 2006; Muller 2000; Young 2009) have recently called attention to the importance of analysing school knowledge. Georgiou, Maton, and Sharma (2014, 253), for example, state 'that "subject matter" has remained relatively underexplored'. Addressing the fundamental question 'what are schools for?', Michael Young argues that:

> The main purpose of schools is to enable all students to *acquire knowledge* that takes *them beyond their experience*. It is knowledge which many will not have access to at home, among their friends, or in the communities in which they live. As such, access to this knowledge is the 'right' of all pupils as future citizens. (Young 2014, 10; original emphases)

Also Bernstein (1999), in his theorisation about the nature of the discourses, calls attention to the importance of analysing school knowledge. Referring to his own work, he states that

although a theory of the construction of pedagogic discourse had been developed (the pedagogic device):

> the forms of the discourses, i.e., the internal principles of their construction and their social base, were taken for granted and not analysed […] thus there was an analysis of modalities of elaborated codes and their generating social contexts, and an analysis of the construction of pedagogic discourse with the modalities of elaborated codes pre-supposed, but no analysis of the discourses subject to pedagogic transformation. (Bernstein 1999, 157)

Conceptual demand has been shown, in our research on science education, to be a powerful construct that can question school knowledge considered broadly. Following its definition, we have used instruments to evaluate the following:

(1) the complexity of knowledge in itself;
(2) the complexity of the relations between distinct kinds of knowledge within a same discipline (intra-disciplinarity); and
(3) the complexity of cognitive skills.

Tables 1, 2, 3 and 5 present selected excerpts from some of the instruments used for analysing Portuguese science curricula: the secondary science curriculum (ages 16–18) and the middle science curriculum (ages 12–15). The excerpts refer to the syllabuses' sections/indicators 'Methodological guidelines' and 'Aims'. They are followed by examples that show the application of the instruments.

The instruments used to analyse the complexity of scientific knowledge, described in Table 1, were mainly based on Bernstein's concept of classification and of the hierarchical structure of science knowledge. However, concepts from the areas of epistemology and psychology (for example, Bruner 1963; Popper 1959) were also used for the construction of the instruments. The degree of complexity was based on the distinction between facts, simple concepts, complex concepts and unifying themes/theories,[5] by considering the definitions given by several authors (for example, Cantu and Herron 1978). This is quite a precise way of defining the complexity of school knowledge which corresponds to analysing the lower or the higher status given to scientific knowledge by considering the hierarchical structure of this knowledge. In terms of classification, this is a four-degree scale where one should be

Table 1. Excerpt from the instrument used to characterise the complexity of scientific knowledge in a secondary science curriculum (11th year).

Degree 1, C^{--}	Degree 2, C^{-}	Degree 3, C^{+}	Degree 4, C^{++}
The focus is on scientific knowledge of low level of complexity, as facts	The focus is on scientific knowledge of level of complexity higher than Degree 1, as simple concepts	The focus is on scientific knowledge of level of complexity higher than Degree 2, as complex concepts	The focus is on scientific knowledge of very high level of complexity, as unifying themes and theories

Examples:

[1] Degree 2 (C^{-}): 'Comparative observation of samples of weathered rocks and samples of not weathered rocks. This activity can be complemented with the observation of altered rocks present in sculptural and architectural exemplars.' (Geology[a], p. 30)

[2] Degree 4 (C^{++}): 'The study of models that explain the emergence of unicellular eukaryotes organisms and the origin of multicellularity can be made through the interpretation of images, including also discussion activities, schematization and systematization of information. […]' (Biology[a], p. 12)

[a]Biology and geology are part of the same discipline.
Source: Adapted from Ferreira and Morais (2014).

understood as representing knowledge with the lowest status (therefore with a very weak classification, C^{--}) and four as representing knowledge with the highest status (therefore with a very strong classification, C^{++}).

Example [1] refers to an activity in which only a simple concept (altered rock) is the focus of the study; Example [2] refers to an activity that involves the study of models, therefore corresponding to a very high level of conceptualising knowledge. Although a balance should exist between the various levels of this scale,[6] this kind of knowledge must be attained by all students at all schooling levels. However, the highest level for a given concept depends on the schooling year. If we take the concept of photosynthesis as an example of school knowledge, the highest degree of complexity for elementary/middle school (ages 10–15) may be defined through the following idea: 'In the presence of light, living beings with chlorophyll absorb carbon dioxide and release oxygen and in this process they synthetize organic compounds'. At the secondary schooling level (ages 16–18), the same concept may be defined according to the following idea: 'Through complex photochemical and chemical reactions (Calvin Cycle), light energy is converted in chemical energy which is stored in organic compounds'. The highest degree of complexity for the primary schooling level (ages 6–10) should be a preliminary concept which may be defined by the following idea: 'Plants need water, mineral salts and light to be able to live'. This way of thinking about school knowledge implies that a clear explication of the concept under study must be made, which means a very strong framing of the discursive rule 'evaluation criteria' (for example, Morais and Miranda 1996; Morais and Neves 2001). Recently, Young and Muller (2013), following a similar line of thought, argue that we can be explicit, at least, about the 'best knowledge' in all subjects.

The instruments we used to analyse the complexity of the relations between distinct kinds of knowledge within the same discipline (intra-disciplinarity) (see excerpts in Tables 2 and 3) were constructed on the basis of Bernstein's concept of classification and by also using ideas from psychology (for example, Bruner 1963). The instruments refer to the relations

Table 2. Excerpt from the instrument used to characterise the intra-disciplinary relations between distinct scientific knowledge in middle science curriculum (ninth year).

C^{++}	C^{+}	C^{-}	C^{--}
The focus is on the relationship between simple knowledge within the same teaching unit *Or* Scientific knowledge essential to the understanding of the relations between knowledge is missing	The focus is on the relationship between simple knowledge of distinct teaching units	The focus is on the relationship between complex knowledge, or between this and simple knowledge, within the same teaching unit	The focus is on the relationship between complex knowledge, or between this and simple knowledge, of distinct teaching units
Examples:			
[3] C^{++}: 'The students may look for the energetic value of various nutrients on labels or on dietary lists and interpret data that relate energy costs of the body in different physical conditions.' (Curricular Guidelines[a], p. 36)			
[4] C^{--}: 'The exploration of a former question about changes in heart rhythm implies knowledge of the circulatory and respiratory systems and the metabolism (e.g., in the case of sport) or of the circulatory, nervous and hormonal systems (e.g., in the case of a situation that causes anxiety or fear).' (Curricular Guidelines[a], p. 34)			

[a]Curricular Guidelines contain the specific part of the curriculum.
Source: Adapted from Calado, Neves, and Morais (2013).

between distinct scientific knowledge (Table 2), and between theory and practice (respectively substantive and procedural knowledge[7]) (Table 3).

In the construction of the instrument used to analyse distinct scientific knowledge, we distinguished between the knowledge of two orders of complexity: simple knowledge, which includes facts and simple concepts; and complex knowledge, which includes complex concepts, unifying themes and theories.[8] The relations that may occur between knowledge within the same teaching unit or between knowledge of different teaching units were also considered. The instrument also takes into account the situation where it is absent scientific knowledge that is considered to be indispensable for the understanding of the relations between given types of knowledge. The simultaneous consideration of the complexity of knowledge and of the teaching unit where knowledge is included led to a four-degree scale of classification which is described in Table 2.

Example [3] refers to an activity that suggests a relationship between simple knowledge within the same teaching unit (food); and Example [4] suggests the exploring of a question which addresses the relations between the complex knowledge of distinct teaching units in the various systems of the human body.

In the case of the intra-disciplinary relationship between theory and practice (Table 3), it was considered that the absence of this relationship corresponds to stronger values of classification (C^{++} and C^{+}) and its presence refers to weaker classifications, C^{-} corresponding to a situation where substantive and procedural scientific knowledge have distinct status and C^{--} corresponding to a situation where these types of knowledge have equal status.

Example [5] involves substantive scientific knowledge only, related to the function of cell organelles; and Example [6] establishes a relationship between theory and practice where substantive knowledge about the dynamics of ecosystems and procedural scientific knowledge (procedures related to laboratory activities and field trip) have similar status.

Another important set of relations is those between discourses such as the relations between vertical discourse (academic knowledge) and horizontal discourse (non-academic knowledge). In this case, Bernstein's concept of classification is used to evaluate the status given to academic knowledge within the hierarchy created by the distributive rules

Table 3. Excerpt from the instrument to characterise the intra-disciplinary relations between substantive knowledge (theory) and procedural knowledge (practice) in a secondary science curriculum (10th year).

C^{++}	C^{+}	C^{-}	C^{--}
The focus is on substantive scientific knowledge only *Or* The focus is on procedural scientific knowledge only	The focus is on both substantive scientific knowledge and procedural scientific knowledge, but there are no relations between them	The focus is on the relationship between substantive and procedural scientific knowledge, higher status being given to substantive scientific knowledge in this relationship	The focus is on the relationship between substantive and procedural scientific knowledge, equal status being given to these two types of knowledge in this relationship

Examples:

[5] C^{++}: 'Recall the cell organelles through the use of schemes and refer the mitochondria as the essential organelle for the process of anaerobic respiration […]' (Biology, p. 85)[a]

[6] C^{--}: 'In order to solve the problem 'What happens to the dynamics of an ecosystem when that ecosystem is subjected to change?', a field trip in articulation with classroom/laboratory activities, to be made before and after the field trip, is suggested. As object(s) of study real environments are suggested, located as far as possible near to the school […]' (Biology, p. 79)

[a]Selected from the data basis of Ferreira (2014)

Source: Adapted from Ferreira and Morais (2014).

underlying the pedagogic knowledge. Table 4 presents an excerpt of the instrument we used in a science classroom context and examples of its application. It contains a scale of two levels of classification only[9]: a strong classification (C^+) corresponds to a situation where academic knowledge has a high status/voice within the classroom context; and a weak classification (C^-) corresponds to a situation where academic knowledge has a low status/voice within the classroom context.

Example [7] shows a horizontal discourse which may be produced in a daily life context but which is totally inadequate in a science lesson. This discourse suspended the vertical discourse about seismic waves which was being studied in the lesson. A completely distinct and legitimate situation would be a situation where the teacher uses everyday knowledge to relate it to academic knowledge in order to allow a better understanding and application of that knowledge (a situation which is made operational with C^+ in the instrument for the analysis of relations between vertical and horizontal discourses).

The instruments to analyse the level of complexity of cognitive skills (see Table 5) have been based on Bernstein's concept of classification and also on psychological theorisations (for example, Vygotsky 1978). For categorising cognitive skills in distinct levels of complexity, we used (among other taxonomies of educational objectives) the taxonomy of Marzano and Kendall (2007) which presupposes that a continuum of growing complexity in cognitive processes exists and considers four levels of the cognitive process – retrieval, comprehension, analysis and knowledge utilisation.[10] As in the case of those instruments used to analyse the complexity of scientific knowledge, the scale/degree ranking (one to four) of these instruments represents a hierarchy within school cognitive skills – a classification scale where the highest level has the highest status (C^{++}) and the lowest level has the lowest status (C^{--}).

In Example [8] it is only intended that students memorise some effects of any given human activities. In Example [9] it is clear that cognitive skills of a high level of complexity are mentioned, as are the cases of concept application and problem-solving.

As we have defended, the analysis of the complexity of skills gives the possibility of obtaining a more precise picture of the conceptual level of school knowledge. In fact, a given

Table 4. Excerpt from the instrument to characterise the relations between vertical and horizontal discourses (indicator 'Discourse valued by teacher') in a science classroom of the secondary school (10th year).

C^+	C^-
The teacher uses a discourse based on academic or official knowledge – vertical discourse – although she/he may use examples of everyday knowledge – horizontal discourse – to explore or apply academic knowledge	The teacher uses a discourse based on everyday or common-sense knowledge, which tends to be local, dependent and specific of the context – horizontal discourse – there occurring a suspension of the vertical discourse. Such everyday knowledge does not contribute to students' science learning

Example:

[7] C^-: Teacher – Ok. When you look at each one of the seismograms you already get an idea of the amplitude of what? Of the seismic waves felt in each one of the media. In which medium did they had higher amplitude?

Student – In the clay.

[…]

Teacher – […] Pay attention, we're correcting now. […] You boy, stop flirting with her! She's stopped reading and now you're just whispering to each other. Stop that 'tête à tête' immediately. You lady, there's no need to play with your hair and come in here looking like an irresistible princess, to try to seduce the boy. You know he's weak [students laugh], he's a weak man, isn't it? He can't resist a pretty face, and she comes in here all dressed up. (Class 15, Teacher Sara)

Source: Ferreira (2014).

Table 5. Excerpt from the instrument to characterise the complexity of cognitive skills in a middle science curriculum.

Degree 1, C^{--}	Degree 2, C^{-}	Degree 3, C^{+}	Degree 4, C^{++}
Cognitive skills of low level of complexity, involving cognitive processes of retrieval, are mentioned	Cognitive skills of level of complexity greater than Degree 1, involving cognitive processes of comprehension, are mentioned	Cognitive skills of level of complexity greater than Degree 2, involving cognitive processes of analysis, are mentioned	Cognitive skills of very high level of complexity, involving cognitive processes of knowledge utilisation, are mentioned

Examples:

[8] Degree 1 (C^{--}): 'The students should be aware of some of the effects of consuming alcohol, tobacco and drugs as well as the effects of changes in the practice of physical activity and in hygiene habits on the physical and/or psychical integrity of the organism.' (Curricular Guidelines, p. 36)

[9] Degree 4 (C^{++}): '[…] it is intended that, after they have understood some concepts related to the structure and functioning of the Earth system, the students are able to apply those concepts in situations related to the human intervention on Earth, solving problems which result from that intervention.' (Curricular Guidelines, p. 9)

Source: Adapted from Afonso et al. (2013); Ferreira and Morais (2014).

piece of knowledge (e.g. a concept) may be explored according to skills of different levels of complexity which means that the conceptual level of school knowledge will be greater if that knowledge is explored using skills of higher levels of complexity. If we take, again as an example, the concept of photosynthesis explored at the elementary/middle school level (ages 10–15, see earlier), the level of conceptual demand of school knowledge is higher when we apply this concept to a new situation (e.g. to solve a problem related to a changing condition in a given ecosystem) than to simply remember/understand the concept.

It is important to highlight that an educational discourse centred on scientific knowledge and on intra-disciplinary relations and skills of low complexity contributes to decrease the conceptual level of knowledge. In the particular case of the relations between vertical and horizontal discourses, a weak classification also puts at stake power relations between teacher and students, by lowering the status of the teacher. Given the teacher's role as a transmitter of the knowledge to be acquired in the school, classification in the relations between teacher and student is necessarily strong, although some weakening may exist as a consequence of aspects of the communication space that the teacher may give to the students in the teaching–learning process.

School knowledge in science education has also been analysed by other researchers (for example, Georgiou, Maton, and Sharma 2014) by using the concept of semantic gravity to discriminate different levels of knowledge. When referring to a study where students' answers to questions designed to encourage them to think beyond the context were analysed, Maton (2011) provides a coding schema that represents a hierarchy from a weaker to a stronger semantic gravity. In contrast to what is stated by Maton when he talks of complexity of knowledge, in his coding scheme semantic gravity is in fact associated with skills – reproductive description, summarising description, interpretation, judgement, generalisation and abstraction (2011, 131). Also these skills are viewed as different levels of context dependence. A similar form of analysing the complexity of skills had been used before by Morais (for example, Domingos 1989a). In that study, more complex skills had already been associated with more context independent meanings (i.e. more associated with an elaborated coding orientation) and less complex skills had been associated with meanings that are more context dependent (i.e. more associated with a restricted coding orientation).

At this point, we do not wish to make judgements about the relative value of the two concepts – semantic gravity and conceptual demand – but to highlight the fact that they correspond to different gazes about the same question, leading to distinct external languages of description. However, we think that the concept of conceptual demand allows us to develop an external language of description that uses a more complex and, at the same time, a more detailed coding scheme. In this scheme, skills and also intra-disciplinary relations between distinct kinds of knowledge add to the coding of scientific knowledge itself, within an innovative broader perspective.

3.3. How should knowledge be learned – studying the characteristics of pedagogic contexts

In contrast to other researchers (for example, Maton 2006; Sadovnik and Semel 2000), we have studied the characteristics of pedagogic contexts (the how of pedagogic code) by departing from the dichotomies collection/integration curricula and visible/invisible pedagogies. We go beyond the extreme values of classification and framing, using instead different levels of classification and framing to characterise distinct sociological characteristics of pedagogic contexts. In Maton's case, he also goes beyond the extreme ideal types when he refers to four types of codes, which are defined as 'legitimation codes of specialization' and which result from the combination of C and F values according to the knowledge structure (epistemic relation) and the knower structure (social relation). However, in his conceptualisation of legitimation codes, Maton's use of classification and framing is centred on the extreme values (C^+F^+ and C^-F^-). Furthermore, his conceptualisation does not make clear what the crucial difference is between the two concepts of classification and framing, and neither does it make explicit which specific categories/relations they are referring to. Although initially connecting to Bernstein's theory of a strong grammar, Maton departs from it without making use of the immense potential it contains. As a consequence, although apparently simpler, Maton's language is, in our view, less capable of leading to sound research.

In our research on science education,[11] we considered Bernstein's concepts of classification and framing separately in order to distinguish, in terms of power and control relations, the how of the pedagogic discourse present in different educational texts and contexts. We used the concept of classification to appreciate power relations between the following:

(a) teacher and students, and between differentiated students in terms of social class, race and gender;
(b) researchers and teachers, and between curriculum authors, textbooks authors and teachers; and
(c) teacher's space and students' spaces, and between spaces of different students, in the classroom context, and also the relations between agencies (e.g. school space and community space external to the school).

We used the concept of framing to appreciate the control relations between subjects in terms of the sociological characteristics that define the pedagogic code underlying the teaching/learning contexts (i.e. discursive rules – selection, sequence, framing, evaluation criteria and hierarchical rules).

In order to show the possibility of defining 'multiple educational code modalities' by using different values of classification and framing, we selected some of the instruments constructed to analyse the characteristics of the instructional and the regulative contexts of the pedagogic practices.[12] The selection was based on some of the pedagogic characteristics which have had greater impact on students' success. The research we have developed in the science classroom context (for example, Morais, Neves, and Pires 2004; Silva, Morais, and Neves 2013) has indicated that the following characteristics of a mixed pedagogic practice can explicate, with strong evidence, the students' success: weak classification of the intra-disciplinary relations between distinct scientific knowledge (see Section 3.2) and of the relations between teacher's space and students' space in the classroom; and very strong framing of the teacher–student relations concerning the discursive rule 'evaluation criteria' and very weak framing of the 'pacing' and of the 'hierarchical rules'. This means that boundaries between distinct scientific knowledge within the same discipline and between spaces must be blurred so that conditions are created for raising the conceptual level of scientific knowledge and for allowing a fruitful communication between students and teacher and also between students; knowledge to be acquired must be made explicit to students so that such knowledge can be assimilated; students require time for good learning; communication between teacher and students must be based on a personal relationship; and teacher must give to all students the opportunity to communicate. The relations between those characteristics of pedagogic practice and students' success was particularly evident in a study (Morais, Neves, and Pires 2004) where the relative weight, on children's learning, of each of the various sociological characteristics that define a given pedagogic practice was analysed. Through the statistical method of stepwise regression, this relationship was appreciated by considering the what and the how of pedagogic practice and, within the how, the characteristics of the instructional and the regulative contexts separately.

Tables 6 and 7 contain excerpts of instruments used to analyse some of the sociological characteristics of the pedagogic practices implemented at different school levels. They are followed by examples of their respective application.

The instrument presented in Table 6 was used in a study (Ferreira 2014) where the relations between teacher and student concerning the discursive rule 'evaluation criteria' were analysed in a biology secondary classroom, in a context of practical work. The respective scale of framing translates a decreasing level of control on the part of the teacher. The lowest degree of framing corresponds to a situation where knowledge is not made clear to students, which means that the control over the knowledge to be acquired is centred on students. In contrast, the strongest degree of framing corresponds to a situation where the control over the knowledge to be acquired is centred on the teacher. It is the teacher who possesses the knowledge to be acquired, and this knowledge must be made very clear to students.

In Example [10], starting from a question she raises, the teacher in dialogue with a student is constructing the correct text, and finishes by providing a synthesis at the end of the dialogue. In Example [11], the teacher begins by departing from the student's question, focusing on a procedural aspect only, and ends up not clarifying for the student with doubts about the 'scares' of the cell wall that they, in fact, correspond to the cell wall thickening. It should be noted that Example [10] also highlights a case of weak framing of pacing; that is, a case where the teacher lets students have control on the time of learning. Explicating the evaluation criteria (strong framing) often requires pacing that is regulated by weak framing

Table 6. Excerpt from the instrument used to characterise 'evaluation criteria' with regard to practical work in a secondary classroom context (10th year).

F^{++}	F^{+}	F^{-}	F^{--}
The teacher systematically indicates what is incorrect, at the level of substantive/processual knowledge, and refers clearly to what is missing in the text production	The teacher indicates what is incorrect, at the level of substantive/processual knowledge, and refers generically to what is missing in the text production	The teacher indicates what is incorrect, at the level of substantive/processual knowledge, but does not refer to what is missing in the text production	The teacher does not indicate what is incorrect, at the level of substantive/processual knowledge, and does not refer to what is missing in the text production *Or* Explanations are confusing and contain incorrect statements

Examples:

[10] [When planning a laboratory activity about the factors that may influence the lactic acid fermentation velocity]

F^{++}: Teacher (T) – And how can I see, where there was more lactic acid fermentation?

Student (S) – Hum … in something we are going to observe.

T – And what are we going to observe, to see if the reaction was more rapid or slower?

S – The pH.

T – You are going to observe the pH. And why are you going to see the pH?

[…]

S – Because it has got the lactic acid bacteria that it is acid, then …

T – No. The bacteria are not acid.

S – No …

T – The fermentation

S – Yes … it is going to be more acid than, hum …

T – The starting point, isn't it?

S – It is the product that is going to be more …

T – […] The product of the reaction is lactic acid, then, it makes sense, in theoretical terms, to think that as it is going to be produced, as the bacteria are going to do fermentation, acid lactic is going to be released. (Class 6, Teacher Vera)

[11] [When observing cells of geranium petals (*Pelargonium sp.*) under the microscope]

F^{--}: S – Our cells look like a kind of scares. Why?

T – [Laughs] Look carefully at them with the micrometric.

S – No. It's really in the cells, come here and take a look …

T – Right, it is. What could that be?

[…]

S – […] I am saying that when I started drawing they were like this [as they were in the drawing] and they now have here these little things on their borders.

P – They have on their borders? They always had.

S – No. No. […]

[…]

T – Then it's because it wasn't focused.

S – It was focused. It was, it was, nobody changed it.

T – I don't know. That's it. I don't know. Look, I am not saying anything else. Miguel, it's now up to you. (the bell rings) It's ringing, let's go out. Switch off the light of the microscopes, ok? (Class 3, Teacher Rute)

Source: Ferreira (2014).

Table 7. Excerpt from the instrument used to characterise the teacher–student relationship with regard to the hierarchical rules in a primary classroom context (first year).

F^{++}	F^{+}	F^{-}	F^{--}
The teacher uses imperative control and does not give justifications of any kind	The teacher uses positional control by giving justifications which are based on established rules	The teacher bases his/her arguments by using personal control in which she/he appeals to his/her own personal attributes	The teacher bases his/her arguments by using personal control in which she/he appeals to both his/her own and children's personal attributes

Examples:

[12] F^{++}: [The teacher addresses a group of children who dropped some seeds they should be using in the experimental activity] Look here! Kids who are standing up are going to go out of the groups and are not going to work any longer. Either you sit down and work or you just go away. (Working session 3, Teacher Sara)

[13] F^{--}: Rita you can't [go on reading], because there are kids who are not respecting you and I cannot understand why Igor and Feliz [children] are not respecting us … they are not respecting us because they are talking … that's it! Let's listen to Rita because she is going to do a very good reading of point 2.8 […] (Working session 14, Teacher Marco)

Source: Adapted from Silva, Morais, and Neves (2013).

Table 8. Characterisation of teachers' pedagogic practice in the primary school science context.

	Sunflower School		Daffodil School	
	Macro level	Micro level	Macro level	Micro level
Instructional context				
Discursive rules				
Selection	F^{++}	F^{++}	F^{++}	F^{+}
Sequence	F^{++}	F^{+}/F^{-}	F^{++}	F^{++}/F^{+}
Pacing	F^{--}/F^{-}	F^{-}/F^{--}	F^{+}	F^{+}
Evaluation criteria	F^{++}	F^{++}	F^{-}	F^{-}
Relations between discourses				
Intra-disciplinary relations	C^{--}		C^{+}	
Inter-disciplinary relations	C^{-}/C^{--}		C^{+}/C^{++}	
Regulative context				
Hierarchical rules				
Teacher–student relation	F^{-}/F^{--}		F^{+}/F^{++}	
Student–student relation	F^{-}		F^{+}/F^{-}	
Relations between spaces				
Teacher space–student space	C^{-}	C^{-}/C^{+}	C^{-}	C^{-}
Student–student spaces	C^{+}/C^{-}	C^{+}	C^{-}	C^{+}

Source: Adapted from Silva, Morais, and Neves (2013).

which shows how characteristics of the practice may vary in opposite directions if effective learning is to be achieved.

The instrument described in Table 7 was used in a study (Silva, Morais, and Neves 2013) where the relationship between teacher and students concerning the hierarchical rules was analysed in the classroom science context of different primary teachers. The scale of framing translates the increasing control being given by teachers to children in terms that relate to the form of communication.

In Example [12] the teacher reprimands the children, without giving reasons that justify the importance of proper team work. Example [13] shows a situation where the teacher explains the reason why the behaviour of some children is incorrect, by appealing to reasons that relate to a personal control (i.e. related to her own and to the children's attributes).

In order to carry out this kind of analyses (which depends on the structure of the context under study), we divided the text into units of analysis.[13] On the basis of this procedure it has been possible to map the distribution of the different levels of classification and framing associated with each of the various characteristics studied. Table 8 presents the global results for this study of a science primary context. In this study the pedagogic practices of two schools/teachers were analysed through instruments whose scales of classification and framing refer to both the instructional and the regulative contexts.

Analyses of the sociological relations which define teaching/learning processes, together with those analyses which are centred on the conceptual level of school knowledge taken in a broad sense (see Section 3.2), have allowed us to characterise the modality of those educational codes which underlie diverse pedagogic contexts (from primary to secondary schooling levels). The results of those analyses suggest that multiple combinations of classification and framing values may exist, including the possibility of combining characteristics of the pedagogic practice more centred on the transmitter (associated with didactic models/visible pedagogies) with other characteristics more centred on the acquirer (associated with progressive models/invisible pedagogies). When students' learning is considered, the studies have suggested that mixed modalities of educational codes contain the potential for leading all students to success.

4. Final considerations

Based on studies in science education, we have discussed the question of raising the conceptual level of school knowledge for all students. We revisited Bernstein's concepts of classification and framing by highlighting their potential to characterise (in a detailed way) what may be called 'multiple educational code modalities'. These concepts allow for the development of a very precise and extensive external language of description which can be used to analyse educational code modalities in terms not only of the conceptual level of school knowledge (the what of pedagogic discourse) but also of the power and control relations that define the contexts in which this knowledge is transmitted–acquired (the how of pedagogic discourse). This external language of description is crucial for the understanding of relations between the school success of socially differentiated students and the characteristics of the what and the how of the educational code modalities.

We clearly acknowledge our commitment to using a Bernsteinian internal language of description for developing our own external language of description. Some researchers use Bernstein's theory together with other sociological theories (for example, Maton 2006), to develop their work. This corresponds, in Bernstein's (1999) terms, to using distinct horizontal structures of knowledge, each with a specific set of questions and relations, and with a different set of theoreticians/speakers. On the other hand, and simultaneously, Bernstein's theory has in many cases been recontextualised in the direction of diminishing its level of conceptualisation (for example, Maton 2006; Sadovnik and Semel 2000). This means, in Bernstein's terms, using a theorisation that has moved from strong to weak grammar.

The external language of description we have developed to appreciate the conceptual level of school science knowledge by using the concept of classification offers innovative use in the application of Bernstein's theory of pedagogic discourse. It has been possible to discriminate the conceptual level of school knowledge in distinct degrees of classification and to say that, for any given schooling level, a higher conceptual level of knowledge is

crucial if schools are to lead students to real success. In Bernstein's terms, this means giving them access to school knowledge with high status and a voice in society; that is, access to strongly classified knowledge within the hierarchical complexity of knowledge. As explained elsewhere (Morais and Neves 2016), educational scientific knowledge at a low conceptual level does not correspond to an absence of vertical discourse (any academic discourse is a vertical discourse) but to a vertical discourse that, according to Morais (Domingos 1989a), is restricted to the vocabulary of science (nominal and terminological knowledge) and not to its syntax (conceptual knowledge). If we want to create a school for all students, not only in terms of access but also in terms of success, it is crucial to create specific conditions to allow them to acquire the structure of scientific knowledge, and this requires conceptually demanding contexts.

Having in mind that scientific knowledge has a hierarchical structure and that at the top of this structure is knowledge with the highest status and power (i.e. powerful knowledge), it is important that the study of school knowledge in a broad sense (i.e. in terms of its conceptual level) offers a more rigorous picture about the status of knowledge, which is the object of learning in the school curriculum. In other words, portraying which knowledge has the power in official pedagogic discourse. This is the knowledge to be legitimised as school knowledge and to be acquired as successful scientific learning by socially differentiated students. This kind of analyses is possible because we have blurred the boundaries between science education and sociology of education, and also psychology and epistemology.

The external language of description we developed to analyse power and control relations in the transmission/acquisition of knowledge also constitutes an innovative way of applying Bernstein's theory of pedagogic discourse. Our analyses were centred on multiple sociological relations that characterise a given pedagogic context. We have made a very precise distinction between the two concepts of classification and framing and used not only different values of classification and framing, but also their respective combinations.

The analyses of the multiple sociological relations present in the learning science contexts, combined with the analyses of the conceptual level of science knowledge, provide a broader picture of the level of conceptual demand of science education. For instance, we can now say that if scientific knowledge of high conceptual level is not made explicit (very strong framing of the evaluation criteria) and if it is studied without giving enough time for students' learning (weak framing of pacing), the conditions which would lead all students to such powerful knowledge are not created. The depth of these analyses offers the possibility of studying the relations between specific characteristics of code modalities and school success of socially differentiated students (social class, gender, ethnicity).

The studies which we have carried out in science education (for example, Domingos 1989a; 1989b; Morais and Miranda 1996; Morais, Neves, and Pires 2004; Silva, Morais, and Neves 2013), at different schooling levels, with different teachers and students, and in different country areas, have suggested that all students (and particularly socially disadvantaged students) may succeed. This occurs when educational code modalities contain characteristics associated with a mixed pedagogy (Morais and Neves 2011), where knowledge should not be reduced to a simple level of complexity and where classification and framing may be stronger or weaker according to specific pedagogical characteristics.

Some progressive educators who rightly defend the view that school must take into account social differences between students, in our view wrongly defend different conceptually demanding learning contexts which they believe should be created to take account

of students' cultural backgrounds. Arguments of this kind contain a fundamental contradiction. To take into account students' social differences does not mean limiting the disadvantaged to knowledge of a lower conceptual level, but using their cultural experiences in appropriate school contexts to lead them to acquire the powerful knowledge. Opposing those arguments, we have defended the view that school success is desirable and possible for all students within conceptually demanding contexts. Differentiated conceptually demanding contexts increase the gap between socially differentiated students, but our research in science education (for example, Domingos 1989a, 1989b; Morais, Neves, and Pires 2004) has shown that even disadvantaged students attain higher levels of scientific literacy in such contexts. In fact, this is the only chance those students may encounter in their lives. Improving education means developing pedagogic practices that narrow such social gaps. On the basis of our research, we say that a democratic school is a school where all students have the same opportunities. This means that, through specific educational code modalities, all students can have access to successful knowledge and to knowledge that leads to success. This surely would lead us to many other questions in education because it is clearly the case of teachers' education – teachers would have to be able and also motivated to implement those specific educational code modalities (for example, Morais, Neves, and Pires 2004; Morais, Neves, and Afonso 2005).

Discriminating aspects of educational texts and contexts to define multiple educational code modalities and to evaluate their relationship with students' school learning was only possible through the use of a detailed and rigorous external language of description. This external language of description was only possible given the potential of Bernstein's theory (namely his concepts of classification and framing) to define educational code modalities not only in terms of the sociological relations present in different pedagogic texts and contexts but also in terms of the conceptual level of school knowledge. As we pointed out (Morais and Neves 2001), Bernstein's theory has a conceptual structure that is diagnostic, predictive, descriptive, explanatory and transferable, broadening the relationships studied and permitting conceptualisation at a higher level, without losing the dialectical relations between the empirical and the theoretical. This strong internal language of description, contained in Bernstein's theory of pedagogic discourse, offers a unique device for conducting sound research.

Notes

1. The ESSA Group is a research group of the Institute of Education, University of Lisbon.
2. According to Bernstein (1996), the external language of description is the means through which a theory (internal language of description) is activated, functioning as the interface between the empirical data and the concepts of the theory.
3. The pedagogic knowledge refers to knowledge related to teaching methods.
4. Indicators refer to parts of texts and contexts that may be separated for analysis purposes. In the case of curricula, the following indicators have been used: 'Knowledge'; 'Aims'; 'Methodological guidelines'; and 'Evaluation'. In the case of classroom contexts, indicators differ according to the specificity of the sociological characteristic to be analysed and may be grouped into macro and micro levels of the context under analysis.
5. A fact is constituted from 'data that result from observation' (Brandwein, Watson, and Blackwood 1958, 111), corresponding to a very concrete situation based on observations, as

for example 'the pure water boils at (or close to) 100 °C' or 'common salt dissolves in water whereas chalk does not' (Millar, Tiberghien, and Maréchal 2002, 13).

A concept is a 'mental construct; it is a grouping of the common elements or attitudes shared by certain objects and events' (Brandwein et al. 1980, 12) and represents an idea that arises from the combination of several facts or other concepts. Simple concepts correspond to 'concepts that have a low level of abstraction, defining attributes and examples that are observable', as are the concepts of tree and insect, and complex concepts 'are those that do not have perceptible instances or have relevant or defining attributes that are not perceptible' (Cantu and Herron 1978, 135), as are the concepts of photosynthesis and cellular respiration.

Unifying themes are structural ideas and correspond, in science, to generalisations about the world that are accepted by scholars in each subject area (Pella and Voelker 1968), as is for instance the case of the theme 'the living things interact with the environment, by changing matter and energy'.

Scientific theories, such as the cellular theory and the electromagnetism theory, correspond to explanations of a wide variety of related phenomena which were already submitted to a significant test (Duschl, Schweingruber, and Shouse 2007; Hickman, Roberts, and Larson 1995).

6. A balance should exist between simple and complex knowledge because no complex knowledge can be understood without the acquisition of the simple knowledge involved.
7. Substantive knowledge (associated with theory), also called declarative knowledge, corresponds to the knowledge of terms, facts, concepts and theories specific for a given discipline. Procedural knowledge (associated with practice) corresponds to the knowledge of how to do something, of techniques and methods specific to a given discipline, but also to the knowledge of scientific processes (Roberts, Gott, and Glaesser 2010).
8. See note 5.
9. In the particular case of this study, the empirical evidence of the situations analysed did not allow for a deeper discrimination.
10. Retrieval involves the activation and transfer of knowledge from permanent memory to working memory and it is either a matter of recognition or recall. Comprehension is responsible for translating knowledge into a form appropriate for storage in permanent memory. Analysis involves the production of new information that the individual can elaborate on the basis of the knowledge she/he has comprehended. The more complex level of the cognitive system – knowledge utilisation – implies the knowledge utilisation in concrete situations.
11. See, for example, Ferreira and Morais (2014), Morais and Neves (2001), Morais, Neves, and Pires (2004), Morais, Neves, and Afonso (2005), Neves and Morais (2001), Neves, Morais, and Afonso (2004) and Silva, Morais, and Neves (2013).
12. The characterisation of pedagogic practices using the instruments constructed was based on both audio (and in many cases video) taping, and its full transcriptions, and researchers' observation.
13. A unit of analysis is an excerpt of the text with one or more periods which together have a particular semantic meaning (Gall, Gall, and Borg 2007).

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