



**Knowledges and values in science syllabuses:
A sociological study of educational reforms**

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**Knowledges and values in science syllabuses:
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Abstract

The study analyses the Natural Science syllabuses of the 5th/6th and 7th years of schooling (ages 10⁻ - 13⁺) to investigate the extent to which the present portuguese reform (1991) for the elementary school introduces fundamental changes in the discourses and competences it values. The analysis used the conceptual framework of Bernstein's model of pedagogic discourse.

The results show changes in the present reform which suggest, in general, an increasing valuing of the regulative dimension of learning. The results also show a greater diversity and specification of the complex cognitive and socio-affective competences. The study also points out to a recontextualizing within the syllabuses, when passing from the curricular level to the disciplinary level, in the direction of blurring the changes observed. These findings are discussed in terms of national and international educational changes and in terms of the socio-political contexts in which present and past reforms took place.

1. INTRODUCTION

Curricular organization and development is a complex process whose study has called the attention of researchers either in a macro or micro perspective, that is at the level of management and theorizing or at the level of application in the classroom. Approaches to curriculum studies may be based on the fields of epistemology, psychology, sociology separately or inter-related. In any case, science curricular research has not been made in a systematic way either in theoretical or practical terms. This difficult efficient curricular reformulations which would allow a better adjustment to the concrete problems arising out of experimental or implementation situations. It seems that a theoretical and practical reflection about new curricula could give sound bases for reformulation.

The study presented in this article is part of a broader research within the field of curriculum development whose objective is the analysis of the present reform of science education in Portugal¹. It is centred on the syllabuses of natural science for the 5th/6th and 7th years of schooling (ages 10⁻-13⁺). The research is fundamentally based on Bernstein's theory of pedagogic discourse (Bernstein, 1990, 1996; Domingos *et al*, 1986) and is focused on a sociological perspective of learning.

The research is constituted by a macro study which involved the analysis of texts produced at the various levels of the pedagogic device (constitutions, basic laws, syllabuses, textbooks). In order to explore the sociological meaning of the changes introduced in the present reform and to analyse the degree of recontextualizing at various levels, the research contains a comparative study in which, for each level, we compare the texts of the present reform (1991)² with the texts of the previous reform (1975). The research as a whole involves the analysis of changes concerned to the relation between school and family/community (Morais and Neves, 1997), inter and intradisciplinary relations (Neves *et al*, 1996), theory of instruction underlying syllabuses (Morais, Neves and Fontinhas, 1999) and discourses and competencies valued in syllabuses. It also involves the study of teacher's space of change in educational reforms (Neves and Morais, 2000). The study presented in this article is limited to the analysis of the discourses and competencies expressed in the official pedagogic discourse of the syllabuses.

Although the analysis of a syllabus can be focused on the specific scientific knowledges they contain and which are to be learned by students at a particular schooling level, that is not the focus of our study. When comparing the syllabuses of the two reforms in terms of discourses and competencies, we aim at developing an analysis which permits to make evident the *level* of scientific literacy intended by syllabuses. This means that in the analysis

of the specific instructional discourse attention is centred on the relative emphasis given to cognitive competencies of distinct degree of complexity. According to many educators (e.g. BSCS, 1995) it is important that scientific learning leads to a multidimensional literacy where students should be led to go beyond the barriers of the nominal or merely functional literacy (based on the learning of terms and facts) to achieve a structural literacy (involving concept understanding) and go forward in a significative way to a multidimensional literacy (with the possibility of applying concepts to diverse situations). Another way of looking at this issue is to say that in this study we want to have a measure of the level of conceptual demand of syllabuses. Previous studies (Domingos, 1989; Miranda & Morais, 1994) have shown how teachers differ in their conceptual demand at the level of the classroom – some teachers restrict their students to a very low level of scientific literacy, science is seen as factual knowledge to be memorized. This may already be the case with the syllabuses teachers follow.

Without undervaluing the importance of the analyses concerned with the discussion of the inclusion in the syllabuses of specific scientific knowledges, we believe that the question of literacy level constitutes a dimension of learning which has particular importance within the curricular analysis. The focus of this study is, therefore, on the rules and norms which regulate the discourses rather than on the discourse content in itself.

The study is also focused on the analysis of socio-affective competencies indicated in syllabuses to be developed by students. We want to have a measure of the level of socio-affective development entailed in syllabuses. To that end we analyse the extent to which syllabuses indicate complex socio-affective competencies as being important for students' development and which competencies are privileged.

According to the perspective referred, the study intends to compare both reforms in the following main aspects: (a) valuing given to the general regulative discourse and to the specific instructional and regulative discourses; (b) principles of relation, order and identity contained in the general regulative discourse; (c) relative emphasis given to cognitive and socio-affective competencies of distinct degree of complexity; (d) type of complex cognitive and socio-affective competencies valued. Starting from these objectives, the study investigates the following problem: *In what extent does the present educational reform for science education at the level of compulsory schooling introduces major changes in the discourses and competencies it values?*

We started from the idea that the present reform would show changes evident by a greater reference to the regulative dimension of learning, by a greater emphasis on the specific regulative discourse and, within each one of the discourses, by a greater emphasis on

competencies of high degree of complexity. The socio-political portuguese context in which the present reform is inserted and the trends in science education at the international level in general and in the european community in particular supported the above hypotheses. In fact, whereas the period which corresponded to the 1975 reform was a period which in socio-political terms was characterized by great change and instability – the turn with the 1974 revolution from a dictatorial society to a democratic society – the period which corresponded to the 1991 reform is a period of a stable democracy expressing explicitly and without reservations the regulative discourse of society.

Furthermore, the extending of compulsory schooling (which in Portugal was limited to the 6th year of schooling in 1975) to the 9th year of schooling would be a reason for the present reform to be based on educational options, which at the level of compulsory schooling, tend to value a strong regulative dimension in education. Present educational trends in the direction of valuing a science education which promotes students' development through the acquisition of cognitive and socio-affective competencies transferable to diversified contexts may also justify the hypotheses put forwarded.

Before going any further and in order to contextualize the reader from the outset, we consider that it is important to give information about the Portuguese socio-political situation in both periods studied. Portugal was under a dictatorship for more than fourty years. The political regime changed to a democracy in 1974, approaching Portugal to other european countries.

Under overt international pressure and the influence of educational changes namely in the USA, a reform of the educational system began in the late sixties. This reform started at the level of the 5th/6th years of schooling (age 10⁻ - 12⁺) and it was known as the Veiga Simão reform after the Minister of Education of the time. For that level of schooling new syllabuses were developed, nameley in science education. The pedagogic principles underlying these syllabuses departed in many crucial aspects from the principles established in the 1933 constitution (which had ruled the country during the whole dictatorial period) and in the educational basic law of the time.

External and internal pressures, together with the death of the dictator Salazar in 1970 and his replacement, created the conditions for the weakening of the regime. It was under these conditions that a new educational basic law was approved in 1973. This basic la contained already some principles of a more open society which were not in accordance with the constitution (1933) still in effect. The revolution which took place in 1974 found the educational system in a state of a considerable incoherence. Syllabuses of the 5th/6th years

(together with isolated educational experiences at the level of middle and high school) based on new contents and quite open relations, a basic law following similar trends but developed *after* those syllabuses, all this going in an opposite direction of the existing constitution and towards many of the principles established later on by the revolution.

Before a new constitution and a new educational basic law were developed and approved, the previous reform kept moving to the 7th year of schooling. In an unstable post-revolutionary period, syllabuses for the 7th year of schooling were developed.

The present reform (1991) followed trends similar to other countries reforms (United Kingdom, Spain, etc.) and was set in a well established democratic system within a new constitution (1976) and a new educational basic law (1986). The above shows how the analysis we proposed to make was rather difficult because we wanted to see the extent to which the new educational reform of the nineties introduced changes to the previous reform of the late sixties and early seventies. However, whereas the present reform took place in a stabilised society where constitution, educational basic law and syllabuses followed each other in time and where contextualizing and recontextualizing can be coherently analysed, the previous reform developed in a non-linear sequence where the educational basic law came after the 5th/6th years syllabuses, all under a dictatorial regime, and before the 7th syllabuses. These last syllabuses were already developed within a democratic system but still they were part of the same reform.

In the article, we start by presenting the theoretical framework with reference to the main concepts used in the study. This is followed by the methodology, the data and their interpretation and finally the conclusions and discussion.

2. THEORETICAL FRAMEWORK

Bernstein's model of pedagogic discourse (Bernstein, 1990, p.197) shows that the official pedagogic discourse can be considered as the result of a set of relations which are established between the various fields where its generation, recontextualizing and reproduction takes place. These relations show that the official pedagogic discourse reflects the dominant principles of society which are generated in the State Field under the influence of the International Field and the production (physical resources) and symbolic control (discursive resources) fields.

However, the model also highlights that the pedagogic discourse is not a mere reproducer of those principles. At the various levels of the official pedagogic device can occur recontextualizings which, leaving space for change, give origin to a reproducing

discourse which does not correspond exactly to the discourse initially produced.

The syllabus of a given discipline represents an official text produced in the Ministry of Education (agency of the official recontextualizing field) and contains in its message the principles and norms which constitute the General Regulative Discourse (GRD) which characterizes a given socio-political context.

However the same syllabus representing the official pedagogic discourse (OPD) contains also a message which reflects a set of options which at this level (and also influenced by the fields referred) appear as more adequate to a given educational context. Among these options are discourses and competencies which should be acquired, the form of pedagogic interaction which should be present in the teacher-student relation (theory of instruction valued), the nature of the relations between the various knowledges of a discipline (intra-disciplinary relation), between the knowledges of the discipline and the knowledges of other disciplines of the curriculum (inter-disciplinary relation) and also between the academic and non-academic knowledge.

According to the model, the syllabus reflects, therefore, *the what* and *the how* of the official pedagogic discourse. *The what* refers to the contents and relations to be transmitted and *the how* refers to the form how those contents and relations are transmitted in the teaching-learning context. When we analyze the official pedagogic discourse contained in a syllabus in terms of discourses and competencies we are centring the analysis on *the what*. This is the objective of the present study. However, according to Bernstein's model, *the what* of the pedagogic discourse is expressed through the formula ID/RD, where ID is the instructional discourse, RD is the regulative discourse and the dash represents the incorporation of the ID in the RD, the latter dominating the former. The specific instructional discourse of the syllabus of a given discipline or disciplinary area is transmitted through a set of knowledges and cognitive competencies which are the direct object of the teaching-learning of that discipline or disciplinary area. The specific regulative discourse is transmitted through a set of values, attitudes, socio-affective competencies which are valued in the teaching-learning context. However, the regulative discourse is a discourse of order, relation and identity, and for that reason it contains also the norms of social conduct which underly and regulate the form taken by the teaching-learning of the specific instructional discourse. In this way, and according to the theoretical model of reference, the official pedagogic discourse expressed in a syllabus contains, in its regulative dimension, the dominant principles of society, i. e. it is also a legitimizing discourse of the general regulative discourse.

Based on this theoretical framework, we start from the idea that the text of a given syllabus (science in the present case) present more or less explicit references to norms of

social conduct related to the GRD which characterizes the socio-political context in which the syllabus was constructed. We also start from the idea that syllabuses can differ in the emphasis given to that discourse and in the relative valuing which they give to the specific instructional and regulative discourses. Within each one of these discourses, syllabuses can also differ in the relative valuing given to competences of distinct levels of complexity.

It is also important to note that when making reference to those characteristics we are aware that the message contained in a syllabus may not be read or followed by teachers. In fact, even in a centralized system, the teacher may not follow in his/her practices the directions given in the text of the syllabus. The implementation of these directions depends on multiple factors (knowledge and ideology of teachers, social context of school, conditions available). Thus, the study does not intend to explore the real control that the Ministry of Education can have over the implementation of syllabuses at the level of teachers' practices. Rather it intends to explore the extent to which syllabuses' text (as official texts directed to teachers) can carry differentiated messages to the teacher and also to discuss the meaning of these messages in terms of potential indicators of change.

3. METHODOLOGY

As we said before, the analysis is focused on science syllabuses – Sciences of Nature in the 5th/6th years and Natural Science in the 7th year - of the present reform (1991) and of the previous reform (1975)³. From a methodological point of view, the study follows an interpretative model where a qualitative analysis was done. We used the sentence as the unit of analysis. In the context of this study, the sentence was taken as a part of the text of the syllabus with one or more sentences which on the whole have a given semantic meaning. In this study, we used only the text of the syllabuses, which refer to the transmission – acquisition context⁴.

The syllabus' content was considered globally – we considered in its analysis not only sentences which refer to all syllabus' topics specifically related to the scientific disciplines but also sentences which refer to parts of the syllabuses which are common to the whole curriculum and which also necessarily relate to those disciplines. The intention was to obtain data which refer to the general principles of the whole curriculum and therefore allowed a deeper analysis of the meaning of the message contained in syllabuses.

In order to carry out the various analyses, we organized, for each reform and for each syllabus, general tables⁵. These tables were made of several columns the first of which contained all sentences of the syllabus sequentially numbered and identified by the respective

area. This was followed by another column that referred to the general categories of analysis considered in this study, i.e. discourses and competencies. This column was divided in sections to separate the various sub-categories of analysis – general regulative discourse (GRD) and specific instructional and/or regulative discourses (SID/SRD); within the specific instructional discourse, simple cognitive competencies (SC) and complex cognitive competencies (CC); within the specific regulative discourse, simple socio-affective competencies (SSA) and complex socio-affective competencies (CSA). (see the following examples and also those in Tables I and II). Through a content analysis based on the categories we had established we identified each sentence. Whenever the sentence contained explicit information about the focus of analysis we indicated its classification in the tables. The classification, which was the result of the analysis initially made was later on validated by other researchers.

According to the theoretical framework of analysis and taking into account the limitations inherent to a content analysis applied to a syllabus, the identification of the sentences obeyed the following criteria:

- (a) When the sentence refers only to the educational macro-level expressing intentions and general principles about knowledges, values, attitudes to be considered in the general educational context, it was classified as transmitting a GRD. When the sentence refers to the micro-level of the classroom expressing knowledges and competencies to be developed in the teaching-learning process it was classified as transmitting a specific discourse and in that case it was indicated by SID and/or SRD according to the sentence's message. If the sentence is exclusively focused on cognitive knowledges and competencies we indicated SID and if the sentence is exclusively focused on attitudes and socio-affective competencies we indicated SRD. If the sentence transmits a message, which contains both discourses, it was indicated by SID/SRD. Since the categories GRD and SID/SRD were considered as being exclusive, whenever a sentence was identified as containing the GRD it was not identified as containing the SID/SRD and vice-versa.
- (b) All sentences containing SID were identified in terms of the cognitive competencies they expressed. It was considered that they valued CC whenever they refer concepts of high level of abstraction or expressed complex cognitive competencies no matter if factual knowledge or concepts of low level of abstraction were referred⁶. It was considered that they valued SC whenever both knowledges and competencies were of a low cognitive level.
- (c) All sentences containing SRD were identified in terms of the socio-affective competencies they expressed. It was considered that they valued CSA whenever they refer values or expressed attitudes of a complex level. It was considered that they valued SSA whenever competencies valued were of a simple level.

TABLE I. Competencies required by distinct reforms

Schooling	Complex cognitive competencies			Complex socio-affective competencies		
	1975 Reform	1991 Reform	1975 Reform	1991 Reform	1975 Reform	1991 Reform
5th/6th years	<ul style="list-style-type: none"> Concept high-level understanding Concept application Data interpretation Conclusion drawing Generalizing Hypothesizing Experimental planning Problem formulation Critical analysis of data Syntheses making Creativity 	<ul style="list-style-type: none"> Concept high-level understanding Concept application Data interpretation Conclusion drawing Data selection Information organizing Critical thinking Problem formulation Problem-solving Critical analysis/data analysis Syntheses making Creativity Knowledge evaluation Relations understanding Scientific rigour Investigating Learning to think 	<ul style="list-style-type: none"> Participation Cooperation Group integration Group work Responsibility Critical mind Free critique Respect for other's opinions 	<ul style="list-style-type: none"> Participation Cooperation Community interaction Intervention Responsibility Critical and curious mind Open-mindedness Other's view-point acceptance Respect for oneself and for others Respect for the environment Open-mindedness to other cultures Personal realization Self-confidence Initiative Persistence Helpfulness Solidarity, justice, truth Autonomy Socio-affective and civic maturity Consciousness/sensitiveness 		
7th year	<ul style="list-style-type: none"> Concept high-level understanding Concept application Data interpretation Conclusion drawing Generalizing Hypothesizing Experimental planning Problem-solving Critical analysis of data Syntheses making 	<ul style="list-style-type: none"> Concept high-level understanding Concept application Data interpretation Conclusion drawing Inferring Hypothesizing Hypothesis evaluation Experimental planning Problem formulation Problem identification Problem-solving Critical analysis Syntheses making Creativity Knowledge evaluation Ideas relating Scientific rigour Data selection Information organizing Information finding Model constructing Critical thinking Project development 	<ul style="list-style-type: none"> Participation Cooperation Organization Intervention Responsibility Group work Decision Initiative Valuing of nature's protection Consciousness 	<ul style="list-style-type: none"> Participation Cooperation Community interaction Intervention Responsibility Critical and curious mind Collaboration Solidarity Socio-affective and civic maturity Consciousness Open-mindedness to other cultures Personal realization Self-confidence Initiative Persistence Helpfulness Solidarity, justice, truth Autonomy 		

TABLE II. General regulative discourse in distinct reforms

1975 Reform		1991 Reform	
<i>5th/ 6th years</i>	<i>7th year</i>	<i>5th/ 6th/ 7th years</i>	
Civism	Participation as transforming agent of society	Critical and creative participation	
Conscious decision	Preparation of future free men	Personal development (individual and social)	
Construction of one's own set of values	Solving of national problems	Responsible citizenship	
Knowing to see, knowing to choose, knowing to invent	Solidarity with other peoples' fighting	Personal, intellectual, moral autonomy	
Dignification of non-hierarchical work	Receptivity to change	Universal humanism	
Dynamic agent of society and culture transformation	Responsibility	Solidarity and understanding	
Responsibility before environment, society and culture	Solidarity	Integrating basic formation	
Skills and attitude development	Pleasure in personal effort	National consciousness and culture	
	Spontaneity and creative intervention	Adaptation to the socio-cultural context	
	Entering active life	Articulation between knowing and knowing to do, and between life and work	
	Cultural decentralization	Integral realization as autonomous, conscious and socially intervening subject	
	Interpret, criticize, organize, communicate information needed to any school, professional, social task	Lasting learning	
	Critical mind, anti-dogmatic and receptive to changes	Democratic action and participation	
	Experiences of inter-personal and inter-groupal relations	Sensitivity development	
	Socio-affective maturity and communication competence	Values clarification	
	Conscious and responsible intervention	Development of spiritual, aesthetic, moral, civic values	
	Attitudes and habits of civic relation	Intellectual progress	
	Finding of affective values	Cognitive and moral development	
	Integration of information and formation	Flexible adaptation to new situations	
	Development of scientific mind and creativity	Self-education	
	Personal progress	Interest in discovery	
		Critical and selective mind	
		Systematic organization	
		Personal	
		Free development of personal maturity	
		Self-esteem	
		Responsibility	
		Integral development of personality	
		Active participation in community's life	
		Creativity, autonomy, solidarity in collective work	
		Democratic mind	
		Learn to learn	
		Learn to do	
		Continuous and creative self-education and self-evaluation	
		Social value of work	

Although complex competencies presuppose single competencies, if the sentence expressed only complex competencies they were the only ones considered. Only when sentences expressed clearly the two types of competencies were both considered. To illustrate this classification we are showing some sentences and their identification⁷.

General Regulative Discourse

From here derives the need to promote child's awareness of what surrounds her/him in order to get the notion of responsibility before the environment, the society and the culture where she/he is inserted. (Sentence 5, Table IA).

Proportionate to students experiences of inter-personal and inter-groupal relations in order to favour their socio-affective maturity, developing the capacity of communication and creating in them positive relational attitudes and habits either in the field of their family, friendship and civic relations or in their conscious and responsible intervention in the surrounding reality. (Sentence 16, Table IIA)

[...] in three essential educational dimensions – personal education in its individual and social dimensions, the acquisition of fundamental knowledges/capacities and the competence for exerting a responsible citizenship [...]. (Sentence 8, Table IIIA)

Specific Instructional Discourse

Simple competencies

To know and localize distinct litological formations at the country level. (Sentence 24, Table VA)

Complex competencies

To stimulate synthesis capacities:

- to detect problems
- to formulate hypotheses
- to plan experiments
- to seek solutions for problems

(Sentence 26, Table IA)

To understand that materials circulation in a food chain corresponds to energy transferences.

(Sentence 30, Table VA)

Specific Regulative Discourse

Simple competencies

The study of this theme [life transmission] will create situations to develop the love and respect by the environment and living things. (Sentence 129, Table IV)

Complex competencies

To incentive the recognition of the social value of work in all its forms and to promote the notion of

help and cooperation. (Sentence 25, Table IIIA)

Fundamental importance of the aspects relative to the development [...] of responsibility and capacity of integration in groups. (Sentence 4, Table IA)

From the analysis of all sentences we constructed synthesis tables⁸ for each syllabus in which data were organized to allow comparisons between the sections of the various syllabuses. The sections were grouped in five major topics: A – Curriculum aims; B – Curriculum structure; C – Discipline aims; D – Discipline content; E – Methodological guidance for the discipline. The table for each syllabus contains, not only for the syllabus as a whole but also for each topic and within each topic for each section of the syllabus, the following data: (a) number and area (and respective percentage) of sentences which contain directions about discourses and competencies; (b) number and area (and respective percentage) of sentences classified according to the discourses they value; (c) number (and respective percentage) of sentences classified according to competencies.

Based on the data expressed in the tables we made the comparative study of the two reforms. We analyzed the global message of the syllabuses concerning the same schooling level – the two syllabuses of Sciences of Nature of the 5th/6th year (1975 and 1991) and the two syllabuses of Natural Science of the 7th year (1975 and 1991). We also analyzed the messages related with each one of the topics created for the analysis of the syllabuses. In order to interpret the data we separated in this analysis, the aspects common to the whole curriculum (topics A and B) and the topics directly related to the discipline (topics C, D and E). The former will be called first section and the latter second section of the syllabuses.

The analysis of the discourses and competencies obeyed to criteria which made evident for each syllabus possible differences in the various categories and sub-categories studied and possible differences in the syllabuses of the same schooling level of the two reforms. Thus we established the following comparisons which constituted the basis for the interpretation of the data:

- (1) For each syllabus, we compared: (a) the number of sentences containing GRD with the number of sentences containing SID and/or SRD; (b) the number of sentences containing SID with the number of sentences containing SRD; (c) the number of sentences containing CC with the number of sentences containing SC; (d) the number of sentences containing CSA with the number of sentences containing SSA.
- (2) For the syllabuses of the same schooling level of the two reforms, we compared the differential valuing: (a) between the GRD and the specific

discourses (SID and/or SRD); (b) between the SID and the SRD; (c) within the SID, between the complex cognitive competencies (CC) and the simple cognitive competencies (SC); within the SRD, between the socio-affective competencies of higher level (CSA) and the socio-affective competencies of lower level (SSA).

To obtain a measure of the differential valuing we used the ratio between the number of sentences which refer to the categories and sub-categories under comparison: GRD/SID+SRD; SID/SRD; CC/SC; CSA/SSA. The values obtained were used as a measure of the direction of the change between the two reforms.

In order to complement the comparison between syllabuses, we analyzed the type of competencies and values they indicated. Tables presented in the annexe show, for each schooling year and reform, a list of complex cognitive and socio-affective competencies and of principles of order, relation and identity (GRD) expressed in syllabuses.

Although we used in the analysis measures based on the quantification of sentences, we can consider that the methodology used in the analysis followed a qualitative/interpretative model. In fact, that quantification represents only a way of organizing the data which resulted from a content analysis of each one of the sentences of the various sections of the syllabus.

4. ANALYSIS AND INTERPRETATION OF DATA

4.1 Relative valuing of general regulative discourse and specific discourses

The general data, which resulted from this analysis, are shown in table I. In this table, we indicate for each schooling level and within each level for each reform, the frequency⁹ of sentences of the syllabus which refer to the general regulative discourse (GRD) and of sentences which refer to specific discourses either the specific instructional discourse (SID) or the specific regulative discourse (SRD). Frequencies refer to the syllabus as a whole and to each one of the syllabus sections which, in the table, are grouped in terms of topics related to common aspects of the whole curriculum (A and B) and topics directly related to the discipline (C, D and E). In the table it is also shown the value, which refers to the relation between the GRD and the specific discourses. For the syllabus as a whole and in the case of the topics C, D and E, that value was obtained on the basis of the ratio SID+SRD/GRD and in the case of the topics A and B was obtained on the basis of the

inverse ratio. The distinct procedure used for different topics had the intention of obtaining always a ratio equal or higher than 1, which would facilitate the interpretation.

On the basis of the data of the Table III, we start by a comparative analysis of the syllabuses of the 5th/6th years of the two reforms. This is followed by a similar analysis of the syllabus of the 7th year and finally we present a synthesis of the main ideas suggested by the analysis. The comparative analysis is centred on the emphasis given to the GRD in relation to the specific discourses (SID and/or SRD).

4.1.1 Comparative analysis of the syllabuses of the 5th/6th years (1975 and 1991)

If we consider the syllabuses as a whole, the data (Table III) shows that more importance is given to the specific discourses (SID and SRD) than to the GRD. The value which gives the relation SID+SRD/GRD is similar in 1991 and in 1975 (respectively 2.7 and 3). Thus the difference in the direction of a greater valuing of the GRD in the present reform does not have much meaning in terms of change.

When we consider the relative valuing of the discourses at the level of the common topics of the curriculum (A and B) and of the guidelines for the discipline (C, D and E), the data of table I shows that, in both reforms, the GRD is more emphasized than the specific discourses at the level of the topics A and B whereas the specific discourses (SID and SRD) are more emphasized than the GRD at the level of topics C, D and E.

TABLE III. Relative valuing of general and specific discourses separated by syllabus sections

Schooling	Syllabuses/sections	Sentence frequency		Discourse ratio		
		GRD	SD	GRD/SD	SD/GRD	
5th/6th years	1975	A + B	12	3	4	–
		C + D + E	1	36	–	36
		Total	13	39	–	3
	1991	A + B	74	39	1.9	–
		C + D + E	5	172	–	34.4
		Total	79	211	–	2.7
7th year	1975	A + B	16	1	16	–
		C + D + E	20	107	–	5.4
		Total	36	108	–	3
	1991	A + B	74	39	1.9	–
		C + D + E	5	126	–	25.2
		Total	79	165	–	2.1

A + B, Curricular section; C + D + E, disciplinary section.

Furthermore, data shows that for topics A and B the greater emphasis given to the GRD relatively to the specific discourses is greater in 1975 than in 1991 (respectively 4 and 1.9)

and for topics C, D and E the greater emphasis given to the specific discourses relatively to the GRD is similar in 1975 and in 1991 (respectively 36 and 34.4). These facts suggest that in first section of the syllabus the present reform tends to diminish the differential emphasis attributed to these discourses whereas in second section the differential emphasis observed in the previous reform is kept. These facts suggest therefore that in the common topics of the curriculum, there is a trend in the present reform to diminish the valuing given to the GRD and that in the topics directly related to the discipline the valuing is similar in the two reforms

4.1.2 Comparative analysis of the syllabuses of the 7th year (1975 and 1991)

Data referring to the syllabuses as a whole (Table III) shows that also at the level of the 7th year of schooling the specific discourses (SID and SRD) are more emphasised than the GRD in both reforms. However there is in the present reform a smaller difference between the emphasis given to these discourses and the emphasis given to the GRD, this suggesting a trend to valuing more the GRD in this reform. In fact, the value which translates the relation $SID+SRD/GRD$ is smaller in 1991 than in 1975 (respectively 3 and 2.1).

When we consider the relative valuing of the discourses at the level of the curricular principles and of specific guidelines for the discipline (Table III), the data shows that the GRD is more emphasised than the specific discourses at the level of the topics A and B, whereas the specific discourses (SID and SRD) are more emphasised than the GRD at the level of the topics C, D and E. Furthermore, the greater emphasis given to the GRD at the level of the common aspects of the curriculum is much greater in 1975 than in 1991 (respectively 16 and 1.9) and the greater emphasis given in discipline guidelines to the specific instructional and regulative discourses is much greater in 1991 than in 1975 (respectively 25.2 and 5.4). This data suggests that with the present reform there is a trend to diminish the relative valuing given to the GRD in the common topics of the curriculum and to reinforce the relative valuing given to the specific discourses in the syllabus topics more directly related to the discipline.

4.1.3 Synthesis

The data obtained (Table III) shows that, for both schooling levels and for both reforms, a greater emphasis is given to the specific discourses than to the general regulative discourse and that in the present reform there is an increase of the emphasis on the GRD relatively to other discourses. This increasing translates a change only at the level of the 7th year of

schooling. These results show that although the message of the syllabus tends to fundamentally express the specific knowledges and competencies to be developed in the teaching-learning context, there is in the present reform of the 7th year a concern to make more explicit the general regulative principles which support the selection of those knowledges and competencies. This concern may reflect the need of leading the teachers to be more aware of the principles which underly the educational context and, in this way, guide them to a more effective implementation of the discipline objectives.

The above relates to differences in the syllabus as a whole. However, it is interesting the trends referred before about the differential valuing of the discourses when we analyse separately the topics common to the curriculum and the topics related to the discipline. It is not surprising that we find for both levels of schooling and for both reforms a differential valuing of the discourses whose direction depends on the nature of those topics – greater relative emphasis of the GRD in curricular topics and greater relative emphasis of the specific discourses in disciplinary topics. In fact, it should be expected that the GRD is more emphasised at the curricular level of the syllabus because it is at this level that it is fundamentally intended to make explicit the great principles which should guide the educational process. Those principles are common to the whole curriculum and should therefore constitute the major way of transmitting the dominant principles of society. It should also be expected that it is at the level of the guidelines of the discipline that more emphasis is given to knowledges, competencies, attitudes, values which represent the specific instructional and regulative discourses recommended in the syllabuses for the different levels of schooling. However, what is interesting to notice, from the analyses done, it is the fact that in the present reform there is a trend (quite evident in the 7th year) to diminish the difference of emphasis between the discourses at the curricular level with the consequent decrease of the valuing of the GRD at this level. And also to reinforce the difference of emphasis between discourses at the level of the disciplinary topics with the consequent increase of the valuing of the specific discourses at this level. Although in the present reform it is kept the differentiation between discourses according to the nature of the two sections of the syllabuses, it seems that the trends referred show a concern (particularly in the 7th year) to make more explicit at the level of the specific aspects of the discipline and in part also at the level of the common aspects of the curriculum, what should really constitute the object of the teaching-learning both in instructional terms (knowledges, cognitive competencies) and regulative terms (attitudes, values, socio-affective competencies).

The comparison of the two reforms also shows differences on the principles of relation, order and identity, which constitute the general regulative discourse present in syllabuses. The data shows (Annexe) that in the 1975 reform, and more explicitly in the 7th year of schooling, the GRD expresses principles and values already adjusted to a democratic society (e.g. civism, freedom, solidarity, responsibility). The change in the 1991 reform is translated in a higher reinforcement of the previous principles and values. That reinforcement is evident in the greater diversity and simultaneously higher transference power of those principles. Such change may reflect a concern of present society at the level of values clarification and development and which is expressed in syllabuses through the increasing valuing of principles related to students' personal and social development.

4.2 Relative valuing of specific discourses and competencies

Data from the analysis are expressed in the Table IV. In this table are shown for each schooling level and within each level for each reform the values which translate the differential valuing attributed to the specific instructional and regulative discourses, to simple and complex cognitive competencies and to simple and complex socio-affective competencies. These values represent the ratio between the number of sentences of each set analysed and refer to both, the syllabus as a whole and the two main sections considered (common aspects of the curriculum - A, B – and specific guidelines of the discipline – C, D, E). The ratio followed the same criteria for the sets already analysed, i.e. it was intended to obtain a value equal or higher than 1 in any of the cases. Thus for the two specific discourses we made the ratio SID/SRD, for the cognitive competencies the ratio CC/SC and for the socio-affective competencies the ratio CSA/SSA. We considered that the higher the ratio the higher the differential valuing between the aspects being compared.

TABLE IV. Relative valuing of specific discourses and competencies separated by syllabus sections

Schooling	Syllabuses/sections	Discourse and competencies ratio			
		SID/SRD	CC/SC	CSA/SSA	
5th/6th years	1975	A + B	1.5	only CC	only CSA
		C + D + E	6.0	1.6	6.0
		Total	4.9	1.6	7.0
	1991	A + B	1.1	3.2	16.0
		C + D + E	4.8	1.5	4.2
		Total	3.2	1.6	5.9
7th year	1975	A + B	1.0	–	–
		C + D + E	15.0	2.7	4.0
		Total	13.3	2.7	4.0
	1991	A + B	1.1	3.2	16.0
		C + D + E	7.4	3.3	4.0
		Total	3.5	3.3	7.3

A + B, Curricular section; C + D + E, disciplinary section.

4.2.1 Comparative analysis of the syllabuses of the 5th/6th years (1975 and 1991)

Considering the relation SID/SRD, the data of table IV show that, in the syllabus as a whole, there is in the two reforms a greater emphasis in the instructional discourse than in the regulative discourse (the relation is always higher than 1). The comparison of the two reforms shows that the relation between these discourses gives a higher value in 1975 than in 1991 (respectively 4.9 and 3.2). This suggests that although in the present reform the instructional discourse continues to be more emphasised than the regulative discourse the latter tends to be more valued in the present reform when compared to the previous one.

The pattern found for the syllabus as a whole is also evident for the two main sections of the syllabuses, i.e. for common aspects of the curriculum (A, B) and for specific guidelines of the discipline (C, D, E). For both reforms the instructional discourse predominates although this is more evident at the level of the discipline guidelines. At the level of the common aspects of the curriculum, particularly in the reform of 1991, the valuing given to the two discourses is similar. When we compare the two reforms in terms of the two sections of the syllabuses, data shows that also here the trend for the syllabuses as a whole is present. In fact, for both sections there is in the present reform a decrease in the SID/SRD relation which reinforces the suggestion of an increase of the valuing of the regulative discourse in this reform.

Analysing the relation between the two groups of cognitive competencies, the data in Table IV show that there is, in the two reforms, a greater valuing of complex competencies when compared with simple competencies. This valuing is more evident at the level of the section which refers to the common aspects of the curriculum (A, B). In comparative terms, it is possible to say that there are no changes in the present reform. In fact, there is in the syllabus as a whole and in the section which refers to the guidance for the discipline a similar differential valuing of the two types of competencies for both reforms. On the other hand a similar pattern exists concerning the differential valuing in terms of the two sections of the syllabuses (i.e. greater relative valuing of the complex competencies in the curriculum common topics than in the disciplinary topics).

The data analysis of the valuing given to the socio-affective competencies (Table IV) leads to the conclusion that the socio-affective competencies of greater level of complexity (CSA) are the most emphasised and that this trend is present in both the syllabuses as a whole and the two major sections considered. Similarly to what happens with cognitive competencies there is a relative greater emphasis of the complex socio-affective

competencies at the level of the common aspects of the curriculum when compared with the relative valuing observed at the level of the guidelines for the discipline. When we compare the data of the two reforms we can see that in the present reform it is kept the valuing given to complex competencies – the value of the CSA/SSA ratio is similar to the value found in the previous reform for the syllabus as a whole (7 in 1975 and 5.9 in 1991).

4.2.2 Comparative analysis of 7th year syllabuses (1975 and 1991)

Data of Table IV shows that the SID/SRD relation for the syllabus as a whole and for the two reforms is a relation where the instructional discourse dominates the regulative discourse. However, the difference between the two reforms (13.3 in 1975 and 3.5 in 1991) makes evident a change in the present reform which translates a significant increase of the valuing given to the specific regulative discourse with a consequent approximation of the two discourses.

With respect to each one of the two sections of the syllabuses (A, B on one hand and C, D, E on the other), data shows that for both reforms there is a greater preponderance of the instructional discourse at the level of the guidelines for the discipline which is more evident in the 1975 reform (15 in 1975 and 7.4 in 1991). This reinforces the idea of a change in the present reform to give more value to the regulative discourse. At the level of the common aspects of the curriculum and for both reforms, the valuing given to the two discourses is similar. This suggests that the SRD is less valued at the level of the disciplinary section than at the level of the common aspects of the curriculum.

Data about the relation between cognitive competencies (Table IV) suggests that there is in both reforms a greater emphasis in the complex competencies in comparison with simple competencies and that this differential valuing is in the 1991 reform similar for the two sections of the syllabus (the absence of a reference to cognitive competencies at the level of the common aspects of the curriculum in the 1975 reform makes impossible this analysis). In comparative terms we can say that in the present reform the trend observed in the previous reform is kept because the value of the relation CC/SC is only slightly greater in 1991 than in 1975 for both the syllabus as a whole (respectively 3.3 and 2.7) and the section related with the specific aspects of the discipline (also 3.3 and 2.7).

The analysis of the data, which refer to the socio-affective competencies, suggests that also here the competencies of higher level of complexity (CSA) are the most emphasized in both reforms. This greater relative emphasis is present in the syllabus as a whole and in each one of the two sections considered, with the exception of the general principles of the

curriculum in the 1975 syllabus where there are no references to socio-affective competencies. In the 1991 syllabus there is a quite evident difference between the two sections, showing clearly a greater valuing of the complex competencies at the level of the common aspects of the curriculum when compared with the valuing given to the same competencies at the level of the specific guidelines of the discipline (17 in the first section and 4 in the second).

The comparative analysis of the data of the two reforms shows that in the present reform increases the valuing given to the complex competencies (the value of the relation CSA/SSA is 4.0 in 1975 and 7.3 in 1991). That increasing is only evident in the syllabus as a whole; the value of the relation is kept for the section where comparison between the reforms studied can be made (C, D, E).

4.2.3 Synthesis

Graph of figure 1 shows the data indicated in the Table IV which refers to the syllabus as a whole. With this graph we intend to make more evident the comparisons done in order to understand the global meaning of the changes at this level between the two reforms.

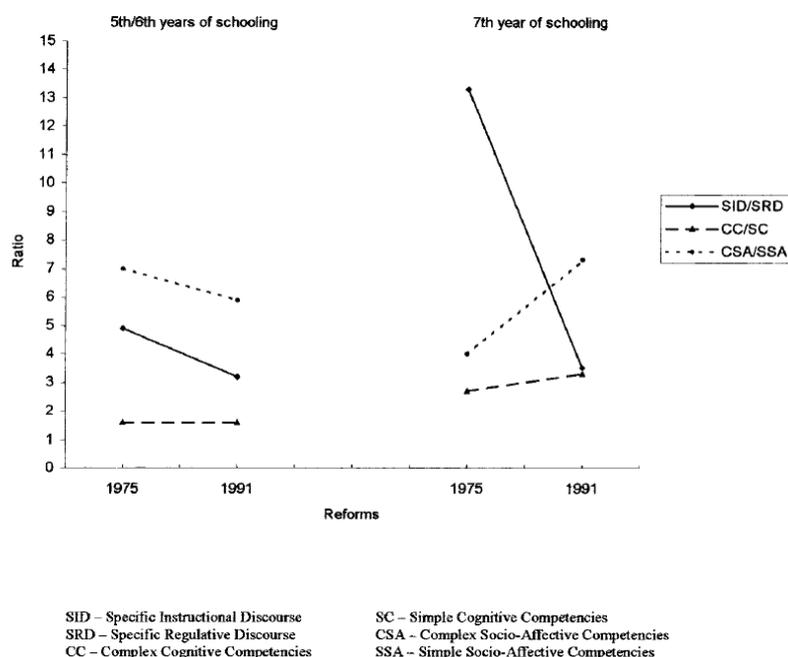


FIG. 1. Relative valuing of discourses and competencies in the whole syllabuses.

The analysis of this graph shows that for both levels of schooling there is a change in the present reform which translates a greater relative emphasis now being given to the specific regulative discourse, approximating in terms of valuing the regulative discourse to the instructional discourse. This change which is much more evident in the 7th year of

schooling may be a sign of a concern to lead teachers to consider together with scientific knowledges a set of values and attitudes necessary to the integration of students in present society. A greater explicitness in the syllabuses of these values and attitudes may be a means to meet that concern.

With respect to changes at the level of competencies, data suggests that only for socio-affective competencies and for the 7th year of schooling a significant change occurred. This change which translates an increase of the valuing of the complex socio-affective competencies reinforces the trend referred before, with still higher meaning at this level of schooling, to give more importance to the socio-affective dimension of learning. In the lower level of schooling (5th/6th years), the slight trend in the opposite direction does not represent a real change and this may translate the fact that a quite great emphasis was given to the regulative dimension of learning in the previous reform. With respect to the cognitive competencies we can say that there was not any change from the previous reform to the present one. In fact, in the lower level of schooling, the differential valuing between cognitive competencies of different degree of complexity is equal in the two reforms and in the higher level of schooling the slight increase in the emphasis given in the present reform to the complex competencies is not relevant to mean a real change.

The fact that changes occurred at the level of competencies refer to the socio-affective competencies and not to cognitive competencies together with the fact that the regulative discourse is becoming more valued, may be indicators of a change which is fundamentally related to the regulative dimension of learning. It is interesting to notice that the analysis of the data of figure 1 shows that for both reforms and for both levels of schooling the CSA/SSA relation is always higher than the CC/SC relation. This means that there is in the syllabuses a more balanced distribution between the two types of cognitive competencies than between the two types of socio--affective competencies. This aspect also shows the extent to which there is a trend for a greater concern about the differential nature of learning at the level of the acquisition of values and attitudes than to the differential nature of learning at the level of the development of competencies related to the acquisition of scientific knowledge.

Another aspect highlighted by this analysis refers to the differential valuing which is attributed to the specific discourses and to the complex cognitive and socio-affective competencies when we compare the two major sections of the syllabuses. In both reforms, the greater emphasis given to the specific instructional discourse is less evident in the syllabus section which contains aspects common to the whole curriculum than in the section

directly related to the discipline. This suggests a decreasing of the relative valuing of the specific regulative discourse when passing from the curricular level to the disciplinary level of syllabuses. Furthermore, in both reforms the greater relative emphasis given to complex competencies is, in general, more evident in the section of the syllabuses which contains the topics common to the whole curriculum. In the section which contains the topics more directly related to the discipline that valuing decreases. Only in the syllabus of the 7th year of the 1991 reform and in the cognitive area is a similar relative valuing in the two sections of the syllabus observed.

This differentiation in terms of distinct parts of a syllabus makes evident a recontextualizing within the syllabus itself when passing from a curricular level to a disciplinary level. It shows also that the direction of that recontextualizing is in general expressed in the undervaluing of the specific regulative discourse and of complex competencies. This can have important consequences in the implementation of the syllabuses.

With reference to the complex competencies, the study highlighted also other interesting points which respect to differences between the two reforms about the type of competencies they value (Annexe). In the cognitive area, the 1975 reform emphasizes for both schooling levels competencies which are fundamentally expressed in terms of investigative processes (e.g. hypothesis formulation, experiments planning, results interpretation). In the 1991 reform we can see a reinforcing of the same competencies but simultaneously a great emphasis is given to competencies which are considered necessary to develop those processes (e.g. scientific rigour, learning to think, organizing information). The change tends in this case to be expressed through a greater diversification and simultaneous discrimination of the complex cognitive competencies valued.

This trend is also observed for the socio-affective dimension of learning. In fact, the socio-affective competencies valued in 1975 are still valued in 1991 and call for values and attitudes which reflect the principles of a democratic society (e.g. participation, cooperation, responsibility). Furthermore, the change observed in the present reform is also expressed by a greater diversity and level of specification of the type of competencies. Personal realization, self-confidence, justice, truth, persistence, are examples only referred in the 1991 reform, which makes clear the increasing importance presently given to the personal and social dimension of students' development in regulative terms.

In general, the results of the analysis made of the two dimensions of learning (cognitive and socio-affective) suggest that the change in the type of competencies goes in the direction

of a greater explicitness of complex competencies.

5. CONCLUSIONS AND DISCUSSION

We started with a problem - *In what extent does the present educational reform for science education at the level of compulsory schooling introduces major changes in the discourses and competencies it values?*

We carried out analyses based on a sociological framework and directed to the objective of comparing the present reform with the previous one in terms of: (a) valuing given to the general regulative discourse and to the specific instructional and regulative discourses; (b) principles of relation, order and identity contained in the GRD; (c) relative emphasis given to cognitive and socio-affective competencies of distinct degree of complexity; (d) type of complex cognitive and socio-affective competencies valued. The analyses were centered on the syllabuses of two reforms (1975 and 1991) referring to two schooling levels – 5th/6th years and 7th year.

We started from the idea that changes in present reform would be translated by a greater reference to the regulative dimension of learning. Data from the analyses support in general this idea. In fact, there is in the present reform an increase of the valuing of the general regulative discourse in the syllabus of the 7th year of schooling. The study also showed that, although more emphasis is given in both reforms to the instructional discourse than to the regulative discourse, there is in the present reform a change in the direction of valuing more the specific regulative discourse. It is at the level of the 7th year that the change is quite evident. The diagram of figure 2 summarizes these conclusions.

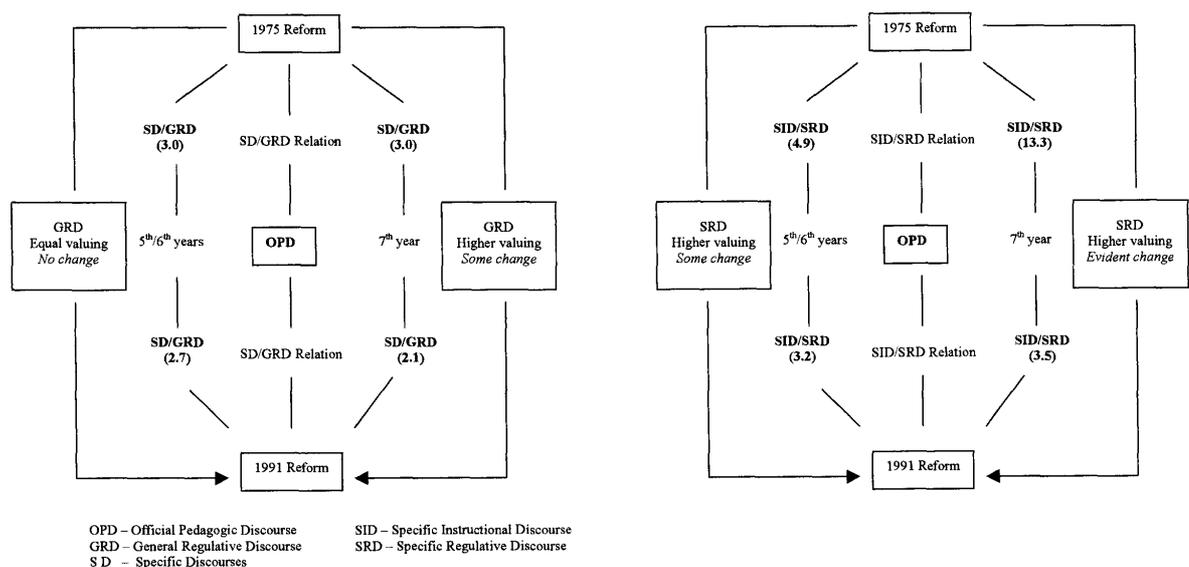


FIG. 2. General regulative discourse and specific discourses: changes between 1975 and 1991 reforms.

It is interesting to notice that in spite of the absence of a significant change in the relative emphasis given to the general regulative discourse when we analyse syllabuses as a whole, there are trends suggesting some change when we analyse separately the syllabuses sections related to the common aspects of the curriculum and to the specific discipline guidelines. Although in the 5th/6th and 7th years syllabuses of the present reform the pattern of relative valuing of distinct discourses in terms of the two syllabuses' sections is kept (greater valuing of the general regulative discourse in the curricular section and greater valuing of the specific discourses in the disciplinary section), there is a change evident in the blurring of the relative emphasis given to the general regulative discourse at the curriculum level, particularly in the 7th year of schooling. The change is also evident in the increasing of relative valuing given to specific discourses at the level of aspects directly related to the discipline, particularly in the 7th year.

With respect to the relative valuing given to competencies in the syllabuses, data suggests that in both reforms there is a trend to give more importance to cognitive and socio-affective competencies of higher level of complexity. The change refers to an increase of that importance only for the socio-affective competencies at the level of the 7th year of schooling. In the lower schooling level the valuing attributed to complex socio-affective competencies relatively to simple competencies is similar in both reforms. The valuing given to the two types of cognitive competencies is also similar for both reforms and for both schooling levels. Here the initial hypothesis is not totally supported. These conclusions are summarized in the diagram of figure 3.

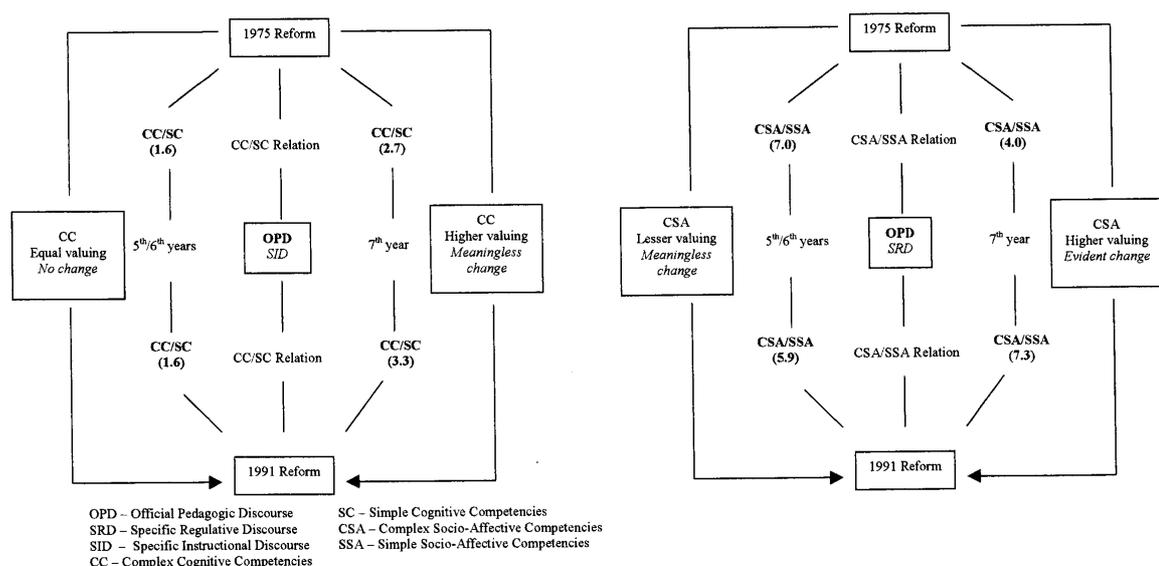


FIG. 3. Cognitive and socio-affective competencies of different levels of complexity: changes between 1975 and 1991 reforms.

The analysis of differences at the level of discourses and competencies allowed also to

consider aspects related to the emphasis given to them in the distinct sections of the syllabuses. It is interesting to reflect on the meaning of the greater valuing given to the regulative dimension of learning and to the complex competencies (cognitive and socio-affective) in the curricular common topics and the decreasing of that valuing in the topics directly related to the discipline. This general trend calls the attention to the recontextualizing which can occur when passing from the curricular level to the disciplinary level. According to the direction of recontextualizing observed, this may lead teachers to undervaluing those learning components when implementing syllabuses. With this undervaluing not only the direction of the intentions contained in the principles of the curriculum is lost but, most important, there is a trend to limit learning to its instructional aspects and to focus it on lower cognitive and socio-affective levels. To be aware of the differences which exist at the various levels of a syllabus and to reflect about their meaning are crucial aspects to be considered in the construction and implementation of the curricula.

Another interesting aspect of the study refers to the comparison between the reforms about the principles of relation, order and identity contained in the GRD and about the type of complex cognitive and socio-affective competencies valued in syllabuses. The principles which constitute the GRD are, in both reforms and for both schooling levels, principles which contain values and norms of social conduct which are intended to be present in a democratic society. Also the type of cognitive and socio-affective competencies which are more valued in both reforms and for both levels of schooling reflect the importance which has been given in scientific education to the development of complex competencies. However, a more comprehensive and explicit reference to those principles and competencies in the present reform leads to think that the change at this level may mean the attribution of a greater legitimacy to the values expressed in the general regulative discourse. It should be noticed that the complex cognitive and socio-affective competencies expressed in syllabuses reflect those values.

Synthesizing, the studied carried out reveals that in the present reform, change is fundamentally expressed in the regulative dimension of learning. We saw not only an increasing valuing of the general and the specific regulative discourses (quite evident in the 7th year) but also an increasing valuing of the complex socio-affective competencies (only evident in the 7th year). A trend to diversify the type of competencies is also observed. These changes may mean an increasing interest of the official recontextualizing field to legitimize a teaching-learning process which promotes more significantly the acquisition by the students of a set of values, norms and attitudes within the general curricular movement

for the personal and social education.

With respect to the instructional dimension, the present reform keeps the relative greater valuing already given in the previous reform to the complex cognitive competencies. Change is in this case expressed by the greater diversity of these competencies making more explicit the importance of developing competencies needed to think and act scientifically.

In the seventies were introduced in Portugal changes in science education, which reflected trends occurred in the sixties in the USA. At that time, the great concern was to increase scientific literacy and consequently to include as objectives of scientific learning the development of cognitive competencies of high level like analysis, synthesis and evaluation.

The 1975 reform took place during this period and for that reason the absence of change in the present reform at the level of greater valuing attributed to cognitive competencies may be a consequence of the fact that such change had already occurred. It is also possible that the absence of change at this level is related to the fact that these are syllabuses for compulsory schooling which in 1975 stopped with the 6th year of schooling and in 1991 was extended to the 9th year of schooling. In fact there is a generalized paradoxical trend to decrease the level of conceptual demand of the curricula at the level of the schooling for all.

To justify the decrease of this demand it is often referred the importance of meeting the differentiated needs of the new students' population. This is paradoxical because if most students finish their schooling at this level they are precisely those who need more an education which promotes the development of competencies of high level of generality and application.

The trend in the present reform to diversify the type of complex cognitive competencies seems to meet present trends in scientific education arising out from the eighties, which go in the direction of reinforcing the development of these competencies in order to prepare students for a critical and reflexive intervention in future society.

At the level of compulsory schooling, the school tends to assume in a more explicit way its regulative role in order to guarantee a more adjusted preparation of the future citizens to the dominant principles of the society of which they are part, leaving to the higher schooling levels (intended to a privileged minority) the preparation for higher levels of scientific literacy. To support this idea it would be necessary to introduce, in the comparisons of science education reforms, the syllabuses of secondary school (10th, 11th, and 12th).

The analysis done suggests that the change in compulsory schooling tends to have a greater expression in the regulative function of learning. This may also reflect the increasing

importance, which in recent years has been given to students' education, to aspects like citizenship, multiculturality, right to difference. This importance has even led to include in recent curricula of many countries a discipline directly aimed at the personal and social education.

It is important to notice that what we have analysed in this study is the syllabuses' text which means to analyse what the Ministry tells teachers to do rather what they actually do. In other words, our analysis was focused at the level of transmission and not at the level of acquisition, that is the shifts we pointed out were discourse shifts and not pedagogic shifts. To do that would mean to study teacher's space of change, which we did (Neves and Morais, 2000), i.e. to analyse the recontextualizing space allowed to teachers by the Ministry. On the other hand, a shift in pedagogic practice would mean to study the teacher's actual practices to see the extent and direction of teacher's recontextualizing. We have done that (it is described elsewhere) and are continuing to develop research on these lines. Shortly, we can say that, although teacher's space of change is quite considerable, teachers tend to use it less than could be desirable and mostly stick to the directions given in the syllabuses specific guidelines for the discipline. And, as we have seen, these guidelines involve a recontextualizing of the best principles contained in the whole curriculum. Most teachers (except in the case of our action research projects) tend to recontextualize Ministry's guidelines in the direction of a still greater lowering of the level of scientific literacy and socio-affective development.

The study presents conclusions, which we consider to be important in the field of the initial and in-service teacher's training because they give to the teachers the possibility of understanding the sociological meaning of the messages contained in syllabuses. In fact, we consider that the awareness of the direction of change(s) introduced with the implementation of the new curricular reform demands the deep understanding of the sociological meaning of the messages transmitted. The study also opens up new perspectives in educational research which should go beyond the specific research context of science education.

The theoretical framework and the model of analysis on which the study is based can be applied to any curriculum and to distinct disciplines of a curriculum and allow the establishment of relationships of the various levels of curricular analysis. This aspect highlights the potentialities of the model in the interpretation of the sociological message contained in pedagogic texts (in this case science syllabuses) and in the evaluation of the changes occurred in any educational reform.

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Notes:

1. Papers on this research, which was developed within the project ESSA – Sociological Studies on the Classroom, are, for example, Neves *et al* (1996); Morais and Neves (1997); Neves and Morais (2000) and Morais, Neves and Fontinhas (1999).
2. From now on we are referring to the 1991 reform as the present reform because that reform is still in vigour.
3. Domingos (1989) and Miranda and Morais (1994).
4. In both reforms science disciplines are organized according to a collection curriculum with distinct boundaries between the various disciplines. The syllabuses contain several scientific areas (chemistry, physics, geology, biology) and constitute, in all cases, compound science courses.
5. The analysis of the evaluation context was not done in this study because the data about the present reform were not all available when the research was performed.
6. These tables are part of a text with the general analysis of the syllabus (Morais *et al*, 1995). They were constructed on the basis of the official documents published by the Ministry of Education (DGEBS, 1991, a, b, c; SEEBS, 1975 a, b).
7. For example, problem solving requires high level cognitive competencies even when the concept (s) involved are of a low level of abstraction.
8. The classification of the various sentences of the syllabuses is part of general tables (Tables IA to VA, Morais *et al*, 1995).
9. These tables are part of the texts produced in the broader research where the present study is included (Morais *et al*, 1995).
10. Although we considered in the analysis of sentences both their frequency and area we used in this study the frequency only because, in comparative terms, frequencies and areas of sentences showed in general a similar value.

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