

# DIFFERENT DIMENSIONS IN TEACHING OF BOTANY IN PORTUGAL: ANALYSIS OF TEXTBOOKS OF PRIMARY SCHOOL EDUCATION (1900-2000)

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## Abstract

Textbooks are of great importance to school and teaching especially in the conformation of forms and contents of pedagogical knowledge. In what natural sciences are concerned, textbooks are aimed at promoting scientific literacy, environment education, the understanding of social and ecological reality. Textbooks develop also important pedagogical functions due to sequence and rhythm of the transmission of knowledge through, for instance, activities by which it is promoted and evaluation forms of knowledge acquired.

This research has as main aim to understand the place that Botany has been given in textbooks of Natural Sciences in primary school education in the last century in Portugal. In an attempt of interpreting the shifts in Botany content approach, we have studied textbooks according to eleven principles.

Content analysis and the establishment of categories as well as cluster analysis support this study. Dendograms built were intended to promote the confrontation of first hand sources in what contents, pedagogical and didactical orientations, educational and curricular policies recommendations are concerned as well as educational, environment and scientific values suggested.

Data analysis shows that the conservation of several contents of Botany distributed by different dimension of Botany namely the notional dimension, the morphological dimension, the functional dimension and the ecological dimension.

Keywords: Teaching Botany, textbooks, primary school.

## 1 INICIAL THOUGHTS

We have privileged the study of Botany contents in our research. Such contents derive from re-organizational approaches within the teaching of Natural Sciences at the primary level in Portugal. Along with the development of scientific knowledge on biological classifications and attempts to solve existing weaknesses in both countries, various governments introduced, throughout the last century, new programmatic Botany contents within the teaching of Natural Sciences at the primary school. Thus, the teaching of Botany becomes more complex with the emergence of new realities, as well as curricular and didactic changes that emphasize such dimensional metamorphoses, which can be seen within classroom contexts and during the teaching-learning process.

We aim to study such complex dimensions within the teaching of Botany, which is placed into a knowledge area undergoing a re-organizational approach where historical and educational circumstances mark Portuguese realities. This knowledge area faces important changes and new challenges resulting from significant environmental and political modifications, new practises and programmatic speeches that have been heard throughout various national and international debates. Such scientific approach on Natural Sciences favours the questioning and conceptual role played by Botany, and should clearly take into consideration the existing approaches in education and science teaching.

The start point of the current study is the relevance of the teaching of Botany within the curricular and didactic structure and the importance texts have in it. Such texts come from outside the classroom and may be seen as regulating tools for the teaching practise by configuring reference universes – school textbooks and programmatic texts are examples. These texts are analysed in their specificity, articulation with the scientific speech, and relationship with the pedagogical transmission. An articulated, diachronic analysis shall be used for such aspects, i.e. with the use of an evolutionary and historical approach.

The investigation of school textbooks has clearly evidenced that Botany contents taught in Sciences during the last century in Portugal, cannot be understood without getting to know the nature of

educational and curricular policies, and teaching-learning methods and procedures as well. School knowledge is markedly printed with all relationships established by actors from multiple interest possibilities, focuses, transmission methods, and by considering the complexity of analyses and articulations between contents and use of school textbooks [1].

School textbooks, taken as important pedagogical, cultural and ideological instruments, contribute to the transmission and consolidation of various knowledge sets, and play a momentous role on content apprenticeship and work methods. Thus, a complex analysis of school textbooks is a consequential source of information to characterize the teaching of Botany in Portugal and its educational processes.

The school textbook timeline seems to rely on three large directions to which distinct disciplinary perspectives head. One of its recent investigation lines encompasses the inner Education history itself. Such analysis field investigates the inner part of educational institutions, tries to figure out the meaning of their activities, and favours the curriculum timeline. A historical approach on the curriculum leads to a study of tools through which a curriculum is established in a country at a certain moment in time. Such tools certainly include school textbooks. Their study is extremely relevant to rebuild the curriculum timeline, as every textbook is historically and geographically delimited, and is a product of a social group in a given time. In the current project, we see the textbook as a differentiated didactic and pedagogical source, concerning the school culture, "whose production corresponds to a complex configuration involving text, shape and speech, [being] a combination of knowledge /skills/ (in)formation" [2].

There is a difference between the defined curriculum in a programme and the one in a school textbook: whilst the former is a prescribed curriculum, the latter is merely a suggested curriculum, i.e. a possibility of the first. That happens because the school textbook is always a subjective interpretation of its authors, who rebuild the meaning of prescribed curricula. As a consequence teachers and pupils are limited and depend on the view authors have over the textbook, as most curricular decisions on the selection and content/activity order, as well classroom applications, have been taken in the textbook [3]. That leads to two conditions: i) makes teachers be less autonomous, as they many times use only the textbook to prepare their classes, and ii) confines the pupil's perspective, whose learning process is strongly tied with the filtered content of the textbook author's subjective view. Thus the school textbook is a tool to examine pedagogical and didactic strategies that follow curricular contents; school textbook studies, so to say, are a way to oversee the evolution of educational contexts, as curriculum interpretations and pedagogical practises are found in them [4].

The "school textbook, as any other teaching means, will always be a means, and cannot be a goal itself" [5]. Many authors, [6], [7], [8], consider the textbook as a core piece within the teaching-learning process. By realising that there is always a dominant approach, we can verify whether school textbooks are representative or reflect an approach, as a dominant approach at a certain moment conditions an activity (e.g. how a scientific area is introduced to society). It is also important that school textbooks turn scientific speech into intelligible didactic speech to be understood by all pupils [9].

## **1.1 Objectives**

Our study deals with Nature Sciences teaching based upon school textbooks, on a diachronic approach whose main goal is to focus on Botany. By considering some premises [2], we aim to: Contribute to understand Botany in Basic School textbooks, throughout the 20<sup>th</sup> century in Portugal; Understand how important school textbooks are for the teaching of Nature Sciences, specially Botany; Interpret the evolution of Botany concepts, content and methodological approaches found in school textbooks, as well as the way such things influenced and have influenced the teaching of Nature Sciences at the Basic Education in Portugal.

## **1.2 Study Objects**

The pedagogical text corpus upon which our study will be developed includes Nature Sciences textbooks. Textbook collection was carried out from a huge sample of publications targeted to Basic School students. Only 25 books were picked from that sample (Table 1). Selection was guided with both quantitative and qualitative criteria. We tried to keep books for all the historical period taken by considering publication dates along with the new entry of program texts.

Table 1. Sample of 25 school textbooks (in Portuguese)

Year	Author, Title and Teaching Level
1903	Cardoso; Rudimentos de Ciências Naturaes
1907	Almeida e Carreira; Ligeiras Noções de Ciências Naturaes
1910	(s. a.); Ciências Naturaes; 9. <sup>a</sup> edição
1914	Araújo; Breves Noções de Ciências Naturais
1916	Andrea e Magno; Ciências Naturais
1920	Borges; Ciências Naturais
1922	Vasconcelos; Ciências Histórico-Naturais e Físico-Químicas; 3. <sup>a</sup> ,4. <sup>a</sup> e 5. <sup>a</sup> classes
1925	Júnior; Simples Noções de Ciências Naturais
1928	Vasconcelos; Ciências Físico-Naturais Higiene e Agricultura; 3. <sup>a</sup> e 4. <sup>a</sup> classes
1930	Santos; Elementos de Ciências Naturais; 4. <sup>a</sup> classe
1933	(s. a.); Ciências Naturais; 4. <sup>a</sup> classe
1942	Barros; Ciências Naturais
1950	Pinho; Ciências Naturais; 4. <sup>a</sup> classe
1960	Carvalho; Ciências Geográfico-Naturais; 4. <sup>a</sup> classe
1968	Lopes e Rodrigues; O mundo que te cerca e de que fazes parte. Ciências Geográfico-Naturais; 3. <sup>a</sup> classe
1974	Ramiro; Ciências Geográfico-Naturais; 4. <sup>a</sup> classe
1982	Carvalho; Por caminhos não andados... Meio Físico e Social; 4. <sup>o</sup> ano
1984	Monteiro; Ecos de Portugal. Meio Físico e Social; 4. <sup>o</sup> ano
1986	Moreira, Moutinho e Oliveira; Bom Dia! Meio Físico e Social; 4. <sup>o</sup> ano
1989	Pinto e Carneiro; O Bambi descobre... Meio Físico e Social; 2. <sup>o</sup> ano
1990	Ramos e Ramos; Coca-Bichinhos 4. Meio Físico e Social; 4. <sup>o</sup> ano
1995	Monteiro; Magia do Saber. Estudo do Meio; 4. <sup>o</sup> ano
1996	Barros e Nunes; Crescer com os outros 2. Estudo do Meio; 2. <sup>o</sup> ano
1997	Monteiro; Saber quem Somos. Estudo do Meio; 3. <sup>o</sup> ano
1998	Borges, Lima e Freitas; Andorinha Turrinha 4. Estudo do Meio; 4. <sup>o</sup> Ano

Eleven appreciation principles were analyzed: Shape; Kingdom; Classification; Organs; Stem; Root; Leaf; Fruit; Flower; Reproduction; and, Dimensions. Analytical categories were subdivided into four levels of importance: Level 1, Level 2, Level 3, and Level 4. In such levels, we could integrate the huge diversity of information found in our sample. Thus, in Table 2 we point out the procedures taken as we built analysis categories and their respective levels of importance.

Table 2. Appreciation principles and analysis levels

<i>Principles</i>	<i>Levels</i>			
Shape	L1	L2		
Kingdom	L1	L2		
Classification	L1	L2	L3	
Organs	L1	L2	L3	
Root	L1	L2	L3	L4
Stem	L1	L2	L3	
Leaf	L1	L2	L3	
Flower	L1	L2	L3	L4
Fruit	L1	L2	L3	
Reproduction	L1	L2	L3	L4
Dimensions	L1	L2	L3	

### 1.3 Analytical procedures

So that we could know how Botany was taught in school textbooks used throughout the 20<sup>th</sup> century in Portugal, we carried out a document investigation based upon bibliography, legislation and school textbooks. We could privilege the establishment of interdependent relationships between theoretical build up and empirical data obtained in a continuous struggling and mutual effort situation.

Thus, a set of tools were used to reach such referred objectives:

a) The content analysis, which essentially consists of a systematization effort, attempts to make contents fully analyzable and involves relatively complex procedures. It is split into various phases that engulf the determination of category and analysis units so that different features on Botany in Portuguese and Brazilian school textbooks are gathered.

b) The *cluster* analysis is used as an exploratory tool for data analysis and classification problem solving. It is also known as taxonomic analysis and attempts to identify homogeneous case groups within a given population, i.e. it aims to identify a set of groups in which intra-variations are minimized and inter-variations are maximized. There is a relationship between case similarity and distances on graphic representations in such analysis. For instance, similar cases share a high level of similarity in dendrograms.

## 2 RESULTS

### 2.1 School textbooks: what similarities?

Looking at Fig. 1, the existence of five significant *clusters* or homogeneous groups of school textbooks can be seen and these *clusters* demonstrate the similarities among different books. The first *cluster* consists of seven cases, the second *cluster* consists of four cases, the third *cluster* has five cases, the fourth *cluster* has four cases and the fifth *cluster* has five cases. The first *cluster* evidences the Shape feature found in textbooks from 1900 to 1920, the second *cluster* evidences Shape peculiarities found in textbooks from 1920 to 1940, the third the same feature in the period 1940 to 1980, the fourth *cluster* evidences Shape features in textbooks from 1980 to 1990 and, finally, the fifth *cluster* reveals the same feature in the period 1990 to 2000 (In such relationships, one cannot omit particular cases found in a textbook dated back to 1925 – found in the first *cluster* – and in textbooks from 1989 to 1990 with position change in *clusters* four and five).

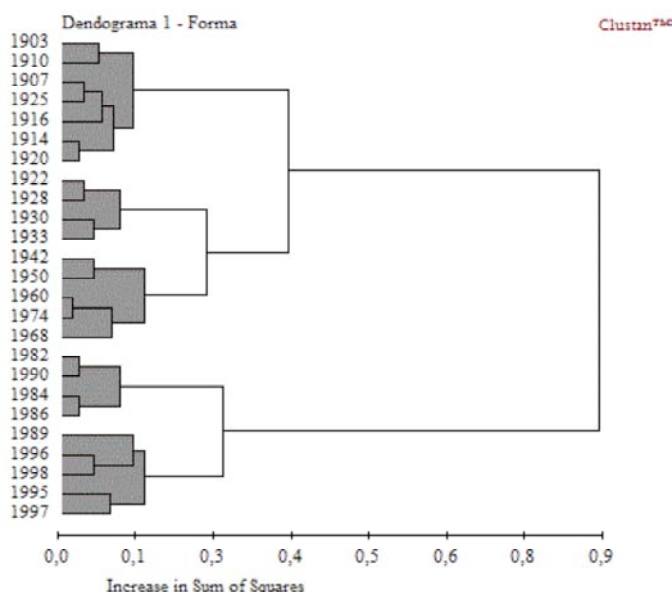


Fig. 1. Shape

The current analysis suggests that such relationships originate from the similarities among school textbooks i.e. it is admitted, by considering the matrix, that Nature Sciences school textbooks used in the Basic Education level throughout the first two decades of the 20<sup>th</sup> century in Portugal are similar in Shape with the same denomination (Natural Sciences, or *Sciências Naturais* in Portuguese). Teaching was given in classes with no images in the text, except for the 1910 compendium in which images take up less room than the text itself. Moreover, didactic activities that favor memorisation including questionnaires and summaries are also found.

Textbooks of the following two decades are similar with a general title, namely, Natural Sciences (*Sciências Naturais*), though in 1933 a school textbook called *Ciências Naturais* was written (for the Basic Education level). Teaching was given in classes, images took less room than texts and there were no didactic activities suggested. Textbooks from the decades 1940 to 1970 are similar in relation to Shape, although different titles - such as *Ciências Naturais* and *Ciências Geográfico-Naturais* (Natural and Geographical Sciences) - are found. All of them encompass the Basic Education level with teaching in classes and coloured images that take up the same amount of space as the texts. Didactic activities on memorisation and experimentation were found. School textbooks from the 1980s are similar and are called *Meio Físico e Social* (Physical and Social Environment). Teaching was given

according to school years. Images are colourful and take up the same amount of space as the texts. In the 1989 textbook, images cover more space than text and didactic activities concerning memorisation, experimentation, research, mural elaboration and the building of a herbarium are found. Textbooks from the 1990s are similar and are entitled *Estudo do Meio* (Environmental Studies). They cover Basic Education levels and teaching was given in school years. Coloured images took up the same amount of space as the text. Didactic activities related to memorisation, experimentation, research, mural elaboration, the building of a herbarium and field and group work are also found.

## 2.2 School botany: what appreciation principles?

Relatively to Fig. 2 and to all appreciation principles that see school Botany on a global view, we can see the existence of five significant *clusters* or homogeneous groups of school textbooks, which bear the similarity found among different books. The first *cluster* has 19 cases; the second *cluster* has one case (the 1930 book); the third *cluster* has one case (the 1922 book); the fourth *cluster* has also one case (the 1928 compendium); and, lastly, the fifth *cluster* has three cases.

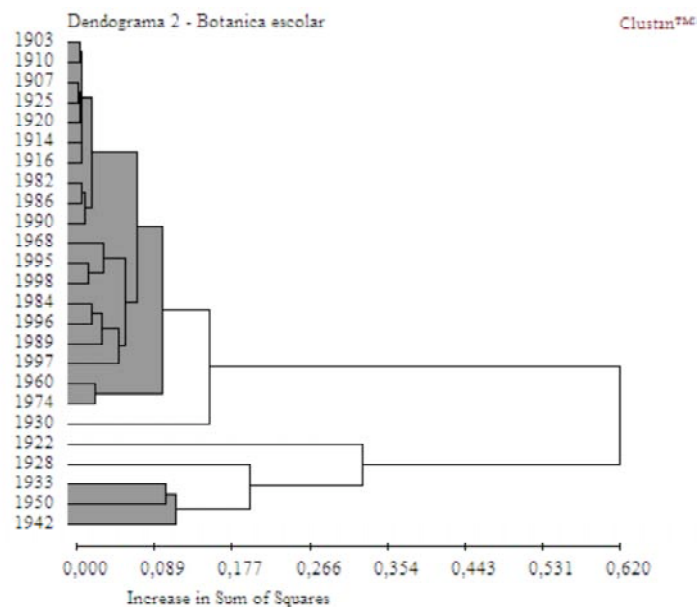


Fig. 2. School Botany

According to Fig. 2, the first *cluster* evidences botanical features found in school textbooks for the first two decades in the 20<sup>th</sup> century, from 1900 to 1920 (including), in the 1925 book, and in the last four decades of the 20<sup>th</sup> century, from 1960 (including) to 2000. The second, third and fourth *clusters* evidence particularities of the school Botany in school textbooks for the 1920s, from 1920 to 1930 (including). The fourth *cluster* corroborates features of the school Botany found in school textbooks from 1930 to 1960.

## 3 FINAL THOUGHTS

In relation to the similarities between school textbooks, the principle of appraising Form, school Botany and the period of analysis allow for the following reflections:

- i) *Variation of terminology in school textbooks.* A first look derives from the analysis taken and it engulfs the different typologies used to identify compendia, from *Sciências Naturais*, *Ciências Naturais*, *Ciências Geográfico-Naturais*, *Meio Físico e Social* to *Estudo do Meio*. Such changes evidence approach modifications as such school textbooks are Nature Sciences books. In the beginning, these denominations versed upon a disciplinary approach – *Sciências Naturais* and *Ciências Naturais* –, and afterwards they were replaced by a disciplinary annex – Nature Sciences with Geography: thus, *Ciências Geográfico-Naturais*. Later on, a new approach considered the environment – in our point of view, in such phase there is a transition from a disciplinary approach to a contextualized approach. Different conceptions of the environment are considered: from a pre-analytical syncretism to a post-analytical, systemic view [3]. In such approach, the

specific context is the environment, initially the Physical and Social Environment, and later on, the Environment Study.

- ii) *Simplification of Botany content.* Such changes on textbook designation evidence that, specifically in the Botany case, whereas such science gets more complex with the generation of new investigation areas that bring up new knowledge and specification, at school Botany gets simpler, as its content tend to evidence gaps in the new scientific themes. We did not verify new knowledge being absorbed into the school Botany [10].
- iii) *Conservation of botanical content.* Looking at Fig. 2 it is possible to affirm that the results show a relational tendency between teaching programmes and the sample of school textbooks in respect of school Botany. Moreover, there is a hint that these rudiments of natural science do not constitute a course, but only a sequence of general knowledge that is suitable for communication to children, since the teaching/instruction was made through intuitive processes with the presentation of appropriate objects and without the possibility of the assistance of images, the valuing of the importance of knowing how to read, write and count that constituted thereunto the work of the first three classes and the worth of primary school instruction, the use of methods based on observation and experience that implies a school Botany based on exemplary objects. The preoccupation of the relationship with the environment, once that contact with local plants and their use has satisfied the curiosity of the children and allowed the attainment of useful knowledge as a life practice, makes available the teaching of Botany using the environment including the choice of plants by their own students, the construction of a vegetable repository, a plant nursery and a school garden, thereby succeeding as an objective study of nature. The demands that the students learn to observe the surrounding environment and to reflect about it anticipates that they should be capable of concluding how people live and if they can be organized in a different way, about the interdependence of man and the environment, the transformation of Nature by work, fully lived experiences, an interest about more distant locations are situations that seek to value and systematise ideas by means of references that the nearby environment provides for them, in an inference of morphological principles and a national richness in an approach towards a manipulative school Botany [11]. Nowadays, however, the contents of Botany related to the transformation of the environment and with the defence and conservation of the environment imply a protective school Botany.

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