

**HISTORY OF SCIENCE IN PORTUGUESE HIGH SCHOOL TEXTBOOKS:
ANALYSIS OF TEN MATERIALS (2011-2018)
HISTÓRIA DA CIÊNCIA EM MANUAIS ESCOLARES DO ENSINO SECUNDÁRIO
EM PORTUGAL: ANÁLISE DE DEZ MATERIAIS (2011-2018)**

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Resumo

Embora as disciplinas de Biologia-Geologia e de Biologia (10^o a 11^o anos e 12^o anos, respectivamente) façam parte da Formação Específica do ensino secundário em Portugal, não há diretrizes explícitas sobre como a História da Ciência e da Tecnologia (HCT) deva ser trabalhada nesse nível escolar. Sabendo-se da importância dada aos manuais escolares como materiais de apoio ao ensino e à aprendizagem dos componentes curriculares, analisamos dez manuais escolares de ensino secundário, de três editoras diferentes, dos anos 2011, 2012, 2014, 2016 e 2018, no tocante a conteúdos de HCT. Foi criada uma grelha com categorias de análise, a saber: ocorrência ou não de conteúdos envolvendo HCT, tipo de conteúdo, erros conceituais/históricos e outros problemas (omissões, simplificações etc.). Em dois manuais (2011 e 2012), não há quaisquer menções a aspectos relacionados à HCT; nos demais, HCT é apresentada de forma variada. No material de 2014, a ênfase dada recai sobre breves biografias de alguns cientistas e/ou naturalistas, tais como Carl von Linné e Charles Darwin; mesmo assim, ainda aparecem termos como ‘pai da taxonomia’ e ‘aquele que consolidou a base da evolução biológica’, em uma visão reducionista e linear da história. Nos materiais de 2016 e 2018, nota-se uma tendência dos autores em apresentar os contextos históricos em que determinados conceitos foram propostos, embora não haja, ainda, uma discussão de como os conceitos haviam sido trabalhados anteriormente. A análise parece evidenciar que, a despeito de uma aparente preocupação em apresentar conteúdos de HCT nos manuais escolares mais recentes, a visão propagada nos materiais ainda é um tanto distorcida, focada em uma perspectiva positivista da ciência e, muitas vezes, descontextualizada.

Palavras-chave: Manuais escolares, ensino secundário, currículo escolar.

Abstract

Despite the fact that Biology-Geology and Biology (10th to 11th grades and 12th grade, respectively) are part of the Specific Syllabi in the Portuguese secondary schooling, there is no explicit guideline on how to work with History of Science and Technology (HCT) in such school level. By admitting the importance of school textbooks as support materials to teach and learn curricular components, we analysed ten high-school textbooks (2011, 2012, 2014, 2016 and 2018) of three different publishers concerning HCT. We devised a spreadsheet with analysis categories, namely: occurrence or not of contents involving HCT, type of content, conceptual/historical errors, and other issues (omissions, simplifications etc.). In two textbooks (2011 and 2012), HCT is not mentioned; in the others, HCT is diversely presented. The 2014 publication emphasizes short biographies of some scientists/naturalists such as Carl von Linné and Charles Darwin; even so, terms like ‘the Father of Taxonomy’ and ‘the one who consolidated the basis of biological evolution’ evidence a reductionist, linear vision of history. The 2016 and 2018 publications seem to present concepts within historical contexts, although there is still no discussion on how such concepts had been previously proposed. Our analysis most likely evidences that, in spite of an apparent concern to show HCT contents in more recent textbooks, the perspective is still a bit distorted, focused on a positivist view of science and, sometimes, out of context.

Keywords: Textbooks, high-school level, school curriculum.

INTRODUCTION

Textbooks are unquestionable and credible materials used throughout schooling years by teachers and students: they normally guide contents to be taught, suggest activities and exercises, comply with the official curriculum, and perform several other tasks¹. Moreover, they are socially built and, therefore, embedded with both ideologies and cultural-historical drivers.

Omissions, simplifications, complexifications and errors are commonly found, as they convey transpositions of the academic knowledge². There has been much research on the importance, use and application of textbooks, as well as strong criticism regarding their adoption³; textbooks may invariably become a didactic 'walking cane' to which teachers are attached and dependent for their classes and, on the other hand, also the only material students may read during schooling years (in many cases, *the only one* material read whatsoever⁴). In Portugal, the situation does not seem to differ from that found in Brazil. Guimarães⁵ researched Portuguese textbooks on various parameters, pointing out diversified historical, ideological, and political trends developed during their writing and publishing. Generally, theoretical and conceptual issues (errors, omissions and so forth) or ideological problems (massive propaganda of political ideologies of a certain historical period, for instance) were found.

If we consider the guidance proposed by the Portuguese Government⁶, we may see textbooks as appropriate and neat materials:

The assessment and certification of textbooks for basic [elementary] and secondary levels aims to guarantee both scientific and pedagogical quality, as well as to ensure their conformity with programmes or curricular orientations; still, these wish to make them fit for curricular targets so that they are seen as an adequate instrument of teaching and promotion of educational success.

Thus, as it happens in Brazil and in other countries, textbooks are pedagogical resources of great importance during the process of teaching and learning of eventually any programmatic syllabus. Yet, what can be inferred from the above quotation is that the Portuguese Government, by assessing textbooks, somehow 'standardizes' contents to be included in textbooks.

The secondary school level (High School) in Portugal comprises a three-year period (Figure 1): 10th, 11th, and 12th years. The curricular component 'Biology and Geology' is offered in the first two years, being part of the syllabus "Specific Formation" (there is another, "General Formation", with several other subjects, such as French, Physical Education, Portuguese and so forth). 'Biology' is offered in the 12th year.

¹ Baganha, *O papel e o uso do livro didático...*, 23; see also Bittencourt, *Livro didático*, various pages.

² Fracalanza & Megid-Neto, "O livro didático de Ciências", 27.

³ Molina, *Quem engana quem*, p. 45. For further discussion on the adoption or not of textbooks, we suggest the reading of Bizzo, "A avaliação...", 78, and Massabni & Arruda, "Considerações sobre o conteúdo...", 125.

⁴ Vasconcelos & Souto, "O livro didático de ciências no ensino fundamental...", 94.

⁵ Guimarães, "Saberes escolares de botânica...", 29.

⁶ Direção-Geral da Educação, *Manuais escolares* (online), translated freely by the authors.

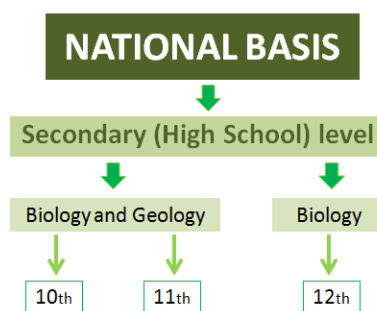


Figure 1. Organization of the Portuguese secondary school level regarding the curricular components Biology and Geology.

There are no explicit guidelines on how History of Science and Technology (HST) should be minimally taught and learnt during the secondary level⁷ in Portugal, despite general directions for teachers to work with students during the secondary level are offered. There has been much talk on the importance of teaching HST contents, or, at least, contextualizing them during Sciences classes; Maldamé⁸ mentions that HST, as it has developed in the twentieth century, has two major concerns, i.e.:

(...) The first [concern] is to understand the way in which scientific knowledge progresses. The second is to understand the notion of science itself, which involves the questions of what methods are truly scientific and what kind of knowledge science actually offers us. The studies that have been carried out in this field show how hard it is to separate the history of science from other branches of history (...). The history of science obviously includes many different facts about things that happened at various times in the past. Yet simply compiling a list of such facts does not suffice for genuine history (...) it is necessary to bring out the relationships between facts, indicating where there is continuity and where there is a break with the past. The history of science has thus to take into consideration the process by which science comes into being (...) the various stages of its development.

Following similar thinking, science education can gain by engaging tightly with the history of science, not only for prospective vocational scientists, but also for educating the broader public about the nature of science⁹. Yet, Science teaching can no longer be confined to an endless list of pure memorization of names, dates, biographies, and scientific concepts; students of the XXI century face other realities, with new skills and competences¹⁰. Students (consequently, citizens) should be able to comprehend, interpret, and make decisions within their own societies by actively participating on problem solving - thus, acquisition of scientific knowledge is essential¹¹. Moreover, scientific knowledge (e.g., facts and theories), skills, techniques of scientific procedures and devices, interaction with technology, as well

⁷ Diário da República, *Decreto-Lei nº55/2018*, p. 2932. You can also read more information regarding the Portuguese curricular organization in *Aprendizagens Essenciais, Articulação com o perfil dos alunos*, p. 1-7, and *Direção-Geral da Educação, idem*.

⁸ Maldamé, "The importance of the history of Science...", p. 238.

⁹ Gooday, Lynch, Wilson and Barsky, "Does Science Education...", 225.

¹⁰ Unesco, *A ciência para o século XXI...*, p. 67.

¹¹ Diaz, "Enseñanza de las ciencias?", 2.

as studies on the nature of science and its development in history are contributors for a diachronic and non-stigmatizing view of Sciences¹².

With all of the above in mind, we aimed at analysing High School textbooks used in Portugal to: a) verify the occurrence of HST contents; b) discuss how HST contents are displayed; and, c) evaluate the quality of texts present in the textbooks in terms of contextualization, updating, adequateness and so forth¹³.

RESEARCH METHODS

Biology-Geology and Biology textbooks (high school level) were chosen as both authors are majored in Biology. Three publishing editors have been selected: Porto Editora (Figure 2a), Areal Editores (Figure 2b), and Editora Asa (Figure 2c), with the following publishing years: 2011, 2012, 2014, 2016 and 2018. A total of ten textbooks was analysed. The last book, published in 2018, is at use at schools throughout the whole year of 2019 in Portugal. A spreadsheet with *a posteriori* categories was designed¹⁴ (Table 1). Each book was carefully scanned and those sections and excerpts that contained anything regarding HST was categorized.

Table 1. Categories used to analyse the ten textbooks.

Category	Description
HST content	Occurrence (or not) of any HST contents
Type of HST content	Only discussed when the above category is present minimally (e.g., biography, historical episode etc.)
Errors	Presence and type of error (conceptual problem, historical problem etc.)
Other issues	Omissions, simplifications and the like

RESULTS AND DISCUSSION

In two textbooks, 2011 and 2012, there is no aspect of any kind related to HST; thus, those two collections present no information about how scientific knowledge has been built and devised in human history. Students (perhaps teachers as well?) may see Sciences (especially Natural Sciences, in which Biology is inserted) as a sudden, linear sequence of events, ideas and theories made up by geniuses who are not part of society; so to say, it is fearful to think that HST is not part of textbook texts, leaving gaps that might lead students to consider science as something neutral, not embedded in geopolitical, economic, social and historical contexts. In the remaining materials, HST is variously displayed, as discussed below.

The focus of the 2014 material is on brief biographies of some scientists and/or naturalists, such as Carl von Linné and Charles Darwin; even so, there are still terms such as ‘the father of taxonomy’ and ‘the one who consolidated the basis of biological evolution’. These conceptions and titles may lead readers to have a reductionist, anachronous, and linear view of history, thus consolidating, once more, a misconception about the nature of science. This kind of perspective, focused only

¹² Vidal & Porto, “The History of Science in the PNLEM 2007...”, 292. Interesting discussions on the same subject can be read in Vidal Júnior & Koch, “O ensino de botânica no Brasil”, 256, and in Santos, *A botânica no ensino médio...*, p. 223-224.

¹³ This paper is a result of a post-doctorate programme held at University of Minho (Braga, Portugal) by the first author.

¹⁴ Our procedure was based upon Bardin, *Análise de Conteúdo*, various pages and sections, with contributions from Leite, “History of science in science education”, 333-359.

on short biographies (and perhaps with historical distortions), crystallizes a limited view of humanity and its scientific and technological advances, and places people who are somewhat arbitrarily above the mere mortals on 'pedestals', as separate entities. We agree with Martins and Alfonso-Goldfarb¹⁵ when they mention that the detachment of the thinker (naturalist, scientist, etc.) from his historical context, among many other contexts, favours this view that science makes huge leaps, being the unique fruit of great thinking personalities that see nature in a brilliant way.

The 2016 and 2018 materials bring historical contents with relative contexts that surround concepts and ideas, such as the discovery of Penicillin and its importance during the Second World War, and the contributions of H. M. S. Beagle to Darwin in formulating his theory of evolution (in this case, Wallace is cited as having formulated an almost identical theory, although not in direct contact with Darwin and not having been aboard the referred ship); however, there is not a deep discussion of how such concepts had been formerly devised. Moreover, there are minor issues regarding the perspective of certain scientists. For instance, Gregor Mendel is seen as the initiator of Genetics, but other views on him should be considered and historically discussed¹⁶, as many other contributors from both the XIX century and the XX century added information and research data on heredity.

FINAL CONSIDERATIONS

Our analysis seems to point out that, despite a discrete trend to present HST contents in more recent textbooks (especially from 2016 on), the perspective is still distorted, focused on a positivist view of Science and, many times, out of context and anachronous, thus leading students and teachers to think scientific development as a linear construction.

It is noteworthy to see that two materials did not mention any aspect of HST; by considering that these had been officially assessed (and recommended) by the Portuguese Government through its Ministry of Education, and consequently adopted and used in many educational units, we think students (and teachers) had a huge blank of information concerning various aspects of scientific and technologic development. So to say, the use of HST within the school context is a powerful methodological tool that may enhance significantly teachers to motivate their pupils' interest in learning Sciences, along with other tools (e.g., theories, observations, experiments and so forth¹⁷).

Distortions, omissions, and even conceptual errors are commonly found in textbooks¹⁸. One cannot put aside the fact that editors and textbook authors may not have any kind of background in HST and, thus, such problems arise. As many researchers point out¹⁹, there is a clear trend that textbooks repeat the same contents and somehow 'imitate' one another, with minor differences; so, if one material does not contextualize or include HST contents, it is probable that other publishers do not do so either. This is a vicious cycle that perpetuates a practice of isolating HST as if it were something out of context and 'superfluous', not part of the curricular syllabi.

¹⁵ Martins, "Arquimedes e a Coroa do Rei", 114; Alfonso-Goldfarb, *O que é história da Ciência*, p. 10.

¹⁶ Martins & Prestes, "Mendel e depois de Mendel", p. 245.

¹⁷ Mota & Cleophas, "História da Ciência...", 35.

¹⁸ Christófaló *et. al.*, "Erros e distorções, históricas e conceituais nos livros didáticos de física...", 95.

¹⁹ For instance, Cassiano, *O Mercado do Livro Didático no Brasil...*, p. 27.

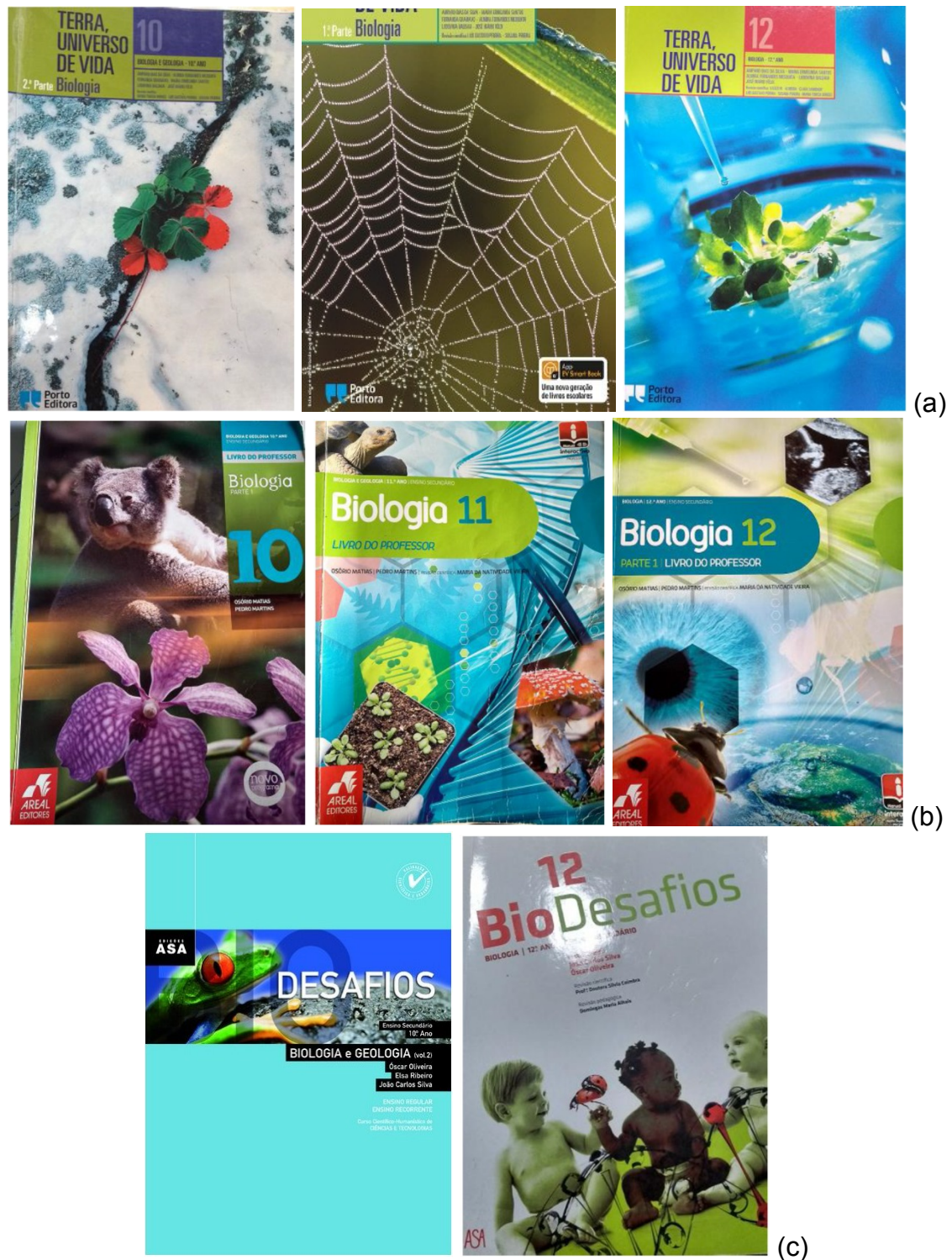


Figure 2. Front pages of the textbooks analysed: (a) Editora Porto (10th to 12th years); (b) Editora Areal (10th to 12th years); (c) Editora ASA (10th and 12th years, both with the corresponding Activities Book).

We agree with the assumption that HST should be taught as a curricular component, or, at least, as a complimentary subject during the teaching of Sciences²⁰. Our analysis, based upon Biology & Geology textbooks designed for

²⁰ Ribeiro & Silva, "A relevância da história da ciência...", 14.

high school students in Portugal, is a limited view; other textbooks, especially those of the so-called 'Natural Sciences' (Physics, Chemistry and Geosciences), would add more data to our research.

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