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Botany in basic education textbooks: conceptual issues regarding simplifications and complexifications in Brazil and Portugal

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Abstract

Botany is one of the oldest knowledge fields in natural sciences. As with other curricular syllabi, its contents constantly change because of recent advancement in research, paradigm breach, new theories and so forth. Textbooks are commonly regarded as reference sources for both teachers and students. Despite efforts to include good reference materials in terms of contents, contextualization and updated information, textbooks are commonly devised having political, ideological, economic and socio-geographic backgrounds with which information may be handled. Our paper aimed to investigate how botanical contents have been presented in school textbooks targeted to basic education learners in Brazil and Portugal in the last decade, having two main questions in mind: a) Have they been presented with non-contextualized, simplified concepts only?; and, b) Have they been presented as excessively complex, with information akin to high school or under-graduation courses?. We surveyed basic school textbooks normally adopted in Brazil, and basic school textbooks researched in Portugal in the last decade. In general, we have seen waves of different approaches of botanical contents in school textbooks, depending on the period analyzed, economic and socio-political trends, and educational directions from both countries' boards of education and equivalent. Although many common characteristics are found in all textbooks, there are significant simplifications in some textbooks, with reflexes found even in pictures, photographs and contextualization, and complexification in some, which tend to be dense, vocabulary-tough materials that might indicate high-level education, perhaps inappropriate to basic school students. Changes in the type of botany commonly found in textbooks, which invariably focuses on morphological and taxonomic aspects of plants, should take place so that students may understand vegetal features and evolutionary kinships as well as their place and importance in ecosystems, daily life, economy and environmental balance, just to mention a few of so many roles they actually play.

Keywords: Botany teaching and learning; School textbooks; Simplification; Complexification; Brazilian context; Portuguese context

INTRODUCTION

Botany is one of the oldest knowledge fields in natural sciences, despite its official, curricular labelling that occurred only some centuries ago (Santos, 2006; Chervel, 1988; Cronquist, 1981). In fact, botanical information extracted from nature gave field to the initial investigations of the human being about the surrounding environment, as plants were part of his routine life in terms of clothing, food, transportation, shelter, medicine use, incense burning and so forth (Thomas, 2010). Until now, Botany and Zoology are seen as the 'core blocks' of all biological studies (Krasilchik and Marandino, 2004).

As with other curricular syllabi, its contents constantly change because of recent advancement in research, paradigm breach, new theories and so forth, as pointed out by



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Fracalanza and Megid-Neto (2003); moreover, such changes are part of the constant advancements that break old ideas and leave path to new ones (Kuhn, 1970).

According to some researchers, such as Lajolo (1996) and Molina (1987), not all of the changes are promptly absorbed in school textbooks, being such didactic transposition sometimes slow and inefficient. Certain aspects of the academic knowledge produced via specific research are intentionally neglected in textbooks, such as more profound information regarding biotechnological and/or molecular investigations originated in recent years (Moraes and Santos, 2013).

Textbooks are commonly regarded as reference sources for both teachers and students. Nevertheless, they play a momentous role during schooling, and may also be seen as the only source used by school agents (Santos, 2009).

Despite efforts to include good reference materials in terms of contents, contextualization and updated information, textbooks are commonly devised having political, ideological, economic and socio-geographic backgrounds with which information may be handled (Proença, 2000; Sano, 2004). Such materials (Figure 1) are influenced by diverse aspects, being the teacher and students the core agents to make use of the knowledge accumulated and generated at academic institutions (Lacasa, 1994). The information handled in textbooks is, then, inevitably compared with the one observed in the surrounding life, represented in the figure as the society dimension and all the experiences an individual may have in his social life.

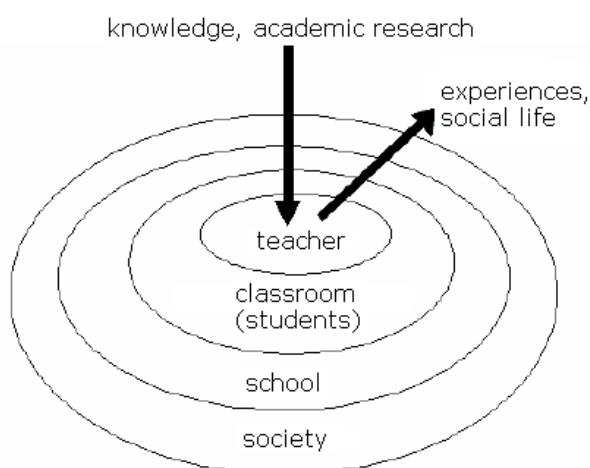


Figure 1. Aspects that influence the generation of textbook information and other pedagogical materials (modified by the authors based on Lacasa, 1994).

There is no 'ideal' textbook, as scientific knowledge reveals only the information collected at a certain period of time by researchers of its own field. Thus, usual problems detected in textbooks are conceptual-linked, i.e. simplifications and complexifications (Wortmann, 2003).

Simplification occurs when a core concept (for instance, photosynthesis) is broken down to minimum components, such as reducing the complex process to a single chemical-mathematical formula, widely known as: $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_2\text{O} + \text{O}_2$. Obviously, photosynthesis is far more complex than the acquisition of an atmospheric gas (in this case,



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carbon dioxide) and the absorption of water through the root system, with the generation of another gas (oxygen, in this case) and a carbohydrate production by the plant with the aid of a molecular catalyser, i.e. chlorophyll. Complex metabolic reactions involving various agents occur in the presence of light and also in the darkness, being one of the most intriguing steps the Calvin Cycle (Martin and Hine, 2014).

Complexification, on the other hand, implies a growing and continuous augmentation of concepts, values, and inter-connections with other skills and knowledge, thus allowing learners to think more abstractly and at a higher level of knowledge acquisition and build-up (Guimarães and Santos, 2009).

Our paper aimed to investigate how botanical contents have been presented in school textbooks targeted to basic education learners in Brazil and Portugal in the last decade, having two main questions in mind: a) Have botanical contents been presented with non-contextualized, simplified concepts only?; and, b) Have botanical contents been presented as excessively complex, with information akin to high school or under-graduation courses?.

METHODS

We surveyed basic school textbooks normally adopted in Brazil, specifically the ones recommended by the Brazilian Board of Education (FNDE, 2016) and used in Brazilian public schools for a three-year period, and basic school textbooks researched in Portugal in the last decade. The Portuguese analysis was carried out according to Guimarães (2007; 2008; 2010), Guimarães and Lima (2010), and Guimarães, Lima and Magalhães (2007).

Textbooks were analyzed in terms of botanical contents following various authors, mainly Lüdke and André (1986), Bardin (2009) and Krippendorf (1980).

RESULTS AND DISCUSSION

In general, we have seen waves of different approaches of botanical contents in school textbooks, depending on the period analyzed, economic and socio-political trends, and educational directions from both countries' boards of education and equivalent. Although many common characteristics (morphology, anatomy, taxonomy, physiology, for instance, just to name a few areas) are found in all textbooks, there are significant simplifications in some textbooks, with reflexes found even in pictures, photographs and contextualization, and complexification in some, which tend to be dense, vocabulary-tough materials that might indicate high-level education, perhaps inappropriate to basic school students.

FINAL CONSIDERATIONS

School textbooks are important objects of study and should be more investigated so that more detailed information regarding its use, implementation, intrinsic conceptual issues and, mainly, botanical contents have been presented and used by educators and learners.



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Still, changes in the type of botany commonly found in textbooks, which invariably focuses on morphological and taxonomic aspects of plants, should take place so that students may understand vegetal features and evolutionary kinships as well as their place and importance in ecosystems, daily life, economy and environmental balance, just to mention a few of so many roles they actually play.

REFERENCES

Bardin, L. (2009). *Análise de Conteúdo*. Lisboa, Portugal; Edições 70, LDA.

Chervel, A. (1988). L'histoire des disciplines scolaires. *Histoire de l'Éducation*, 38, 59-119.

Cronquist, A. (1981). *An integrated system of classification of Flowering Plants*. New York: Columbia University Press.

FNDE – Fundo Nacional do Desenvolvimento da Educação (2016). *PNLD 2015 (2016)*. Online access: <<http://tinyurl.com/hxphghp>>. Last visit: 08 Feb. 2016.

Fracalanza, H.; and Megid-Neto, J. (2003). O livro didático de ciências: o que nos dizem os professores, as pesquisas acadêmicas e os documentos oficiais. *Contestado e Educação*, 2, 22-31.

Guimarães, F. (2007). *A Botânica nos manuais escolares dos Ensinos Primário e Básico (1.º Ciclo) no século XX em Portugal*. Braga: Universidade do Minho/Instituto de Estudos da Criança (PhD Thesis).

Guimarães, F. (2008). Saberes escolares de Botânica nos Livros Didáticos de Ciências da Natureza dos Ensinos Primário e Básico (1.º Ciclo). Análise ao seu estatuto curricular no último século em Portugal. *Plures – Humanidades*, 10, 27-45.

Guimarães, F. (2010). *O ensino de Botânica em Portugal: Análise de manuais escolares do 1.º Ciclo do Ensino Básico (1900-2000)*. Lisboa: Fundação Calouste Gulbenkian/Fundação para a Ciência e a Tecnologia.

Guimarães, F., Lima, N.; and Magalhães, J. (2007). Conteúdos que privilegiam diferentes dimensões do ensino da Botânica. Análise de manuais escolares dos Ensinos Primário e Básico (1.º Ciclo). In: J. Sousa (Pres.) et al. (Orgs.). *Educação para o sucesso: políticas e actores*. Vol. 2. Livro de Actas do IX Congresso da SPCE (pp. 1397-1408). Funchal: SPCE (CD-ROM).

Guimarães, F.; and Lima, N. (2010). A Botânica escolar em Portugal no século XX. Análise dos conteúdos programáticos nos manuais escolares dos Ensinos Primário e Básico (1.º Ciclo). In: J. Pintasilgo, A. Teixeira, C. Beato; and I. C. Dias (Orgs.). *A História das Disciplinas Escolares de Matemática e de Ciências: Contributos para um campo de pesquisa*. 3 (pp. 1-16). Lisboa: Escolar Editora (CD-ROM).



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Guimarães, F.; and Santos, F. S. (2009). Botany teaching in Portugal and Brazil: analysis of school textbooks and their application in elementary school classes (2001- 2010). In: L. Gómez Chova, D. Martí Belenguer; and I. Candel Torres (Edits.). International Conference of Education, Research and Innovation 2009 - Madrid. *Proceedings* (pp. 6785-6790). Valencia - Spain: International Association of Technology, Education and Development (CD-ROM).

Krasilchik, M.; and Marandino, M. (2004). *Ensino de ciências e cidadania*. 1.ed., 3.reimpr. São Paulo: Moderna.

Krippendorf, K. (1980). *Content Analysis: An Introduction to its Methodology*. Beverly Hills: Sage.

Kuhn, T. S. (1970). *The structure of Scientific Revolutions*. Chicago: The University of Chicago Press.

Lacasa, P. (1994). *Aprender en la escuela, aprender en la calle*. Madri: Aprendizaje Visor.

Lajolo, M. (1996). Livro didático: um (quase) manual de ensino. *Em Aberto*, 16 (69), 40-49.

Lüdke, M.; and André, M. E. D. A. (1986). *Pesquisa em educação: abordagens qualitativas*. São Paulo: Editora Pedagógica e Universitária.

Martin, E.; and Hine, R. (2014). *A dictionary of Biology*. 6.ed. Oxford: Oxford University Press.

Molina, O. (1987). *Quem engana quem: professor x livro didático*. Campinas, SP: Papirus.

Moraes, R.; and Santos, F. S. (2013). Análise de conteúdos de sistemática filogenética em livros didáticos de Ensino Fundamental II e Ensino Médio. *Scientia Vitae*, 1 (2), 20-27. Online access: <http://www.revistaifsp.com/sv_v1_n2_3.pdf>. Last visit: 29 Sept. 2016.

Proença, M. C. (2000). Los manuales escolares: Reflejo de influencias pedagógicas e intenciones políticas. Una reflexión desde la experiencia portuguesa. In: A. T. Ferrer (Ed.). *El libro escolar, reflejo de intenciones políticas e influencias pedagógicas*. Madrid: UNED.

Sano, P. T. (2004). Livros Didáticos. In: D. Y. A. C. Santos; and G. Ceccantini (Orgs.). *Proposta para o ensino de botânica: Curso para atualização de professores da rede pública de ensino*. São Paulo: Universidade de São Paulo – Instituto de Biociências.

Santos, F. S. (2006). A Botânica no Ensino Médio: Será que é preciso apenas memorizar nomes de plantas?. In: C. C. Silva (Org.). *Estudos de história e filosofia das ciências: Subsídios para aplicação no ensino*. São Paulo: Editora Livraria da Física.



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Santos, F. S. (2009). A disciplina de Ciências no Ensino Fundamental II: um estudo de caso com alunos de uma escola municipal de Cubatão, SP. *Plures – Humanidades*, 12, 105-120.

Thomas, Keith (2010). *O homem e o mundo natural: mudanças de atitude em relação às plantas e aos animais (1500-1800)*. Trad. João Roberto Martins Filho. São Paulo: Companhia das Letras.

Wortmann, M. L. (2003). Currículo e Ciências: as especificidades pedagógicas do ensino de ciências. In: M. V. Costa (Org.). *O currículo nos liminares do contemporâneo*. 3.ed. Rio de Janeiro: DP&A.