

# Analysis of the Language of Scientific Divulcation Texts Related to Genetics Inserted in the Biology Textbook

Bruna Sarpa Miceli <sup>a</sup>  
 Marcelo Borges Rocha <sup>a</sup>

<sup>a</sup> Centro Federal de Educação Tecnológica Celso Suckow da Fonseca (CEFET/RJ), Programa de Pós-Graduação em Ciência, Tecnologia e Educação, Rio de Janeiro, RJ, Brasil.

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## ABSTRACT

The Scientific Divulcation texts (SD), when inserted in Biology textbooks, are capable to help to bring students closer to scientific knowledge, especially in relation to Genetics, which is still seen as a difficult discipline to understand and which is linked to ethical, social, political and cultural issues. In this way, it was questioned the aspects of the language when the SD texts are inserted in the Biology textbooks. Thus, the goals of this research was to analyze the language presented by SD texts related to Genetics present in the Biology textbooks. In this sense, 17 texts were selected from a collection of textbook and were analyzed based on the presence of metaphors, analogies, explanatory terms and conceptual errors. The results indicated that the most of the texts presented linguistic resources and that they were used with the intention to facilitate the student's understanding of this theme. It was concluded that maintaining these resources, we could contribute to bring the reader closer to knowledge about Science.

**Keywords:** Scientific Divulcation; Genetics; Textbooks; Language.

## Análise da Linguagem de Textos de Divulgação Científica Referentes à Genética Inseridos no Livro Didático de Biologia

### RESUMO

Os textos de Divulgação Científica (DC), quando inseridos nos livros didáticos (LD) de Biologia, são capazes de auxiliar na aproximação dos estudantes com o conhecimento científico, especialmente em relação à temática de Genética, que ainda é vista como uma disciplina de difícil compreensão e que está vinculada à questões éticas, sociais, políticas e culturais. Desta forma, questionou-se acerca dos aspectos da linguagem quando os textos de DC são inseridos no LD de Biologia. Sendo assim, o objetivo desta pesquisa foi analisar a linguagem apresentada pelos textos de DC relacionados à Genética presentes no LD de Biologia. Neste sentido, 17 textos foram selecionados de uma coleção de LD e foram analisados com base na presença de metáforas, analogias, termos explicativos e erros conceituais. Os resultados indicaram que a maioria dos textos apresentou recursos linguísticos e que os mesmos foram empregados com o intuito de facilitar a

Corresponding author: Bruna Sarpa Miceli. Email: brunasm213@gmail.com

compreensão do aluno sobre o tema. Ao manter estes recursos, pode-se contribuir para aproximar o leitor dos conhecimentos sobre Ciência.

**Palavras-chave:** Divulgação Científica; Genética; Livros Didáticos; Linguagem.

## INTRODUCTION

Scientific Divulgarion (SD) is characterized as a socialization resource of scientific knowledge for the general population. In other words, it is responsible for transmitting the knowledge of science (produced by scientists) to a public that generally does not dominate aspects related to scientific and technological training (Bueno, 2010; Souza & Rocha, 2015, 2017).

According to Ferrari, Angotti and Cruz (2005), SD is inserted in the scientific and cultural contexts of a society. Thus, in addition to bringing the knowledge produced by the researcher to the public, it aims to inform how scientific knowledge is developed, helps in the language and the provision of a scientific vocabulary and contributes to the understanding of the relationship between Science, Technology and Society. At the school level, it is also an important resource, since it can arouse young people's curiosity about important issues related to the daily life in which they are inserted.

In addition, SD can be understood as a “discursive reformulation activity”. It undergoes a series of adaptations (both speech and language) to become understandable to the public (Zamboni, 1997, p.114). In agreement, Martins, Cassab and Rocha (2001) affirm that the SD is one that includes diverse discursive formations related to different profiles of texts, such as those present in the scientific articles, in the newspapers and magazines and in the textbook. However, in order to understand them, it is necessary to understand the particularities of each text, such as its operation, the way they are elaborated, the impact of they cause on the reader, and especially in relation to the way the discursive re-elaborations of a text, from the moment of its production (through scientific articles), untill to the use of this knowledge in the school context (through textbooks).

According to Azevedo and Neto (2014), the textbook, for being an important resource, must be able to stimulate the critical sense of the students, arousing the curiosity and the ability to investigate and interpret themes related to scientific knowledge. In many cases, these skills can be worked through the SD texts in the textbooks. This insertion can be observed through sections directed related of Science with current themes, which are titled in various forms, such as ‘Science and Technology’, ‘Science and Society’ and ‘Learn more’. The use of these texts approaches of the school public with the elements of Science. In addition, they are able to provide discussion about a variety of themes, instigate student's curiosity, and help in the development of skills, such as reading and interpretation (Martins, Cassab & Rocha, 2001; Souza & Rocha, 2014).

Within this context of scientific knowledge problematization, the topic of Genetics is discussed, which is characterized as an area that brings discussions to society,

especially of the aspects related to the ethics research, since in the current parameters, it allowed not only manipulation of genetic material, but the manipulation of life. In this sense, it can be said that the insertion of this theme in the textbooks and in the texts related to SD is important, since the ethical and social question started to be inserted in the studies of Science and Technology. According to Garcia and Chamas (1996, p.106), “molecular biology has become a great ‘business’ for society” and has come to share opinions about its use, especially in studies of cloning, in vitro fertilization and the use of transgenic and stem cells.

Considering what was presented and having the textbook as the object of research, the goals of this research was to analyze the language presented in SD texts related to Genetics, when they are inserted in the Biology textbook. It is believed that these texts present in the didactic material, as well as in their original sources, use linguistic resources in order to facilitate the reader’s understanding.

It is emphasized that the choice of the textbooks as research object is based on the fact that this material is still considered as an important resource in the teaching-learning process, being prestigious by the school community and used by students and teachers (Fioreze & Delizoicov, 2015).

The choice of the genetic theme was due to the fact that it is an interdisciplinary area of science. In this sense, it is capable to bring ethical, social, technological, political, and economic issues incorporated in the application of scientific knowledge and at the possibility that this theme offers to reflect about Science, Technology and Society (Moura et al., 2013).

## **METHODOLOGY**

This study consists of a qualitative, descriptive and documentary research (Gil, 2002; Sá-Silva, Almeida & Guindani, 2009). The collection of textbooks analyzed was the Biology: Unity and Diversity, by José Arnaldo Favaretto. The choice is justified according with your approval on PNLD of 2018 (which represents the most recent textbook program aimed at high school). In addition, the collection is available in the Textbook Guide of 2018, wich informs, critically, the aspects of these materials (Brasil, 2017).

After the analysis of the books of the three collections, 17 texts were found (Table 1). It is worth remembering that during the reading and searching for the texts, it was decided to restrict the analysis to the texts whose original references were of a journalistic nature, being taken from the digital media (internet portals such as blogs and news from scientific research institutions) and printed (newspapers and magazines). After the selection, the texts were analyzed based on the presence of linguistic resources (metaphors, analogies, explanatory terms) and conceptual errors.

Table 1

Selected texts and their original sources.

CODE	BOOK	TÍTULO	SECTION	SOURCE
T1	B1	Brazilian wasp poison kills cancer cells without reaching healthy cells	The news	Magazine 'Superinteressante'
T2	B1	Pioneer stem cell treatment for pulmonary silicosis is effective	The news	Website 'Veja'
T3	B1	Three researchers who discovered DNA repair mechanisms win Nobel of Chemistry	The news	Website 'G1'
T4	B1	Experts discard cloning to save threatened species	The news	Website 'Carta Capital'
T5	B1	How does chemotherapy work?	The news	Magazine 'Superinteressante'
T6	B1	Prevention and risk factors	Connections	Website 'Inca'
T7	B1	Japanese create sperm from embryonic stem cells	The news	Website 'Folha de São Paulo'
T8	B1	Japanese researchers create ovule in the laboratory	The news	Website 'Folha de São Paulo'
T9	B1	For the first time, scientists transform adult cells into embryonic stem cells	The news	Website 'Veja'
T10	B1	Nobel Prize in Medicine awards scientists for working with stem cells	Connections	Website 'Época'
T11	B1	Stem Cells: Time is the lord of reason	Conexões	Website 'Folha de São Paulo'
T12	B1	Changing lifestyle can reverse cell aging	Text and context	Website 'Veja'
T13	B3	Mendel's Juggling	The news	Website 'Folha de São Paulo'
T14	B3	Study identifies genetic factors that determine the height of people	The news	Website 'G1'
T15	B3	Angelina Jolie	The news	Website 'Folha de São Paulo'
T16	B3	Untitled	Connections	Website of National Genome Research Institute
T17	B3	When fruit flies get sick	The news	Website of NC State University News

## RESULTS AND DISCUSSION

### Linguistic Resources

Regarding the characterization of the language in the SD texts, some aspects were taken in consideration: the use of metaphors, analogies and explanatory terms. Several authors have used these elements in their analysis of SD texts (Martins, Cassab & Rocha, 2001, Goldbach & El-Hani, 2008, Kemper, Zimmermann & Gastal, 2010; Souza & Rocha, 2014, 2015, 2017).

Goldbach and El-Hani (2008, p.165) discuss the importance of using metaphors, since they “are often used in the construction of knowledge and communication in science. They are also very recurrent in school knowledge, as it has long been recognized for research in science education”. The metaphors still helps in the explanation and understanding of scientific concepts (Souza & Rocha, 2014). The analogies, according to Kemper, Zimmermann and Gastal (2010, p.38) are understood as a kind of relation of equivalence, similarity between two terms, differing from metaphors, which establish a comparison with a word that is “in a different sense”.

The first text (T1) didn't use metaphors, analogies or explanatory terms. In this case, a small simplifications of vocabulary were observed in this two fragment: “... *a toxin opens holes in the cells ... According to João Ruggiero Neto, from Unesp, co-author of the research, these holes ...*” and the presence of the first person of the plural in the phrase “*But a new scientific discovery has revealed that we have been unfair to the wasps*”. This indicates, according to Ferreira and Queiroz (2011), an attempt by the author to approach the reader in order to show him ‘something in common’, some similarities between their daily lives. The same occurs when the word ‘you’ is found in these texts in order to establish a possible dialogue with the reader (Nascimento, 2005).

In T2, it was observed the presence of only one explanatory term related to the lung silicosis disease: “*Lung silicosis is a disease caused by the inhalation of silica dust ...*”. In addition, it was noted that in relation to the original text, another explanation about stem cells was deleted and wasn't used in the didactic text. It is believed that this exclusion was performed, since the text was inserted in the chapter of cellular compartments, where the approach planned by the author would have been referring to the inhalation of silica and the subsequent rupture of lysosomes.

The T2 was still characterized by the presence of unexplained scientific terms (such as ‘bronchoscopy’ and ‘fibrosis’) that required a previous knowledge of the readers. Rocha and Vargas (2015) realized that some unexplained scientific terms were not accompanied by their meaning because they were often considered of the public domain. However, we can say that these ‘non-explanations’ may stimulate the readers to search for the meaning or can disturb the students’ understanding.

The third text (T3) presented several explanatory terms, such as the meaning of DNA: “... *that repair errors in DNA, the molecule that contains information for the development and functioning of living beings*”, Enzyme: “... *all connected with enzymes,*

*proteins that promote biochemical reactions ...*” and repair by nucleotide excision: “*He discovered the repair of nucleotide excision, which detects defects extracted in larger pieces of the molecule ...*”. The explanations were also observed by Galieta (2013) in the re-elaboration of the original text (taken from the SD magazine *Ciência Hoje das Crianças*), which presented the term ‘*supra renal gland*’ to the term ‘*adrenal gland*’ in the didactic text.

The text also presented an analogy by associating DNA repairs with a toolbox, in the sense that it aims to repair possible errors: “... *mechanisms that exist in all living beings and serve as natural ‘toolboxes’ to repair these defects that arise spontaneously*”. In addition, it was noted that in the fragment “... *in the copy of the nitrogenous bases that make up the ‘letters’ of the DNA code*”, the word ‘*letters*’ was associated with the purine (A and G) and pyrimidine bases (C, T and U) that are in the composition of the genetic material, as well as RNA, and finally, the expression ‘*double-edged knife*’ in the speech of one of the researchers was observed and that is related to the fact that the DNA repair represents something good, but at the same time, their presence in cancer cells represent something that must be studied and understood. According to Souza and Rocha (2017) the quotation marks are usually used by the authors of the texts with the purpose of highlighting a word known from everyday life that is possibly replacing a more complex scientific term.

The text T4 presented a metaphor to compare the measures adopted by the researchers and their support in the research: “*Many other measures are crutches, which in the long time offer little success, says the biologist Thomas Pietsch*”. In this case, the word ‘*crutches*’ is related to the support offered by the researches and, according to the researcher Thomas Pietsch, they present little success. It is worth remembering that metaphors are resources that help to understand the text through the use of words that are known in the reader’s vocabulary (Kemper, Zimmermann & Gastal, 2010; Ferreira & Queiroz, 2011). There was also a simplification in the seventh paragraph of T4: “*Our priority is to try to keep animals in their natural habitat. If we talk about conservation in zoos, we’ve lost the battle ...*”, where during the speech of the researcher (Colman O ‘Criodain), the word ‘*battle*’ refers to the idea of fighting over the preservation of species through cloning, which would not help the threatened species.

The T5 didn’t present many linguistic resources. The analogy “*Antimetabolites attack as infiltrated spies. They imitate the structure of cancer cell elements, taking the place of the original*”, was found only in the original text. In this case, a comparison is made between ‘*antimetabolites*’ and ‘*infiltrated spies*’, in the sense that they can cheat the cancer cell. According to Rocha and Vargas (2015, p.7) the function of the analogy consists of a “translation of scientific knowledge.” In other words, it is understood that this resource aims to simplify certain scientific terms from the establishment of comparisons between these terms and words generally known and used in everyday life. Still in relation to the above fragment, it could be seen that the author of the original text uses the word ‘*imitate*’ to explain the process performed by the antimetabolites rather than using scientific terms to explain this item.

It was noted that T6 didn't present metaphors or analogies. However, this text was used of several explanatory terms. In the first paragraph the definition (explanation) of risk factors was maintained and what are preventive factors were added. In addition, T6 explained what the latency period was: "*It is important to consider the concept of the latency period, that is, the time between exposure to the risk factor and the onset of the disease.*" and differentiated 'chronic exposures diseases' of 'continuous exposures diseases': "*In chronic diseases, the first manifestations may arise after many years of single exposure (radiation, for example) or continuous (in the case of solar radiation or smoking) to the risk factors*". It is worth remembering that the explanatory terms are found by several authors during the analysis of the language of SD text, including by Nascimento (2005). When analyzing a text referring to cloning, this author noticed that the term 'ovule' was accompanied by its explanation. It was also observed that some words were accompanied by their synonyms, possibly in an attempt by the author to guarantee the understanding of the information, as in the following excerpts: "... *may be involved in the origin (genesis) ...*" and "*Multi-causality is frequent in the formation of cancer (carcinogenesis) ...*".

In relation to T7, this didn't present metaphors and analogies. This text removed two explanatory terms presented in the original text. One of them treated the meaning of stem cells: "*Stem cells are the mother of the cells and the source of all cells and tissues*". The other explanation was for germ cells: "*Primordial germ cells of humans [cells that turn into ovules or sperm]*". It should be remembered that these parts don't corroborate with what was observed by Nascimento (2005) during the re-elaboration of a SD text from the textbook (since such terms are maintained) and by Souza and Rocha (2014), where these authors realized that during this process, the didactic text added explanations about terms that weren't present in the original source. It is also noticed that the suppression of explanatory terms can cause distortions in student's reading.

The T8 excluded from didactic text two metaphors that aimed to facilitate the understanding of the student. In the fragment: "... *the iPS, which are adult cells 'convinced' by laboratory techniques to return to a stage similar to embryonic...*", the word 'convinced' is used to induce the cell, through laboratory techniques, to back to a primitive stage. In the second excluded metaphor: "... *primordial germ cells, which have a very basic cellular personality*", we noted again that in this example, 'cellular personality' is associated with germ cell behavior. This language resource was also found by Goldbach and El-Hani (2008) in SD texts related to the genes theme. The authors realized that several concepts were compared to several more abstract ones such as 'instruction manual', 'book of life' and 'genetic code' and that these metaphors were of great importance in the construction of scientific knowledge. Finally, we observed another term, which this time, was maintained in didactic text: "*The birth rate, however, was lower than that of offspring from 'traditional' ovules.*" It is worth remembering that the word 'traditional' is related to ovules that haven't undergone any type of cellular alteration / induction. Possibly this fragment was used with the intention of facilitating the vocabulary, as it was perceived by Martins, Cassab and Rocha (2001) during the analysis of aspects of the language between a SD text and the text found in the textbook. These

authors noted the presence of quotation marks in certain terms (such as *'to fertilize'* and *'to embellish'*) also signal a metaphorical reading of these terms, since they are used to simplify ideas and make the text clearer.

In the case observed in T9, there is the exclusion of an explanatory term present in the original text referring to stem cells: *"Embryonic stem cells are capable of transforming into the various types of cells that make up an organism"*. The author probably chose to remove the meaning of stem cells because the chapter in which the text was taken (chapter 12) emphasizes this type of cell. At another time, this same text contains an explanation for pluripotent stem cells, as can be seen in the fragment: *"In 2006, the Japanese scientist Shinya Yamanaka created an artificial type of stem cell, produced from genetic changes in normal adult cells. These are called induced pluripotent stem cells"*. The explanatory terms are constantly found in these SD texts present in the textbooks and in their original sources. They were also observed by Souza and Rocha (2017) in several analyzed texts, where concepts such as 'trophic cascade', 'recovery of ecosystems' (and among others) are accompanied by their meaning. These explanations allow a reader with basic scientific knowledge to understand the content presented in these texts. It is emphasized that T9 presented no conceptual errors, analogies and metaphors.

No explanatory terms or analogies were observed in T10. This text only presented a metaphor found in the fragment: *"We now understand that mature cells do not have to be forever confined to their specialized state, said the institute."* It is possible to see that the term *'confined'* was assigned to cells in the sense that they didn't need to remain in a specialized state. Nascimento and Martins (2005) also noticed the presence of metaphors during the analysis of a text referring to Genetics, where genes are associated with elements that contain recipes and instructions, in the sense that they control the characteristics that can be expressed.

In T11, a metaphor was found in the title: *"Stem cells: time is the lord of reason"*, where according to the author of the original text, time would be responsible for bringing the truth about the use of embryonic and adult cells. Among other linguistic resources, Miceli, Rego and Rocha (2018) also observed the presence of a metaphor in a text referring to water. In the phrase *"Brazil is a potency of water"*, the country is compared to a power of water, in the sense that it has such a resource in abundance. Like Souza and Rocha (2017), these authors concluded that metaphors are used with the purpose of facilitating the understanding of a certain term for the reader.

Still in relation to this text (T11), several explanatory terms were found, such as the pluripotent effect of cells: *"... to obtain the same pluripotent effects – that is, the possibility of giving rise to practically all the tissues of the human organism"*, the term 'teratomas': *"... when problems of rejection and formation of teratomas (tumors) were solved."* and 'zygotes': *"... concluding that the zygote (first cell) is a human being"*. The explanatory terms were also observed by Rocha and Vargas (2015) in most of the texts taken from Scientific American magazine on the Biological Evolution theme. Of the twenty-four texts analyzed, twenty-one contained some explanation that aided in the elucidation of scientific concepts and ideas.



In addition, it was realized the use of the first person singular at various times: “*I showed that ...*”; “*By the CNBB, I defended in 2008 in the STF not to kill embryos ...*”, “*I showed them that experiments with embryonic cells ...*”. Thus, it is inferred that the presence of the author in the original text and didactic helps to bring him closer to the reader through an account of the experience lived during the judgment of the constitutionality of the law that deals with the use of embryonic stem cells for research. Corroborating this idea, Ferreira and Queiroz (2011, p.359) say that “the narrator is also a participant interlocutor, called to share the same emotions”.

In relation to T12, the presence of explanatory terms on telomeres was observed in both texts. This fragment is accompanied by an analogy between ‘*telomeres*’ and ‘*shoelaces*’: “*Telomeres are protein structures located at the end of each chromosome. They provide a similar protection to the one at the ends of the shoelaces*”. In this case, this comparison is established since the ends of the shoelaces are generally protected in order to prevent them from being undone.

In another moment, this text didn’t use for the textbook another analogy that is established referring to telomeres: “*These are the ‘caps’ at the ends of the chromosome, a form of protection similar to the one at the ends of a shoelace*”. From the use of the word ‘*caps*’, it is inferred that the telomeres are compared with structures capable of protecting the chromosomes. The suppression of this analogy may interfere with the student’s scientific knowledge, since such comparisons are made with the intention of facilitating the reader’s understanding of a subject from a term known to them (in this case, the word ‘*caps*’).

In T13 it was noticed the presence of several elements that aimed to approach the scientific information of the reader, as simplifications and the presence of a metaphor. At the beginning of the texts, there is a simplification of the vocabulary from the use of two very common terms in genetics classrooms: “... *learning to put together ‘azão’ with ‘azinho’ and glimpsing the mysteries of the dominant and recessive genes*”. In this case, we know that ‘*azão*’ and ‘*azinho*’ are associated with alleles, and that they correspond to a more abstract way of showing the transmission of characteristics to a particular offspring. Another simplification found in the texts refers to the word ‘*smoothness*’: “... *dominant for ‘smoothness’, as we say today*” where it was possible to understand that this word was characterizing the peas that have the smooth texture.

The metaphor was observed in two moments. One of them claims that Mendel’s questioner, the researcher Weldon, remained refusing studies developed with the monk’s peas: “*Until his death in 1906, Weldon continued not swallowing the peas*”. In other words, this fragment uses the term ‘*not swallowing*’ in order to make an association to the fact that the scientist did not accept that research. The second sentence which contained a metaphor is the following phrase: “...*known as the father of modern genetics ...*” where the monk in question (in this case, Mendel) is considered the father of Genetics, in the sense that he was the previous studies related to the transmission of characteristics, which would later contribute to DNA and Genetic research in a more comprehensive way. According to Kinouchi, Kinouchi and Mandrá (2012) the metaphor consists of

comparisons that are carried out in a more abstract sense with the intention of describing more complex terms.

This text presented several rhetorical questions, such as *“Do you remember Mendel?”* and *“What if the seminal results of this priest of the present Czech Republic, known as the father of modern genetics, were actually kind of weird? What if the most appropriate title for him was the father of modern scientific misconduct?”*. This type of inquiry was possibly used in an attempt to establish a dialogue with the reader and make him to reflect about the studies made by Mendel. It is also added that the possibility of these questions arouse the curiosity of the reader to what is being addressed in the text, since this content seeks to portray something that is not usually presented in the textbooks: the contestation of Mendel’s experiments.

The T14 didn’t present metaphors and analogies and, in addition, this text excluded two explanatory terms. The first was about collagen: *“Some were related to collagen, a component of bone...”*, possibly, the author didn’t portray this information because the text relates the genetic factors to the height in a superficial way (without going deeper into studies conducted previously to the research). The second explanation, which was suppressed, treated about genetic variants and was present in the speech of one of the researchers: *“We found the genetic variants – pieces of DNA that vary from person to person – that account for 20% of the genetic component for normal variation at height, said geneticist Timothy Frayling of the University of Exeter in the UK”*. It is worth remembering that omission of these terms, as well as other research data, can negatively impact a student’s understanding of the content and its conceptions of the world, since it doesn’t show the way in which Science and Technology have consolidated in the current days.

Similarly to the previous text, in T15 no metaphors and analogies were observed. However, it was considered that the next fragment have a small explanation about the idea that was being presented: *“The choice is defined by the risk tolerance of each patient – personal and non-transferable decision, to which contributed, in the case of Jolie ...”*. During the analysis of SD texts taken from *Ciência Hoje* magazine, Ferreira and Queiroz (2011) realized the presence of several explanatory terms and approximations of the vocabulary with the daily life of the reader. However, the authors noticed that the terms that presented more abstract definitions were observed more frequently.

The T16 presented two explanatory terms in both sources (original and textbook). One was the definition of ‘genes’: *“The gene is the basic unit of inheritance. Genes are passed from parents to offspring and contain the information needed to specify traits”*. The second explanatory term explained what the chromosomes were: *“Genes are arranged, one after another, on structures called chromosomes. A chromosome contains a single, long DNA molecule”*. The explanatory terms were also found in the study of Legey, Jurberg and Coutinho (2009) on Cell Biology, where concepts such as cloning and stem cells were accompanied by their meanings.

The T17 presented only one metaphor and several explanatory terms. In relation to metaphor, this was found in both texts in the fragment (in this case, taken from the

didactic text): “... *the females ‘increase the bet’ in having at least some offspring ...*”, the term ‘*increase the bet*’ is associated with the fact that fruit flies create great genetic diversity among their offspring.

The first explanatory term corresponds to an explanation of the meaning of haploid, which is maintained from the original source to textbook: “*Fruit flies’ reproductive cells are haploid, meaning that, there is only one copy of each chromosome*”. Another three explanatory terms, which have been observed, consist in the addition of explanations only in textbook. This treats about the meaning of recombinant gametes, which can be seen in bracketed words: “...*and a 50 percent chance of receiving a recombinant chromosome. [who suffered crossing over]*”. It still observed that a fragment contained an exemplification of an unfavorable condition for the drosophila: “*In unfavorable environmental conditions (for example, in the presence of parasites), it could be advantageous ...*” and an explanation of the fruits flies, observed in the first paragraph of the didactic text: “*when fruit flies (or Drosophilidae of the Drosophilidae family) are attacked...*”. These additions of explanatory terms made by the author of the book show his concern to make that information clearer for the readers and for the students. We note that several authors observed during the analysis of the re-elaborations of SD texts inserted in the textbooks, that the explanatory terms were present, possibly in an attempt to facilitate the understanding of a certain scientific concept and to make the information more intelligible to the public (Nascimento, 2005; Kemper, Zimmermann & Gastal, 2010; Ferreira & Queiroz, 2011; Souza & Rocha, 2017).

On the other hand, it was also observed that two explanatory terms were not inserted in the didactic material (in this case, this fragment was taken from the original text): “*During meiosis, the form of cell division that creates eggs in females and sperm in males, female fruit flies produces ...*”. In this case, this fragment treats about an explanation about meiosis. The second example talked about a definition of allele: “... *combinations of alleles (versions of particular genes)*.” It is believed that this information was not maintained because the author chose not to deepen such discussion in the book because it is considered to belong to the knowledge of the student, since this content is already taught during high school.

### **Conceptual Errors**

The presence of conceptual errors consists of the wrong form in which the concepts of science are presented. During their analysis, Souza and Rocha (2017) realized that such errors were frequent in the original sources (SD texts). However, when the texts are inserted in the textbooks, these ‘misconceptions’ were suppressed. The authors, therefore, affirm that teachers should analyze such texts before using them in their activities, and can stimulate a critical reading of the students.

In the present study, it is emphasized that these errors were observed in only two texts. In relation to T2, a misunderstanding was detected in the original text and corrected

in the didactic text from the insertion of the word ‘aplicação’: “... *The treatment consists of ingestion [application], by bronchoscopy, of adult stem cells ...*”. In this case, it was observed that the use of the word ‘ingestão’ was not correctly applied to the term stem cells, since this word is usually associated with feeding. It is inferred that such an error occurred in an attempt to simplify the vocabulary for the reader. According to Kemper, Zimmermann and Gastal (2010) the presence of conceptual errors can be an important element in classroom discussions, since it provides a greater criticality to the students during the reading of the texts. Thus, these misunderstandings can also be used in the teaching-learning process in order to assist in the development of a more critical reading about a certain subject.

The T13 presented a conceptual error in both sources (original text and textbook). It was a fragment already mentioned earlier: “... *for carrying at least one copy of the dominant gene for ‘smoothness’...*”. It should be noted that the word ‘gene’ was used incorrectly, since it can be understood as a part of the DNA responsible for controlling certain characteristics. In this example, the correct word would be the term ‘*allele*’, which is understood as “alternative forms of a gene, which acts on the same trait” (Favaretto, 2016, p.162). It is worth remembering that the author of the LD signaled the presence of this error in the text, but did not modify it. Possibly this author has chosen to keep the error and signal it so that, in this way, the student can understand this error and in future will be able to differentiate these two concepts.

## FINAL CONSIDERATIONS

The SD texts, when inserted in textbooks (which still represent didactic resources widely used in teaching), are able to arouse the curiosity of the reader to bring themes related to the daily life in which they are inserted. The importance of these texts is even more evident when it comes to Genetics, since it involves interdisciplinary issues (social, cultural, ethical and economic). Thus, it can offer the student the possibility to reflect critically about the genetic applications and scientific advances in society.

When analyzing the language of the original and didactic texts, it was noticed that the conceptual errors were found in the original sources of two texts, one of them corrected the word for the textbook and the other, signaled. In this sense, we emphasize that the didactic material makes such corrections and that this shows a concern on the part of the author to approach correct concepts and to take them to the school environment.

Most of the texts presented metaphors, analogies and, in particular, explanatory terms. This may be a move to make scientific information clearer and more comprehensible to the reading public by bringing students closer to scientific knowledge. In view of this, we can consider these texts as important resources for the school context, since they make possible a more critical and reflexive reading on subjects inherent to Science.

## AUTHOR CONTRIBUTION STATEMENTS

M.B.R. supervised the project and conceived the idea presented. B.S.M. developed the theory and both authors adapted the methodology to this context, created the models, performed the activities and collected the data. The two authors analyzed the data. Both authors discussed the results and contributed to the final version of the manuscript

## DATA AVAILABILITY STATEMENT

Data supporting the results of this study will be made available by the corresponding author, B.S.M., upon reasonable request.

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