eISSN 2179-426X 10.26843/rencima.v15n1a13
Received: 09/11/2023 ■ Approved: 15/02/2024 ■ Published: 28/02/2024

Dear Einstein: scientific disclosure in the scientist's correspondences to children

Joyce Loraine Lopes Cunha[1]

Sheila Alves de Almeida[2]

Abstract: Einstein is one of the names with the greatest impact in the scientific field. Furthermore, the physicist corresponded with children from different parts of the world. The documents can be consulted in the book "Dear professor Einstein: Albert Einstein's letters to and from children", which is precisely the corpus of this investigation. Focusing on the scientific theme, the central objective of the research is to analyze the textual discursive strategies used by the scientist to disseminate science to children and the aspects of the science communication genre for children that are present in the letters. The didactic discourse, aspects such as the playful dimension, humor, transgression, and interpellation, with a use of words that bring the presumed public closer to scientific content, stand out in Einstein's letters. The existence of Einstein's letters remains a rare example of contact from a renowned scientist who proposes to dialogue with children.

Keywords*:* Einstein. Dialogy. Scientific Dissemination for Children.

Querido Einstein: la divulgación científica en la correspondencia del científico con los niños

Resumen**:** Einstein es uno de los nombres con mayor impacto en el ámbito científico. Además, el físico mantuvo correspondencia con niños de diferentes partes del mundo. Los documentos pueden consultarse en el libro "Estimado profesor Einstein: correspondencia entre Albert Einstein y los niños", que es precisamente el corpus de esta investigación. Centrándose en la temática científica, el objetivo central de la investigación es analizar las estrategias discursivas textuales utilizadas por el científico para difundir la ciencia a los niños y los aspectos del género de comunicación científica para niños están presentes en las cartas. En las cartas de Einstein destacan el discurso didáctico, aspectos como la dimensión lúdica, el humor, la transgresión y la interpelación, con un uso de palabras que acercan al presunto público a los contenidos científicos. La existencia de las cartas de Einstein sigue siendo un raro ejemplo de contacto de un científico de renombre que propone dialogar con los niños.

Palabras clave: Einstein. Dialogía. Divulgación Científica para Niños.

Querido Einstein: a divulgação científica nas correspondências do cientista às crianças

Resumo: Einstein é um dos nomes de maior impacto no campo científico. Além disso, o físico se correspondia com crianças de diversas partes do mundo. Os documentos podem ser consultados no livro "Querido profesor Einstein: correspondencia entre Albert Einstein y los niños", que é precisamente o corpus desta investigação. Focando na temática científica, o objetivo central da pesquisa consiste em analisar as estratégias discursivas textuais usadas pelo cientista para divulgar ciência para as crianças e os aspectos do gênero de divulgação científica para as crianças estão

[1] Universidade Federal de Ouro Preto — Minas Gerais, Brasil ✉ joycecunhs@gmail.com https://orcid.org/0000-0003-2982-0443.
[2] Universidade Federal de Ouro Preto — Minas Gerais, Brasil. ✉ sheilaalvez@ufop.edu.br https://orcid.org/0000-0002-2030-5173.

presentes nas cartas. Destaca-se nas cartas de Einstein, o discurso didático, aspectos como a dimensão lúdica, o humor, a transgressão e a interpelação, com um uso de palavras que aproximam o público presumido dos conteúdos científicos. A existência das cartas de Einstein segue como um raro exemplo de um contato de um cientista renomado que se propões a dialogar com as crianças.

Palavras-chave: Einstein. Dialogia. Divulgação Científica para Crianças.

1 Introduction

Albert Einstein is the well-known and recognized icon of theoretical physics and author of the Theory of Relativity who revolutionized science. However, in addition to his outstanding scientific discoveries, Einstein also stood out due to his commitment to the promotion of science and the critical thinking.

Besides all this legacy, the physicist used letters to make science accessible and attractive to his admirers, who looked for answers to their questions, as well as for advice, and guidance on several subjects in the letters. Part of those letters were from children.

It is obviously true that Einstein mastered themes related to Physics and disseminated his investigations for those interested in the area. However, considering that the audience of scientists is formed by adults, how did Einstein communicate with children? According to Gomes (2000), knowing science does not necessarily imply knowing how to communicate the scientific knowledge. The author considers that information about science does not clearly arrive to readers, for not all scientists are capable of informing, explaining, or giving opinions about the subjects of science to an uninitiated audience. But, when it comes to Einstein, the letters exchanged with children indicate that he was using textual discursive strategies to engage children in the subjects of science in a very peculiar manner.

In the letters, children felt free to ask, as did Einstein to answer. To some letters, the scientist answered in a formal manner, while in other letters, he offered a dialogue that besides of clearing the doubts, showed that the scientific activity is characterized by doubt instead of certainty. It showed that the scientist is not a solitary genius that live alone inside a laboratory wearing a white coat. Moreover, an example of the communication between Einstein and the children is his self-description. When asked about his appearance by a niece he had not met personally, he described himself as follows,

> let me tell you what I look like: pale face, long hair, and a tiny start of a paunch. In addition, an awkward gait, and a cigar in the mouth – if I happen to have

> one – and a pen in pocket or hand. But crooked legs and warts he does not have, and so is quite handsome – also there's no hair on his hands, as is so often the case with ugly men. So, it really is a pity that you didn't see me.
>
> With warm greetings,
>
> Your uncle Einstein. (Calaprice, page 108, 2002).

When describing himself, he builds a speech with a ludic and friendly tone, using words that are accessible to the children's vocabulary. The image that Einstein chooses to talk about himself is in accordance with his essentially human character. The answer of the scientist corroborates the idea that "building another narrative about what science is, how it is produced and validated, and who the scientists are and how they live, continues to be a pedagogical requirement of education for the general public." (Almeida and Lima, page 31, 2016).

In another letter sent to the scientist on July 10, 1946, a girl from southern Africa says she did not know he was alive because she believed Einstein had been born in the eighteenth century and was buried in America. Then, on August 25, 1946, he thanks for the letter and apologizes for being still alive.

In the missives, therefore, it is evident the involvement of Einstein with the scientific education of children, as well as the style and notion of type of scientific communication for this kind of audience. The letters of the scientist to the children provide a dimension of the importance of disseminating science to children, while being a challenge even nowadays. Thus, even at that time, Einstein, in different ways, insisted on writing to children because he understood the relevance of the dialogue between scientists and children as a unique experience for the children's development of a "reading of the scientific world".

These letters are part of a collection of correspondences published in the book *"Querido profesor Einstein: correspondencia entre Albert Einstein y los niños"*. This material comprises a total of 85 letters, among which 19 are letters written by Einstein and the other 66 are letters sent to him. The book shows messages written by children from several countries, mainly from Europe and United States. The correspondences are dated from 1914 to 1955, the year in which the Physicist died. According to Calaprice (2002), all the letters that Einstein answered to the children were written by himself in his own handwriting. He did not delegate the task to his secretary or any other person. Considering that the flow of letters was quite large, it is not known for certain the criteria used to select the letters to be answered, but it may be deduced

that he used to choose, somehow, the instigating ones, as it was impossible to answer all of them due to the volume of letters received. In the letters from the scientist to the children, we can see aspects of the speech evidencing he had a style to disseminate science to the addressees.

According to Bakhtin (1997), it is possible to identify an individuality of the enunciator based on the style of his narrative, which consists in his peculiarities, specific selection of words, grammatical and sound features, which together form the patterns that allow the identification of a given speech as belonging to a certain person or group. The style in Einstein's letters, then, is established by the way how the Physicist related to the facts approached under a sociocultural perspective and by the way how he related and selected words and textual elements to disseminate science to children in every discursive situation.

In this sense, and aiming to contribute to the research on dissemination of sciences to children, we analyzed the communication modes used by Einstein in the letters, intending, therefore, to answer the following questions:

i) What textual discursive strategies were used by the scientist to propagate science to children?

ii) Which aspects of the genre of scientific diffusion for children are present in the letters?

Specifically, we selected and analyzed five correspondences from Einstein to the children, which had content related to science.

2 Theoretical and methodological referential

Here we focus on two general aspects that interest us to analyze the correspondences. The first one refers to dialogism as per Bakhtin, and the second one refers to the genre of scientific diffusion for children.

2.1 Dialogism in Bakhtin's theory

According to Bakhtin (1997), it is through the word that each human being is revealed as such. Words are chosen according to what the person wants to show about themselves and what they think to the other. He emphasizes, also, that each person, according to the personal perceptions, feelings, and connections, will assimilate the experiences and will build their thoughts and, consequently, the speech style in a

unique manner, maybe differently from what another person would do under the same context. Therefore, it is evident that there is an individuality that restricts dialogism, but also that it is created based on the experience with others.

In this way, the author explains that the voices in the speech are, literally, everything that the person has heard and understood throughout life, under the several moral, cultural, sentimental, economic, and social manifestations with which each individual perceives, either voluntarily or involuntarily, while interacting with the peers. Thus, Bakhtin (1997) declares that there are innumerous assertions that are constantly produced, comprehended, and answered. However, he points out that it is important to say that each assertion appears according to a specific context, in accordance with the needs of interaction that the enunciator has in the everyday life, within the scope of work, religion, culture, leisure etc. From these situations, the assertions are created with common characteristics, objectives, and styles. In general, this is how it is understood that the textual genres are formed.

For the author, even though every speech is influenced by different voices, it is the contextualized individuality that allows the identification of dialogic traces in different assertions of the same person. Bakhtin (1997) elaborates on several dialogic aspects that can be observed and analyzed and three of them are the focus for the analysis of the Einstein's letters, which are: intonation, style, and axiological position.

In line with the relation that the enunciator has with his reader to build his speech, Bakhtin (1997) highlights the use of intonation. For him, an isolated word, without context, is just a word. However, if that word is pronounced with intonation, then the word alone becomes an assertion. By saying that, the author points out that in genres (because they have a certain structure as characteristic) there will be intonations more commonly used with each of them, depending on the social function.

In the written texts, the intonation will occur through the choice in the use of words, use of figures of image, description of situations and feelings etc. In these cases, the written assertions will also have the intonation indicated in the context in which they were written, in the relation of the enunciator with the person to whom he talks and in the subjects included in that speech.

The theme, then, will be the object of the meaning within the assertion, the link that enables two persons with distinct or similar assertions to establish a dialogue, always within a social-historical reality. The theme provides the unity that will guide the

construction of the assertion, allowing a dialogic relation between speeches and subjects. In this sense, the theme plays an important role in speech, since it is the guiding principle of the speech in which the enunciator will talk according to his relationships and perceptions about the subject. The enunciator will choose the genre that allows him to better express himself under that theme.

Thinking that the social relations of each person are diversified according to the social areas frequented, Bakhtin (1997) brings to light phenomena called exotopic position and axiological position. In general terms, the exotopic position is the author's ability to place himself "outside" the situation approached in a work, to be able to build his dialogue based on an analysis of what will be necessary (or desired) to express in that specific context. The exotopic position allows the existence of the social quality required to make any speech, but do not annul the global comprehension that the enunciator has and expresses about certain subjects.

Directly related to the exotopic position, Bakhtin (1997) describes the axiological position as a way to express oneself, expressing opinions, thoughts and feelings based on an individual perspective that passes by the ethical and moral values. In this way, even when the construction of a person is influenced by the environment and the social integration in which that person lived and lives, each individual will have his own perception, as already mentioned. With these brief notes about Bakhtin's theory, the conclusion is that all these aspects of a person's speech will cause the person to build a style in the texts.

2.2 The scientific diffusion for children

Even nowadays, the materials aimed to create a link between science and children are quite rare. Massarani and Neves (2008) believe that the scientific diffusion is a useful instrument for the consolidation of a scientific culture in the society. Massarani (1999) furthermore stresses that it is a responsibility of the scientists to spread science to children as well. For the author, science with quality is not disclosed enough to children because many consider that the cognitive development in children occurs only after the age of 12. According to the author, this mistaken perception excludes children from the interest of most scientists, for they believe that children are not enabled to comprehend concepts that are considered too complex and complicated. However, as stated by Massarani (1999), children have demands and interests that are specific to their ages. This factor does not disqualify them to learn

whatever subject there is. It does bring to the scientists the responsibility to adapt the ways of understanding in order to include the children's needs. According to Massarani (2008),

> it is important to talk about controversies and the impact of science and technology on society. But we cannot put aside a fundamental facet of the communication of science to the children: the evocation of their curiosity about topics of science and about what is going on around them. In short: we must establish a dialogue with children about topics of science and technology, the controversies and impacts on society. However... to what extent have we really established such dialogue? And, most importantly, how do we do this? (p.3).

In turn, Castelfranchi *et al* (2008, p. 16) highlight the necessity of "doing science with children and for children" and building a dialogue with them. For the authors, this dialogue is better established when we know the perception of the children about the science and scientific activity performed by the scientists. According to the authors, some founding elements of what the image of the scientists is and about the role of science in the society are structured since the childhood and stay with the subject for the entire life. That children demonstrate a quite articulated perception of the scientific process, including the ethical dimension of this practice, knowing how to distinguish "mythical aspects connected to the media fiction, as well as current and concrete aspects of the scientific practice." (Castelfranchi *et al.,* 2008, p. 18).

In line with these notes and reflecting about the specificities of the scientific diffusion for children, Ramos (2014), when analyzing aspects of the structure and operation of the texts for scientific diffusion destined to children, points out the dual objective of this genre: informing and attracting the interest of children. According to these studies, the information concerning "What" is provided by the simple transmission of data, usually materialized through descriptive and expository textual sequences, while the explanations are made by showing "How" or "Why", with more complex interference in the reader's knowledge about a subject.

According to Ramos, Marques and Duarte (2015), when diffusing scientific knowledge to children, the authors have special consideration for their acquirements and life experiences. Aspects such as ludic dimension, humor, or transgression, for example, gain significance and functionality. Another characteristic of this genre highlighted by the author is the interpellation, using words that put the intended audience closer to the reading material. Ramos (2014) notes that, most of the times, a certain theme is discussed as an irrefutable truth and those people disclosing the

theme assume the attitude of being the holders of that knowledge, which emphasizes the disparity in the relation between the children and the scientists who are disseminating science. This behavior, in the opinion of Ramos (2014), is contrary not only to the children's needs, but also to the functionality of science on its own, which is built based on doubt, constant refutation of hypothesis and search for new answers.

For this reason, Ramos (2014) stresses that the consideration for social demands and interests is fundamental for the choice and elaboration of texts. And, based on this, it is a requirement to have a writing that is comprehensible, accessible and attractive; the information must be truthful and reliable, and the narrative should emotionally involve the reader.

3 Construction of data and analytical processes

The letters analyzed in this work were selected from the book "Dear Professor Einstein: Albert Einstein's letters to and from children", with prologue written by his granddaughter, Evelyn Einstein, and preface and organization elaborated by Alice Calaprice. Despite the existence of a version of the book translated into Portuguese, the only version currently available is in Spanish. The 205-page book is divided into 11 topics, namely: Foreword; Preface; A note to children; Chronology of Einstein's life; A short biography; Einstein's education; An Einstein's pictures gallery; The letters; Afterword; Additional reading; and Index of names and materials. For this investigation, the main focus was on the epistolary, however, the information throughout the material was essential to understand the history of the professional and the personal life of the Physicist, as well as to the understanding of his relationship with the children, obviously.

Based on the Bakhtin's studies (1997) about the language and those of Ramos, Marques and Duarte (2015) about scientific diffusion for children, our intention in this work is to identify the textual discursive strategies used by the scientist to disseminate science to children, as well as the implications for the understanding of the scientific concepts approached.

It is worth mentioning that the letters disclosed, received by the Physicist, indicate only the name of the senders, date, and place of origin, with no direct indication of the social and cultural conditions of the children who wrote the letters, their family relations, financial situations, education background etc. Besides, the themes dealt with by the children in the correspondences were quite variable, such as: their

admiration for the scientist; congratulations for his birthday; histories about their school and/or private life; requests for autographs; doubts raised about physics and nature in general, among others.

Considering the objectives of this work, we decided to analyze only the letters that Einstein wrote to the children, and we selected those approaching themes that demonstrate, mainly, the vision of the Physicist about science. We selected those letters that enable us to perceive the style and aspects of the structure of a text for scientific diffusion for children. With this, among the 19 correspondences present in the book, we identified five of them that meet our criteria. Initially, we will present the transcription of each letter and afterwards, the analysis considerations of the researchers. It is important to mention that the book "*Querido profesor Einstein: correspondencia entre Albert Einstein y los niños*" was published in Spanish and contains the translation of the letters written by Einstein and the children into English and German.

To analyze the materials in this work, we translated all the letters into Portuguese and transcribed them before each analysis. We understand that translation deals with comprehension. It is not a matter of just translating the text of another person. As per the statement of Bakhtin, comprehension is a process in which we enter a foreign world: "in one moment, to see how the other person sees; it is to travel through all the intentional nuances of the one who speaks to us; it is to transform the person's words into our words when already within the grounds of our intentions and ours points of view" (Tezza, page. 55, 1988). In this way, translation is a dialogue between the text and the translator, between the speech, the voice of the other person and the listener/reader. It is under this perspective that we challenged ourselves to translate the letters. With this said, in the following topic we present the general context of each letter, then we transcribe the letters and finally, we analyze the textual discursive strategies used by Einstein to diffuse science for the children, as well as the implications for the comprehension of the scientific concepts approached.

4 Result and discussions

The selected letters are presented below. Firstly, we have a more technical description of the letter addressing the origin page in the book "*Querido profesor Einstein: correspondencia entre Albert Einstein y los niños*", together with the subject of the letter. After that, we present the letter/answer of Einstein, translated into

Portuguese, and the reviews according to the criteria explained previously. That said, we initiate the explanation of the results and discussions.

4.1 Letter 1

The letter presented here is on page 115 of the book "*Querido Profesor Einstein: Correspondencia entre Albert Einstein y los niños*" and, even if the initial question of the child is not presented, we can infer, from Einstein's answer, that the boy asked three questions related to physics explanations for observations made about the everyday life, which is the central point of the letter.

> *January 13, 1930*
>
> *Dear little cousin,*
>
> *You are not the most savvy little customer, but it is good that you are at least a curious young fellow. So then: The soup does not cool down as much because the layer of fat on the top makes evaporation more difficult and thereby also slows the cooling. The matter of the lantern would be quite serious if the waves in the line of sight were privileged.*
>
> *Actually, the cause of the phenomenon is due more to the fact that in the case of waves that come in under a shallow angle, the angle of rotation of the reflected wave is much larger when one rotates a mirror around an axis perpendicular to the line of sight than for rotations around an axis in the line of sight. The phenomenon of the third riddle is due to the circulatory movement of the water, which is contingent on the fact that the centrifugal force due to friction on the bottom is less important than in the higher layers.*
>
> *Cordial greetings from*
>
> *Einstein.*

This letter initiates with Einstein greeting the child as "Dear little cousin", which revels a treatment with welcoming intonation and strategy, as well as indication of parenting relation of the scientist with the boy. And, at the end of the letter, he greets and signs it with his surname.

In the first two lines of the letter, Einstein says to the boy that even if he is not the smartest person in the world, at least he has curiosity. With this approach to the child, we can bring up two assumptions. The first one is that the physicist is referring to some kind of information that the boy himself wrote in the letter addressed to him: the boy may have told the scientist that he did not consider himself very intelligent, or something like this. If this is the case, then the answer of Einstein denotes a joke with the child together with a compliment about his curiosity. In this sense, he would be both comforting and stimulating the boy, explaining that despite of not seeing himself as the most intelligent person in the world, his curiosity incites him to look for answers. However, considering a second hypothesis in which the boy did not comment on his own intelligence, the tone addressed to the child would denote irony concerning some

kind of error made by him in the original letter. Based on the several correspondences presented in the book, the way how Einstein usually treats and refer to the children leads to the idea that the first assumption is the more plausible. But, as the letter does not offer further clues about the tone used, we established the possibilities of dialogue without a truth party.

The letter sets out three riddles proposed by the child. In the thematic level, Einstein's answer seems to be consistent with the proposed riddles. The answers are an invitation to an interlocutor that is capable of being carried away by the words of the physicist. The selection of the scientific concepts that compose the answer reveals on its own the image of a reader who has possibly more intimacy with some Physics concepts. In this case, Einstein increases the level of demand with his scientific explanations. The existence of this letter is one more evidence that the texts are designed according to what the scientist believes would be the more adequate for a child with such questions and concerns.

In this letter, Einstein takes on his position as scientist by just answering some of the child's questions, without the use of affection or ludicity. With this, we can assume that when the physicist decided not to provide more tangible examples to the boy, he considered that the boy had some knowledge or conditions to access the information, due to indications provided by the child and/or due to his age and school level.

We can observe in the letter of Einstein the concentration of lexical terms and use of expressions that are characteristic of the field of physical sciences. He adopts an "intermediate" discourse, situated between the "erudite" area of activity of a specialist, and the area of activity of common readers, a fact that translates into a discourse whose intertext returns to the questions of the boy. The letter of the scientist, which is monologal, refers to an explicative discourse expressing a real intention of didacticity. Also in this letter, the scientist does not use humor, analogies, or metaphors, not even situations of the everyday life to explain the theory to the reader. There is no materialization of abstract concepts that are difficult to be understood by children, like the texts of scientific diffusion that currently circulate in the media.

However, a coinciding feature of this genre in the letter is the accent of the enunciator as something imbued with absolute truth about the scientific facts reported. There is also in this letter, as a way to be closer to the reader, the interpellation of the

scientist using at least two words that bring the scientist closer to the child – “little cousin” and the pronoun “you”. Also, concerning the language used, the text is organized based on assumptions about the presumed reader – a child problematizing questions of the science observed in the daily life. Under this perspective, Einstein’s letter uses didactic arguments to explain the questions to the interlocutor when he enters into the child’s discursive game that treats the questions as riddles. This is one of the characteristic objectives of the discourse of scientific diffusion for children.

4.2 Letter 2

In this letter, specifically, Einstein explained to a girl his ideas about religion and science, as the girl wanted to know if scientists pray. Little Phyllis letter is on page 120 of the book “*Querido profesor Einstein: correspondencia entre Albert Einstein y los niños*” and Einstein’s answer is on the page that follows. Calaprice (2002) observes that the girl wrote to Einstein encouraged by her Catechism teacher. The idea is that the teacher did so because there is an image of the physicist sculpted in the Riverside church, in New York, from where the letter was sent. In this regard, Calaprice (2002) mentions that Einstein was the only living person with such an honor and that the scientist was quite proud of that.

> *January 24, 1936*
>
> *Dear Phyllis,*
>
> *I will attempt to reply to your question as simply as I can. Here is my answer:*
>
> *Scientists believe that every occurrence, including the affairs of human beings, is due to the laws of nature. Therefore, a scientist cannot be inclined to believe that the course of events can be influenced by prayer, that is, by a supernaturally manifested wish. However, we must concede that our actual knowledge of these forces is imperfect, so that in the end the belief in the existence of a final, ultimate spirit rests on a kind of faith. Such belief remains widespread even with the current achievements in science.*
>
> *But also, everyone who is seriously involved in the pursuit of science becomes convinced that some spirit is manifest in the laws of the universe, one that is vastly superior to that of man. In this way, the pursuit of science leads to a religious feeling of a special sort, which is surely quite different from the religiosity of someone more naive.*
>
> *With cordial greetings,*
>
> *A. Einstein*

Through Einstein’s answer, we can surmise that the subject matter of this letter is related to religiosity and faith, with more emphasis on the beliefs of scientists and researchers. Since his first sentence in the correspondence, Einstein demonstrates care/effort to elaborate the answer to be given: “I will attempt to reply to your question as simply as I can. Here is my answer.” This movement can be understood as the beginning of the construction of the intonation used by the physicist, who firstly tries to

interpret the child's question and then, he adapts himself to be understood by the girl. This is an indication of the priority in his narrative and that he likely spent time thinking about the answer to be given and what words would be the most appropriate ones to express his opinion on the subject. Moreover, it is in line with Bakhtin (1997), who observes that whenever a person builds their discourse, this is based on the perception that the person has of the addressee, i.e., the words to be used and the way how they are organized take into consideration what the enunciator believes the recipient of the message is able to assimilate.

In the first passage of the letter, we can perceive two important points about the axiological position of Einstein: 1) he, possibly, believes that, as a scientist, he must be a promoter of his knowledge, with the function of adapting his narrative so that the listeners/readers can be able to assimilate the information provided; and 2) there is also a distinctive concern toward the childhood, because the physicist puts the child at the center of the dialogue, and tries to build his speech based on what he perceives that will be accessible to the girl. Differently from what happens in the two first letters, in this one, Einstein fits best his language to the audience, just like Ramos (2014) suggests. We can see, also, the understanding of the dialogical variation in accordance with the context and the theme, pointed out by Bakhtin (1997).

In the first two lines of the second paragraph, the physicist also indicates his axiological position when he understands that science is the result of laws of nature and that, while the scientific knowledge is built, these laws are then considered as true. In this fragment, the physicist uses expressions such as: "scientific research", "based", "laws of nature" and "applies" – terms that usually are used in scientific texts and that Einstein uses in the letter written to a child. This action is part of the stylistic process of Einstein, who uses it in the occasion to speak as a scientist. Silva (2002) addresses this relation as an asymmetric relationship between the correspondents, where the parties occupy a distinct position. However, whereas the physicist takes his role, he also indicates his respect for the capacity of the child, which is in line, again, with the ideas of Silva (2002) when he stresses out that even if the letters with asymmetric relations indicate different hierarchies between the correspondents, the way how the relationship between those involved will be established will depend on the position assumed and the words chosen by each of the parties.

It is worth noting that even if he did not use the exact terms used by the child to

answer the question and even without answering precisely if scientists do pray or not and, in case they do, to whom they pray, when Einstein establishes a relation among science + religiosity + scientists in the third paragraph he actually expresses his point of view about Phyllis' question. About this, Bakhtin (1997) says that because the speech is formed by many voices and because it is result and producer of certain contexts, it is also established by what is not said and by the connections established with both the recipient and the subject matter. Besides, the assertion is finished at the conclusion made by the receptor.

In the passage below, Einstein continues his reasoning and indicates once again his opinion about faith, based on his scientific understanding, when he compares the belief in the laws of nature to some kind of religiosity. At this point, the physicist subtly puts himself in a superior position towards religious people because he refutes and researches logical existences. By considering that a belief without questioning is a naive attitude, he mildly indicates his opinion and also demonstrates the need to take a stand critically with relation to the explanations and information that he receives. In this way, he intends to make the child to want to know more about science and religion itself in the attempt to understand the universe and its peculiarities. To do so, he uses objects of discourse that include religious terms (faith, spirit, supernatural being, belief) to talk about science, linking the possible knowledge of the child to what he wants to explain.

It is important to highlight, yet, that in other opportunities to express his opinion about faith and science, Einstein (despite of having also compared both fields and stated the belief in the laws of nature) uses an approach that negatively criticizes the churches and the belief in God, as we can observe in the following passage:

> Religion is experienced, above all, as misery. It is not invented, but essentially structured by the sacerdotal cast, which institutes the role of intermediary between fearsome creatures and the people, thus founding their hegemony. Often the chief, the monarch, or a privileged class, according to the elements of their power and in order to safeguard the temporal sovereignty, adopt the priestly positions. Or else, a community of interests is established between the dominant political cast and the sacerdotal cast (Einstein, 1953, p. 12).

Following this thinking, Einstein (1953) revels that he believes in the laws of nature as being exempt from moral, punishments and political interests and, therefore, as being superior. In this way, the physicist highlights the existence of a link between science and religiosity, which results, as he calls it, in a cosmic religiosity.

The physicist, despite of giving indications of this thinking in the letter addressed

to the child, demonstrates his axiological position by not criticizing openly the Church or God, maybe with a dialogic movement that includes his style in this letter. He does so insofar that he represents his ideas as a scientist in a manner that encourages the critical thinking of the girl, without, however, the explicit judgement of the girl's faith, since she introduces herself as Catholic. Based on the initial information provided by the child, he uses accessible words and link them to scientific terms that are possibly new or at least not usual in the girl's life. This attitude is in line with what Oliveira (2015) reveals concerning the possibility of better understanding and critical thought by means of scientific communication, not only in relation to scientific knowledge, but also in relation to social and personal issues.

4.3 Letter 3

This letter can be found in the book "*Querido profesor Einstein: correspondencia entre Albert Einstein y los niños*", on pages 138 and 139, with the Spanish translation of Tyfanny's letter addressed to Einstein. On page 140 there is, also, a copy of the manuscript of a fragment of the letter of the child and, in the sequence, there is the typed version and the Spanish answer of the scientist. In the letter of the physicist there is a humorous answer to an equally funny comment made by the girl, together with some recommendations about the school.

> *August 25, 1946*
>
> *Dear Tyfanny,*
>
> *Thank you for your letter of July 10th. I have to apologize to you that I am still among the living. There will be a remedy for this, however.*
>
> *Be not worried about "curved space." You will understand at a later time that for it this status is the easiest it could possibly have. Used in the right sense the word "curved" has not exactly the same meaning as in everyday language.*
>
> *I hope that yours and your friend's future astronomical investigations will not be discovered anymore by the eyes and ears of your school-government. This is the attitude take by most good citizens toward their government and I think rightly so.*
>
> *Yours sincerely,*
>
> *Albert Einstein.*

Once again, Einstein greets the girl referring to her as "Dear Tyfanny", an addressing form similar to that employed in other occasions, to which we raise implications concerning semantic load. The physicist also uses a standard closing salutation, a common closing. This letter, which has a different theme, is permeated by Einstein's good humor towards the scientific knowledge of the girl. We can observe, at the beginning of the letter, that the only formality used by the physicist is in the

opening, because he is funny and uses ludic forms afterwards throughout the narrative.

During the writing, Einstein provides hints of the affection he felt for the letter received. The first one happens right in the first line, when he thanks the girl for writing to him. This attitude can also be understood as an attempt to tranquilize the girl, who for more times, expresses concern about disturbing him. Continuing with the letter, the physicist adopts an intonation of good humor, and he jokes with the girl, as she imagined that he was not alive. The intimist and joyful approach that Einstein uses to address the girl is probably established by the freedom demonstrated by the girl herself when she writes about details of her dreams, her admiration for him and for science as well, and even when she confides her secrets to him. This assumption can be interpreted based on what Bakhtin (1997) formulated, understanding that every speech is an answer to another one and that its intonation and style will be constructed based on the information received previously. In addition, when thinking about the context in which this letter was written (beginning of the 20th century), this witty attitude revels discrepancy towards the way how adults and children used to relate to each other in those times, even if we consider that - although at that time there was already a concern about caring for the children, the treatment was rigid and with little affection (Nascimento; Bracher; Oliveira, 2008). On the contrary, Einstein is natural and good humored when he tells the girl that he was still alive.

In the second paragraph of the letter, Einstein makes a comment about the question of Tyfanny, but he does not answer it directly, indicating that the topic is a complex one to be understood at the age of the girl or to be explained in a letter. However, he emphasizes that she will have in the future the ability to assimilate the concept mentioned when he says that she “will understand at a later time”. With this, he encourages her curiosity and the desire to learn, based on the dialogic principle of giving information only concerned to what he thinks the girl is capable of accessing.

In the sequence, Einstein introduces new information to the girl that may have helped her in the thinking about the themes studied, even if the information did not explain the doubts she had about astronomy. When he says, “Used in the right sense the word “curved” has not exactly the same meaning as in everyday language”, he indicates that under science and the common sense, the same term can have differences. He says that it is important to pay attention to these details and to look for the true information. The use of these words can encourage the child to search for

scientific answers to the aspects of the everyday life and can also instigate curiosity and the investigative process.

In continuation to his exotopic position encouraging the curiosity of the girl, Einstein demonstrates that he thinks that the search for knowledge is extremely important and revels that, in some cases, the way how adults behave and establish rules for children is not always appropriate. We can infer that when he says that he hopes the adventures of the girl are never discovered. With this, it is clear that his attitude with children was different from that of most the adults at the time. There was a tendency to follow rules and norms, and to take adults as the maximum authority to be respected (Nascimento; Bracher; Oliveira, 2008). Going the opposite way of this mentality, Einstein acts differently and explicitly expresses to the child that this is not a priority, if compared to the search for answers to the personal curiosities, and he puts childhood, once again, at the center of his narrative. In the sequence, he says he considers curiosity as a characteristic of good scientists, thus encouraging the girl to look for answers to the things she is curious about.

In this letter, Einstein adopts a light and humored position, both in style and intonation, which is typical of texts for scientific diffusion for chidren, as investigated by Ramos (2014). In addition to the scientific concepts (to which the physicist prefers not to delve into), he shows that he became more interested in the funny personality of the girl, and so he tried to act in the same way. About the letter, the physicist's granddaughter, Evelyn Einstein (2002), comments that this was quite similar to the correspondence she used to have with her grandfather. She added that in her opinion, the physicist dedicated time to write to Tifanny because the girl reminded him of his own granddaughter.

The variation in the dynamics shows that the physicist adapted the way how to talk to each child according to the demand presented by the child in the initial letter, using as main subject to be discussed the one proposed by the kid and the feeling the child caused in him. This is stated by Bakhtin (1997) as characteristic of the process for construction of style, which is adaptable in each discourse made by someone.

4.4 Letter 4

The letter that will be discussed below has the initial question of the children available on pages 167, 168, and 169 of the book "*Querido Profesor Einstein: Correspondencia entre Albert Einstein y los niños*". In this letter, a group of six children

describes the theme when they raise their questions about the importance of solar light, which is responded by Einstein in a few lines, accessible for consultation on page 169 of the referred book.

> *December 12, 1951*
>
> *Dear children,*
>
> *The minority is sometimes right, but not in your case. Without sunlight there is no wheat, no bread, no grass, no cattle, no meat, no milk, and everything would be frozen. No life.*
>
> *A. Eistein*

In the first phrase, when the scientist says that the "minority is right in some cases," but that this is not the case with those children, Einstein, before giving the scientific explanation about the theme, he right away announces to the little ones that they are wrong. However, we can infer, when he says, "the minority is sometimes right", the physicist is not limiting himself to only indicate the mistake of the children, but he demonstrates that they were wrong on that specific situation and that it is possible that in other moments when they disagree with the opinion of the majority, they could as well be right. With this, Einstein not only responds to the question of the children, but he encourages them to keep being questioners. In this scenario, despite of giving an objective response, Einstein creates an intonation that is amiable, where he exposes to them what they made wrong, with no reprimands and still encouraging them to keep being curious and inquisitive.

With that said, Einstein goes on to explain the question made by the children and, for such, he does not talk precisely about the physical and chemical effects of the incidence of the sunlight on Earth. He prefers to use examples of elements present in the ordinary life of the kids, to make them understand the necessity of the sun for the earthly life. In line with the need to contextualize the children's universe, mentioned by Massarani (1999), he establishes examples that encourage a reasoning of interdependency and lists some food items consumed by human beings and probably known by the children. Therefore, to have bread, it is necessary to have wheat; and to have meat and milk, it is necessary to have cattle, which in turn, is fed with grass. Consequently, without these basic items, the human being is not nourished. And for all this to exist, the sunlight is indispensable. With this script, he concludes: Without sunlight, there is no life. He still emphasizes: Everything freezes – he underlines that what keeps the entire planet warm is the sun, which is an important factor for the existence of the living beings.

With this, Einstein introduces his style. In the children's letter there were other questions that were not answered by the physicist, such as whether the sun releases hydrogen and whether the stars are bigger than the sun. As per these questions, it is possible that Einstein considered the children as not yet prepared with the theoretical knowledge to understand the explanations and therefore, he answered only the questions about the existence of life on Earth providing the examples cited. However, the physicist does not answer as well if the kids could probably be scientists. Maybe he just chose to answer the question that attracted him the most. This question leaves doubts about the reasons why Einstein established a more serious and succinct style, building a discourse that is centralized in his position as scientist and in the question chosen by him to be responded.

Additionally, being a collective letter, it is possible that Einstein used a more generic intonation, with no supporting or affectionate words for the children, thus revealing also his axiological position in this letter. The information included (or the absence of them) in the corpus of the research does not allow affirmations about this case, but only the assumptions raised.

We consider that Einstein's choice to prioritize one question to the detriment of others is a characteristic of his didacticism. The explanation of only one question is meant to make the children to become more competent in what the enunciator considers as premise for the comprehension of the phenomenon. The importance attributed to the results corroborates with the studies of Ramos (2014). However, as the children ask specific questions to the scientist, the ludic dimension and transgression, which are characteristics of Einstein's personality, disappear in certain correspondences.

4.5 Letter 5

Are human beings animals or not? About this, some children agree, and others do not, but, what does science say? And what does Albert Einstein say about this subject? It is precisely this theme that Letter 11 is about, available on pages 184 and 185 of the book "*Querido Profesor Einstein: Correspondencia entre Albert Einstein y los niños*". Besides, on page 183 please find the letter from the children's sciences teacher, anticipating Einstein about the surprise of the kids when they hear that human beings are indeed animals.

November 26, 1952

Dear children,

We should not ask "What is an animal?" but "What sort of thing do we call an animal?". Well, we call something an animal which has certain characteristics: it takes nourishment, it descends from parents similar to itself, it grows, it moves by itself, it dies if its time has run out. That is why we call the worms, the chicken, the dog, the monkey an animal. What about us humans? Think about it in the above mentioned way and then decide for yourselves whether it is a natural thing to regard ourselves as animals.

With kind regards,

Albert Einstein

In the content of this letter, Einstein uses a didactic intonation, focusing exclusively on the scientific question of the children, since in her initial letter, the girl tells him about the difficulty faced by her class in understanding human beings as animals. This action of the physicist is a reflection of what Bakhtin (1997) says that every enunciation is active and involves a response, specifically, the letter of the child, in the manner as it was written, generated Einstein's answer based on the intonation he understood as the more adequate. In the same way, the letter produced by the physicist certainly generated a new discourse of the little girl, even considering that Einstein did not write a counter answer to her.

Another dialogical aspect present in the letter is that whereas Einstein is addressing the letter of the girl, he directs his speech to a group of students, and he even greets them as "Dear children". This is possible because, for Bakhtin (1997), every enunciation is a link in the chain of other enunciations, that is, a discourse will always be affected by others and will always affect enunciations that are beyond its recipient. Calaprice (2002) suggests, also, that several children of that class sent the same question to Einstein. This is probably why he does not make any comment that goes beyond the scientific explanation, as he is answering several letters in one single enunciation, using an impersonal style.

That said, at the beginning of his letter, Einstein reformulates the question of the kids and by responding it with a question, he uses this object of discourse to urge the children to think about the importance of reformulating the question. When reformulating the question, the readers may already start to reflect on the answers, even before giving continuity to the narrative of the scientist. In this way, he does not give them an exact and fixed response about whether or not human beings are animals. In this letter, he makes clear his intention when he suggests that they should decide by themselves what the conclusion for their own question is. However, even asking for the students to create their own inferences, Einstein demonstrates a little

what science says about animals being a biological and behavioral category.

Therefore, Einstein's style is constructed from his social place as scientist. He indicates to the children a path through which to obtain the expected results, creating a narrative trajectory to offer question, information, reflection, and conclusion. This point is noticeable when he chooses to use the word "thing" to refer to the animals. In doing so, he uses a generic term, which does not exemplify any existing animal. This could cause the children to have to search for their own references of what an animal would be. Next, the scientist mentions examples of animals that are usually known by the children, so that they can observe in the examples the cycle of life that he described previously. After that, we return to the question about the case of the human beings, making the new information provided to affect the understanding of humans' classification.

The physicist yet emphasizes the need to think about what they have just read when he asks them to think about the way how he mentioned. Therefore, even if not saying directly that human beings are, actually, animals, Einstein indicates the answer. After that, he asks them to decide on their own whether it is a natural thing the human being to be considered as animal. In this fragment, the use of the word "natural" can be understood with dualism: it has, at the same time, a sense within a genuine affirmation, as well as, once again, a clue that being an animal is a classification made by biological questions, from nature. We confirm so the axiological position of Einstein in allowing and influencing children to go through an exercise of reflection to be able to attain the answers they are looking for.

5 Final considerations

The analysis of Einstein's letters sent to the children reveals the textual discursive strategies that were used by the scientist to diffuse science to children, as well as aspects of the genre of scientific diffusion for this kind of audience in the correspondences. The analysis of the texts took into consideration that the audience of Einstein was not (usually) children.

Therefore, it can be seen that the intonation adopted by Einstein in each letter was adapted to the theme of the correspondence and to the level of intimacy demonstrated by the child in the initial letter. In this way, significant differences were verified among the letters addressed to different children.

In this way, it can be stated that Einstein's most recent letters dated 1946, 1951, and 1952 to children show a typological diversity that is more in line with the genre of scientific diffusion for children. Besides of the theme of the letter, it is likely that the regularity in the communication with the children led the scientist to produce another form of interaction with them to diffuse science. The discussion about science with children requires not only the knowledge of the theme, but also the construction of objects of discourse to materialize the dialogue. Such construction involves from pronouns of treatment to ways of explaining the concepts.

Aware of his own credibility, Einstein adopts a position of superiority – at the level of knowledge, but also at the level of a positioning that allows him to use interpellations, encouragements, and recommendations. In this picture, the scientist invites children to keep on investigating the question that motivated de letter. This "invitation" also works as a didactic strategy.

In letter 2, Einstein presents science as an unstable and problematic field of knowledge in a discourse that represents the investigation scenario. The controversy, the divergence in points of view, the unfilled gaps, are all presented in the correspondence.

In some letters, Einstein uses a lot of technical and scientific terms and not always he is concerned with the comprehension of such terms by the interlocutor, probably because he considers that the recipient knows the subject being dealt with. However, even in these letters, the physicist does not produce a superficial discourse for the children. He feeds the curiosity and restlessness of the children, evoking dilemmas for the readers, even when he responds directly to the questions of his interlocutor.

Although the explicative discourse is present in the correspondences, we do not observe the use of analogies, metaphors, and images in the letters investigated. This does not mean that Einstein did not use these resources in other communications.

Good humor and ludicity are observed in the letters containing questions that were more instigating for the scientist. An attitude more focused on the explanation of the scientific principles was adopted in moments when children asked him strictly about conceptual questions. Maybe the tone used by Einstein in some letters was influenced by characteristics of the German culture. Consonant with the intonation, Einstein attributed his own style, giving place, in some moments, to the attitude of a scientist

who is concerned with making himself understood and instigating the kids to be critical and to elaborate their own ideas based on the information provided.

Nonetheless, we are not talking about a rigid and purely characterizing style of the person. Style will always be the result of the conceptions of the author, however it is also delimited by the relation with the other, to whom the person dialogues, and this movement is perceived in the style and in the dialogy of Einstein, in each letter he wrote to children from all the world. As seen, each correspondence has its own theme and peculiarities, which, therefore, led Einstein to establish his own dialogy in his enunciations. In spite of this, we can notice that there are similar aspects both in the subjects discussed and in the manner how the physicist responded to the children.

In addition to the dialogy present in the discourses of Einstein, we observe also the social role assumed by the scientist when communicating with the children and the implications of this to the present days. The very existence of the Einstein's letters constitutes a rare example (mainly for the context in which they were produced) of an effective and, why not, affective contact of a renowned scientist who is willing to dialogue with the children through the only means of paper and ink. This evokes a reflection about the commitment of the scientist today.

Allowing children to have access to scientific diffusion, other than keeping them informed and with their reasoning stimulated, allows them to maintain their curiosity instigated and, maybe is the stimulus to encourage them to keep on studying and to become scientists one day (MASSARANI, 1999). With this in mind, Einstein broke with the image of a solemn scientist focused exclusively on his work and thus permitted the children that used to see him as a famous genius to start seeing him as a "human" version of the renowned physicist.

It is not possible to say that Einstein was a common person because he was not. However, undeniably, we can affirm that he approached children, talked about their difficulties, raised, and discussed teaching and learning issues and used to welcome the curiosity in children. With this, he enabled them to have a vision of what doing science could be. He showed them that it was possible to make science; he showed them a little of the role of a scientist, and he gave them a glimpse of who Albert Einstein was.

References

ALMEIDA, S. A; LIMA, M. E. C. C. Cientistas em revista: Einstein, Darwin e Marie

Curie na Ciência Hoje das Crianças. **Ensaio Pesquisa em Educação em Ciências**, Belo Horizonte, v.18, n. 2, p. 29-47, maio/ago. 2016.

BAKHTIN, M. **Estética da criação verbal.** Trad. Maria Ermantina Galvão; rev. trad. Marina Appenzeller. 2 ed. São Paulo: Martins Fontes, 1997.

CALAPRICE, A. **Querido profesor Einstein**: Correspondencia entre Albert Einstein y los niños. Barcelona: Editora Gesida, 2002. 205 p.

CASTELFRANCHI, Y; MANZOLI, F.; GOUTHIER, D.; CANNATA, I. O cientista é um bruxo? Talvez não: ciência e cientistas no olhar das crianças. In: MASSARANI, L. **Ciência e criança:** a divulgação científica para o público infantojuvenil. Rio de Janeiro: Casa de Oswaldo Cruz; Fiocruz, 2008.

EINSTEIN, A. **Como vejo o mundo**. 11 ed. Rio de Janeiro: Nova Fronteira, 1953.

GOMES, I. M. A. M. **A Divulgação Científica em Ciência Hoje:** características discursivo-textuais. 2000. 306f. Tese (Doutorado em Linguística). Universidade Federal de Pernambuco. Recife.

MASSARANI, L. Não na frente das crianças! As controvérsias da ciência e a divulgação científica para o público infanto-juvenil. **JCOM**, v. 7, n. 1, p. 1-3, 2008.

MASSARANI, L. Reflexões sobre a divulgação científica para crianças. In: **Anais do XXII Congresso Brasileiro de Ciências da Comunicação**, Rio de Janeiro: Universidade Gama Filho, 1999, p.3-7.

MASSARANI, L.; NEVES, R. A divulgação científica para o público infantojuvenil: um balanço do evento. In: MASSARANI, L. (Ed.). **Ciência e criança:** a divulgação científica para o público infantojuvenil. Rio de Janeiro: Museu da Vida/Casa de Oswaldo Cruz/Fiocruz, 2008.

NASCIMENTO, C. T.; BRANCHER, V. R.; OLIVEIRA, V. F. A construção social do conceito de infância: algumas interlocuções históricas e sociológicas. **Contexto & Educação**, Ijuí, v. 23, n. 79, 2008.

OLIVEIRA, M. P. Divulgação Científica para o público infantil: um instrumento de inclusão social e fortalecimento da cultura científica. In: **Anais do Encontro Nacional de Pesquisa em Educação em Ciências**, Águas de Lindóia: 2015, p. 2-8.

RAMOS, R.; MARQUES, M. A; DUARTE, I. M. Hiperestrutura em textos mediáticos de divulgação científica para crianças. In: MARQUES, M. A.; SANCHÉZ REI, X. M. (Ed.). **Novas perspectivas linguísticas no espaço galego português**. Corunha: Universidade da Corunha, p. 133-149, 2015.

RAMOS, R. Construção dos objetos de discurso em artigos mediáticos de divulgação científica para crianças. **Redis**: **Revista de Estudos do Discurso**, n. 3, p. 1-28, 2014.

SILVA, J. Q. G. **Um estudo sobre o gênero carta pessoal**: das práticas comunicativas aos indícios de interatividade na escrita dos textos. 2002. 209 f. Tese (Doutorado em Estudos Linguísticos). Universidade Federal de Minas Gerais. Belo Horizonte.

TEZZA, C. **Trapo**. São Paulo: Brasiliense, 1988.