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DIALOGUES BETWEEN LITERATURE AND MATHEMATICS: CONVERGENCIES IN THE DIGITAL AGE

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TO START

In the context of Language Studies, this chapter provides a brief reflection on the relationship between Literature and Mathematics in the early years of Elementary School, mediated today by Digital Information and Communication Technologies (TDIC).

Adopting a multidisciplinary approach, we seek in this chapter to analyze the convergence of these two areas, at first, seen as opposites by some. However, mathematics, a science of nature, is in no way opposed to literature, positioned in the field of art. The artist often recreates and interprets nature in his work, while the natural scientist needs this art to humanize himself. Along the way, we bring up the following questions: why do some beginning students experience so much difficulty in learning mathematics? How literature could make this task less painful or, at least, more pleasant.

For this purpose, we started from two surveys, one already concluded, which had as research object two collections of Teacher's Manuals (MP), components of the Digital Mathematics Textbooks (LDDM), distributed only to teachers from the 6th to the 9th grade of Elementary Education (EF) in public schools, by the National Textbook Program (PNLD), in the period 2017-2019 (CARVALHO, 2021). These two collections, in digital format, and nine others, in printed format, made up the mathematics collections approved for the PNLD 2017, available for the choice of mathematics teachers (BRAZIL, 2016). Having Social Semiotics (SS) as a theoretical basis and Kress (2003, 2010) as a reference; Kress; Van Leeuwen, 2005. Kress and Van Leeuwen, 2004), this research addresses LDDM under three thematic axes: book technologies, didactic material and multiliteracies. In these axes, the languages, in their various modes of expression, that is, multimodal texts, constitute the focal point of this study and the digital book, object of the research.

The second research, still in progress, has as its object the investigation of the use of the Digital Literary Book (LLD), in the early years of Elementary School. In this context, reading and writing in the digital environment have become important tools widely used by students and teachers during the Coronavirus pandemic. With the closure of schools, there was an expansion in the use of this book, as well as other teaching materials: videos, maps, schemes, slides and everything that was possible to produce for the execution of remote classes online. This phenomenon was due, in part, to the leasing of digital libraries to schools, with direct access by students. This new type of business, book rental, is still not widespread, but it could expand with the growth of the digital book.

In the use of the digital literary book, the theoretical foundation is based on a sociocultural, semiotic and anthropological conception of literacy, whose main references in Brazil are Soares (2010) and Kleiman (1995). Such authors present the concepts of literacies by adding social practices. In literature, we dialogue with Pinheiro (2007), Ferreiro (2013), Versiani (2007) and Lajolo (2001).

However, by adopting SS as a theory, we are implicitly assuming social practice as a premise. Mathematics teaching only makes sense if it is connected to the real world, in which the teacher articulates what he teaches with the student's social reality. Critical and progressive pedagogical theories, in defense of a democratic education, already proclaimed these principles in the struggle for literacy at the end of the 20th century. This is how Paulo Freire can be understood when he says that "The reading of the world precedes the reading of the word, hence the subsequent reading of the latter cannot dispense with the continuity

of the reading of the former. Language and reality are dynamically linked" (FREIRE, 1989, p. 9). We agree that, generally, those who have the habit of reading are able to articulate words and facts well in argumentation, both in oral and written language. In mathematics, the interpretation of codes and the social practices of the student's real world are also inseparable in the early years of PE.

As Chartier (2020) states, reading on the screen does not pose major difficulties for this new generation, despite reading less verbal texts, such as printed books. However, analyzing data from Europe and North America, this author shows that the number of readers has been systematically falling in the age group of 15 to 25 years. Perhaps, this age group reads less printed books or reads other texts and still does it differently. Texts, in Language Studies, must be understood and extended to their broadest form, that is, other modes of expression, in addition to the written or oral verbal form: image, music, map, drawing, video and an infinity of other texts and genres circulating on the internet today.

Reading and writing, two sides of the same coin, move today from printed to digital text, and, on the screen, we read more than just words, we read static and moving images, plus sounds and other modes of communication. language expression. Chartier (2020) also states that this is a fragmented, decontextualized and superficial reading: "The digitization of the world is a magnificent promise and, at the same time, a loss if it ignores or erases the legacies that allowed and still allow multiple reading experiences. and writing" (CHARTIER, 2020, p. 166-167).

A large number of students who do not have permanent access to TDIC are highlighted here, especially those from public schools, far from large urban centers. Therefore, when we refer to TDIC in schools today, we cannot generalize its use. The Covid19 pandemic has exposed the fragility of both student access to the internet and the lack of structure in public schools for remote teaching. Once again, the private education system came out ahead.

The great challenge facing teachers is that "[...] students currently belong to an iconic civilization, while teachers belong to a pre-iconic civilization" (TARDY, 1976, p. 27). Thus, it is necessary to seek strategies so that teachers and students can develop new skills in the construction of knowledge and autonomy, with the use of images, static and in motion, and other semiotic resources, present in digital books and in other screen writing and reading devices. The reproduction of old practices will not produce different results, as required by current educational practices.

MULTILITERACIES AND MULTIMODALITY

Within the SS, two concepts deserve to be highlighted: multiliteracy and multimodality, as they are very present in the digital books of the aforementioned studies. The concept of multiliteracies is adopted from the study group of English-speaking researchers, gathered in New London (USA) in 1994, whose document is published as an article two years later (CAZDEN et al., 1996). Multimodality is a much older concept, since all text is multimodal, even the verbal text, the manuscript or even the figures painted in caves thousands of years ago. In this research, however, we dialogue with contemporary authors, such as Kress (2003; 2010), Van Leeuwen (2005); Kress and Van Leeuwen (2006). Kress and Van Leeuwen's SS, in turn, is based on Systemic-Functional Linguistics (LSF), developed by Halliday in 1989 and reformulated by the same author with Matthiessen years later (HALLIDAY; MATHIESSEN, 2004).

What does it mean to work with reading

and writing in the contemporary world? Rojo (2009) provides some clues and proposes three types of literacies, constituents of the basic competences that she calls: multiple literacies and, for us, constitute the basis on which any other type of literacy must be built today: 1) Multisemiotic literacies – that is, reading and producing texts in different languages and semioses (verbal, oral and written), sound (music, rhythms, sounds), visual or imagery (static or in movement), spatial, corporal or in movement (dance, performance, sport, gymnastics), mathematics (games, simulation, arts), digital and other ways of meaning; two) *Multicultural literacies or multiliteracies* – that is, addressing cultural products, literate or not, both from school or dominant culture and from different local and popular cultures; 3) Critical literacy – that is, approaching texts and products in different media, critically and capable of revealing their purposes, intentions and ideologies, locating the text in time and space (ROJO, 2009, p. 119-120, highlights ours).

However, every text is multimodal, that is, it has variations between and within each language expression mode and according to the context. When telling a story, meanings are constructed through narratives that gain attention and lead the listener to want to know more. Children's literature takes us to the playful dimension, fantasy, play and affection. Storytellers, for example, competently explore the use of sounds, pauses, colors, gestures, scenarios and body language to produce meaningful effects and hold the participant's attention. The storyteller's performance provokes the listener's interest and curiosity. In this context, the abundant use of images is essential at the beginning of the school phase and an integral part of the language of children's books. Adults, however, distance themselves from it as they advance in dominance in the world of printed text.

Faced with changes in the national and international scenario, promoted by the Coronavirus pandemic in 2020, there was an urgent need to adapt activities in the world of work to the massive use of digital technologies. The educational system also moved, even in an emergency way. Remote learning is no longer an option and has become a fundamental, albeit temporary, means. Thus, digital books have become important didactic material for remote classes in literature.

However, when face-to-face teaching returns, unlike private companies, there is a return to some old practices: emphasis on printed text, banning the use of mobile devices and centrality on the teacher. The return of old practices reinforces the hypothesis that digital technologies are not yet incorporated into everyday school culture. The emergency use of digital information and communication technologies during the pandemic was just a survival strategy for schools.

In the public network, for example, little is heard today about investment in infrastructure at schools due to lack of equipment and internet access conditions. We missed yet another window of opportunity to advance on this issue. It was clear from the beginning that public education was not yet prepared for such a situation and, once again, the private education system took the lead.

In terms of language, despite honest criticism of content and current pedagogical options, printed or digital mathematics textbooks have innovated in form, mainly in their graphic design and in the aspect of visual communication. An editorial project involves different professionals today and each one leaves their footprints in the works.

In the textbook, the author produces texts, usually printed, and works as a kind of consultant in the editorial phase. The editor starts to have a greater weight on the work because he commands a team involving

several professionals. In LDDM, in addition to all the project stages mentioned above, computational and audiovisual projects are added, in general, carried out outside the publishing house. A digital book, instead of being a commodity, becomes a service, that is, an application, including audiovisual and other multimedia resources. They are simply electronic files (CARVALHO, 2021).

Finally, language aspects constitute the focus of these researches. As the teacher has no choice about the content to be taught, he defines the teaching strategy that goes through the language resources. He makes the most appropriate choices for the teaching and learning process, articulating the book's content to the student's world. "Those who are in the classroom, if they do not create the content they work with, create a meaning for that content and every action of elaborating the meaning of something can reveal a style", says Cruz (2016, p. 13, emphasis ours), with whom we fully agree. In this sense, every teacher "co-creates" the content to be taught and, thus, becomes a co-author of what he teaches (SILVA, 2014). We saw a lot of this, in practice, during the Covid-19 pandemic: videos, lives, presentations, synchronously or asynchronously. According to Silva (2020), co-authorship is a process of interactivity, a phenomenon of current communication, in which the producer participates with the receiver in the creation of a work.

Therefore, representing the world and producing meanings are one of the functions of language. The SS deals with semiotics and the social. For Santos and Pimenta (2014, p. 298), the focus of Social Semiotics is the social function of language. Halliday and Mathiessen (2004) also consider that language is shaped and structured in the social environment, that is, it is created by society and, in turn, dialectically, contributes to creating society. The term social semiotics, therefore, can be thought of as an ideology or intellectual instance, a conceptual angle on this subject. Kress (2003) also reinforces that SS, when considering the multimodal aspects of languages, ceases to be a linguistic theory and becomes a semiotic theory of literacy, or multiliteracies (CAZDEN et al., 1996).

Thus, for Santos and Pimenta (2014), the emphasis of language is on the process of meaning, placing it as part of the social construction, that is, in the use that the individual makes of languages to solve his problems in the world. In everyday activities, we use language for everything: talking, screaming, crying, protesting, shutting up, reading, reciting, reciting, singing, writing, drawing, graffiti, giving orders, editing, interpreting, photographing, greeting, saluting, gesticulating, sleeping, eating, jumping, jumping etc. Our verbal, bodily, visual, gestural and sound expressions say a lot about our state of mind, temperament, educational level, beliefs and values. We are hostages of languages, they reveal us and say a lot about us. In the culture of education, everything starts in the mother tongue, learned orally, in the family and in the community where we live.

This way, we live today in a world crossed by images in every time and place: on the store's poster, on the signs, on billboards, on smartphones, on TV and on the computer. In most devices today, the individual takes a photo, edits it, puts sound and caption and distributes it on social networks. The metaphor of "semiotic landscape", mentioned by Kress (2003), means that several modes of language expression interact and complement each other, forming a meaningful whole. Thus, the author completes: "The world told is a different world from the world shown. The effects of the shift to the screen as the main medium of communication will produce far-reaching changes in power relations, and not

just in the sphere of communication (KRESS, 2003, p. 1).

In the book: ''*Literatura infantil Brazileira: uma nova/outra história*", Lajolo and Zilberman present the history of Brazilian literature for children and young people over the last 30 years. By highlighting the possibilities offered by the digital world, they include the composition of aesthetic productions from an amalgamation of languages and call into question the traditional definitions of the book. "New technologies imposed other formats and materials, new modes of production and circulation, different ways of reading, restoring in many cases the relationships between communication, body, voice, look and gesture" (LAJOLO; ZILBERMAN, 2017, p. 26). If these technologies brought new text formats, they also bring different ways of reading and constructing meaning, in different contexts and using different skills and reading skills (LAJOLO; ZILBERMAN, 2017, p. 26).

So, in the world of mathematics, it is no different. The textbook of the past, with definitions, postulates and demonstrations of theorems, in a predominantly verbal form, has given way to the current book, rich in illustrations, maps, graphs, photographs, tables, schemes, applications and simulators, both in printed form and in print. digital. Mathematics is no longer an end in itself and is now taught as a tool or as a resource to solve problems in the student world, that is, as a social practice, according to the principles of multiliteracies.

Unfortunately, the Study of Languages is not part of teacher training, but today it has become indispensable in the continuing education of Mathematics and Natural Sciences teachers.

CONVERGENCES BETWEEN MATHEMATICS AND LITERATURE

We learn math more easily when we enjoy reading and relate what we read to the real world. However, the student's relationship with mathematics produces surprising reactions: "Mathematics annoys some students, others seduces" (FAYOL, 2012, p. 7), reading also produces different reactions. In general, this relationship is built in the first years of school life, in the literacy phase. Who produces this reader?

Smole (1996), reflecting on mathematics education, already recognized the richness of the literary potential for literacy by the stimulus it represents in the construction of the written language code and states:

> Children's literature has been presented as an open, current pedagogical practice that allows children to live with a non-passive relationship between written and spoken language. In a way, literature appears to children as a manifestation of feeling and knowledge, which allows them to invent, renew and disagree (SMOLE, 1996, p. 2).

To bring literature into mathematics classes, this author also proposes that:

> [...] it is important, in the first place, that the teacher enjoys reading and has the books he wants to work with in his hands so that he can learn about the history and visualize the engravings that often suggest the exploration of one or more themes, and also so that be able to design activities that are appropriate for the class you are working with.
>
> Second, it is critical that students know the story and are interested in it. For this, the teacher can initially resort to the same resources he uses when working with stories in mother tongue classes and it is even interesting that he does so so that the activities emerge naturally [...] (SMOLE, 1996, p. 8).

However, in the TDIC environment and

digital libraries, it is necessary to go further. We must also take into account the mastery and availability of technological resources for teachers and students. Otherwise, instead of an activity facilitating the interaction of literature-mathematics, between professors and students, in a perverse way, it will be one more factor of exclusion of those who lack resources, mainly public school students.

Observing the questions above, we add that an almost always common trait of those who appreciate the area of exact sciences is to have had an inspiring mathematics teacher in childhood, in whom we mirror today. The opposite also seems to be true: many were frustrated, not because of incompetence or lack of mathematical skills, but because of lack of motivation. It is from this inspiring and communicative teacher, capable of relating mathematics to other areas of knowledge, including literature, that we are dealing with here.

In general, the bridge between orality and writing is made by the literacy teacher - she can be the teacher -, sower of desire and, in most cases, responsible for the reader's birth. It is she who shows him the key to decoding the world of writing, teaching him the relationship between sound and words. Sow the desire for reading, help in childbirth, nourish and see the reader's growth: this is the mission of this great teacher (PINHEIRO, 2020).

However, there is little publication bridging the gap between literature and mathematics. To exemplify, we selected two authors with different proposals, linking literature and mathematics. The first is the well-known poem by Millôr Fernandes, called Mathematical Poetry: "On the many pages of the mathematical book a Quotient fell madly in love one day with an Unknown".[1] [...]", in which the author embodies mathematical terms, in a humorous game of analogies and metaphors.

A second author is Malba Tahan, the pseudonym of Professor Júlio César de Mello e Souza, a student at Colégio Militar and Colégio Pedro II, in Rio de Janeiro. He graduated as an engineer and became a professor at that institution years later. He researched the Arab culture, which contributed so much to the development of mathematics. He produced a vast literary work, with more than 15 books, showing how to work with mathematics in a contextualized and interdisciplinary way. In his narratives, this author emphasizes mathematics as part of our lives, through intriguing problems of arithmetic and logical reasoning. His characters reveal religious tolerance, love of art and cultural diversity. The language used is captivating, taking care to explain each Arabic word or expression in footnotes. The playful aspect, in the form of short stories, permeates the work. His book: ''*O homem que calculava*", released in 1938, it became a classic. It was also nominated for Literary PNLD 2020 for the II cycle of Elementary School.[2]

The proposal in the PNLD Literary 2020 guide is to work this book interdisciplinary in the areas of Mathematics, Physical Education, History, Music and Geography. After almost a century, the work remains contemporary and enchanting new generations of readers.

Literature, having mathematics as the theme, still has a lot of room to grow, but the reader of this new generation is different. The writer of the 21st century, perhaps, is a youtuber, a live presenter, a video producer, a builder of spreadsheets, simulators or an infographic designer on the internet. There are several texts on the internet, good and bad, contextualized and decontextualized. Obviously, not all can be classified as literature. Thus, it is up to the

1 Available at: http://egui.blogspot.com/2005/08/poesia-matemtica-millr-fernandes.html. Acessed in 9 june of 2022.

2 Available at: Guia_pnld_2020_literario_2020-literario_ensino_fundamental_anos_finais.pdf (ufal.br) Acessed in: 9 june of 2022.

mathematics teacher to curate and select what meets his or her objectives. The mathematical author is still very focused on technique and logical reasoning. Where does the art that generates fruition and enchantment begin to engage the reader? It is necessary to demystify mathematics by making it part of the student's daily life. Perhaps, this is the greatest challenge in working mathematics and literature. Just remember that mathematics matches any discipline because everything in nature can be quantified or related to it, under some aspect of multimodal language – visual, spatial, sound, gestural and, naturally, verbal.

The LDDM, in the digital version of the Teacher's Manual, is a promoter of multiliteracies (CAZDEN et al., 1996; SILVA, 2015; CARVALHO, 2021), because it uses several modes of expression of languages. Mathematical language also borrows the term "numeracy" (FAYOL, 2012; CEALE, 2022), in analogy with adjective literacies in other areas. However, working with the digital book requires new literacies such as the visual, the digital and the media. The complexity of editorial production today involves more than the author's speech, whose words are not chosen at random. It also brings a choice of images (static or moving) and application technologies to support the use of the digital book. Reading images, analyzing discourse and mastering DICT are not always fully taught in teacher education, and must be sought in continuing education throughout professional life.

In our society, according to Fayol (2012), mathematics has become intensely valued: in professional activities and in high school, for most professions. In the so-called knowledge society, mathematics occupies a significant position in scientific culture. Finally, at school, it plays a dual role as a discipline and a cutting-edge tool, both contributing to (over) evaluating successes and dramatizing student failures (FAYOL, 2012, p. 7-8).

Reading and writing are factors of "empowerment" of the subject in society. "Reading and writing, when they become habits, make the individual think and position himself politically as a citizen, transforming his worldview. Therefore, denying this possibility to someone is also an act of violence" (COSTA; CARVALHO, 2019, p. 137). This denial explains, perhaps, the choices made by some rulers: illiterate people become more dependent on public policies and, consequently, the maneuvering power of some politicians. "Reading is an integral part of the literacy process at school; the (dis) pleasure of reading at this stage can determine habits and develop a taste (or repulsion) for it" (COSTA; CARVALHO, 2019, p. 137). It is with literature, as fruition, that we defend a possible connection to the teaching and learning of mathematics. It is literature that delights and provides pleasure in Early Childhood Education.

Therefore, through the connection between mathematics and literature, it is possible to establish cognitive relationships aimed at reading the world of students, inserted in social practice in order to promote relationships of analysis, argumentation, synthesis and extrapolations. This form of interaction between literature and mathematics is an attempt to show the interfaces of two distinct areas of knowledge, but which intertwine and share knowledge. It's not an easy task.

TO FINALIZE

SS makes an important contribution by providing the theoretical basis for research whose outline shows this articulation between literature and mathematics for meaningful and deep learning, as discussed in this article. Reading on the screen is navigating, going from one point of the text to another, in a hypertextual way. In general, it is different

from the linear reading of printed text, read top to bottom, left to right in Western culture.

The connection between mathematics and literature must be established from kindergarten to the final grades of high school. Because, in this phase, not only orality and writing are developed, but also the imaginary, analysis and argumentation. The interdisciplinary work between mathematics and literature can enable the development of these skills, helping in reading, interpreting data, solving problems and also in organizing logical-mathematical thinking. Languages permeate written texts, and the image has great weight in current communication. Image reading has a different logic than verbal text reading. The amount of images that circulate on the Internet increases every day and is further facilitated by smartphone capture, editing and instantaneous distribution to accessories connected to it.

BNCC emphasizes the importance of literature in training readers with openness to dialogue with other areas of knowledge. Therefore, it is essential that there is dialogue between areas for a greater integration of literature with mathematics; because students are often resistant to mathematics due to the traditional way in which the topics studied are proposed. Literature can revolutionize the teaching of mathematics, become an integral part of the student's social practices. Reading and writing are two sides of the same coin. Write well who reads and interprets well. However, reading today goes beyond verbal language, as shown earlier in this article.

Finally, in terms of general competences, the BNCC for Elementary Education has two points that deserve to be highlighted and reinforce the positions we defend here:

> 4. Using different languages – verbal (oral or visual-motor, such as Libras, and writing), corporal, visual, sound and digital –, as well as knowledge of artistic, mathematical and scientific languages, to express oneself and share information, experiences, ideas and feelings in different contexts and produce meanings that lead to mutual understanding.
>
> 5. Understand, use and create digital information and communication technologies in a critical, meaningful, reflective and ethical way in the various social practices (including school ones) to communicate, access and disseminate information, produce knowledge, solve problems and exercise protagonism and authorship in personal and collective life (BRAZIL, 2017, p. 9).

By showing mathematics as a language, we ratify the general competence 4 of the BNCC. The expression and sharing of information, experiences, ideas and feelings become part of the subject's life, learning in childhood. It is in her that the values and attitudes that determine her life are transmitted, for good or for bad, without neglecting the participation of the family as the first school, with all the arrangements that a family can have today.

When dealing with digital book and digital literary library, we confirm the conformity of the research with competence 5 of the same BNCC. Digital information and communication technologies (TDIC) already enable creative and meaningful practices in languages, however, they demand from teachers new literacies in multisemiotic resources, with which the majority did not even have contact in academic training. For about 30 years, this issue has been discussed in Brazil and has been the object of study in many academic studies.

In the world of TDIC, the teacher becomes the curator of relevant teaching materials to approach new themes, analyze and deepen the student's critical view and awaken their imagination. Interactivity, which goes beyond dialogue, is a concept that best translates teaching activity today (SILVA, 2020). According to this author, the concept comes from the theory of communication

and assumes that the teacher articulates the construction of knowledge, sharing, in co-authorship with the student. In this case, there must be a sender and a receiver for interactivity to occur. The teacher speaks as an equal, takes care of the didactic design and articulates all of this in the architecture of the canvas. This way, the teacher becomes a knowledge manager.

Despite this, the global Covid-19 pandemic showed the effort and determination of Brazilian teachers in the use of DICT. The creative work of these professionals saved the school institution, despite the return of old practices in the return to face-to-face teaching. However, the seed has already germinated.

Thus, literature could be a challenging and playful way for children to think about mathematical notions (SMOLE et al., 1996) and also complement the didactic material in classes (BRAZIL, 2017).

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