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Teaching and learning Probability through Children's Literature: a possibility Elementary School

Sandra Gonçalves Vilas Bôas
Universidade de Uberaba
Uberlândia, MG — Brasil
✉ sandraavilasboas@yahoo.com.br
0000-0002-2162-4635

Josimara Almeida Domingues Gomes
Universidade Estadual de Montes Claros
Mato Verde, MG — Brasil
✉ josimara6332@gmail.com
0009-0008-9859-9694

2238-0345

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Abstract: The research on which this article is based was developed within the Graduate Program in Professional Education at the University of Uberaba. The methodology used was qualitative research with a bibliographic study on the teaching of Probability and Children's Literature. The general objective was to analyze the possibilities of intertwining Children's Literature and the teaching of Probability through the book *The Diary of the Tyrannosaurus Rex*, an educational product of the Master's thesis. The plot explores the daily life of the dinosaur world by integrating concepts, such as possible, impossible, probable, and improbable events that flow in our daily lives. By exploring the teaching of Probability through Children's Literature, we present a strategy to help students gradually develop different ways of thinking about Mathematics. Therefore, when calculations become increasingly complex, it is believed that understanding Probability concepts will be easier since they were introduced to them in a playful manner.

Keywords: Mathematics. Probability. Children's Literature. BNCC. Elementary School.

Enseñar y aprender Probabilidad a través de la Literatura Infantil: una posibilidad en la Educación Primaria

Resumen: La investigación, en la cual se basa este artículo, fue desarrollada dentro del programa de Posgrado en Educación Profesional de la Universidad de Uberaba. La metodología utilizada fue investigación cualitativa con estudio bibliográfico sobre la enseñanza de Probabilidad y Literatura Infantil. El objetivo general fue analizar las posibilidades de entrelazar la Literatura Infantil y la enseñanza de Probabilidad a través del libro *El diario del Tiranosaurio Rex*, producto educativo de la disertación. La trama explora la rutina del mundo de los dinosaurios, integrando conceptos, como eventos posibles, imposibles, probables e improbables que ocurren en nuestro día a día. Al explorar la enseñanza de la Probabilidad a través de la Literatura Infantil, presentamos una estrategia para ayudar a los estudiantes a desarrollar gradualmente diferentes formas de pensar en Matemáticas. Por lo tanto, cuando se presenten cálculos que se vuelvan cada vez más complejos, se cree que la comprensión de los conceptos de Probabilidad será más fácil, dado que fueron introducidos a ellos de manera lúdica.

Palabras clave: Matemáticas. Probabilidad. Literatura Infantil. BNCC. Educación Primaria.

Ensinar e aprender Probabilidade por meio da Literatura Infantil: uma possibilidade nos Anos Iniciais do Ensino Fundamental

Resumo: A pesquisa em que este artigo se ancora foi desenvolvida junto ao programa de Pós-

Graduação em Educação Profissional da Universidade de Uberaba. A metodologia utilizada foi pesquisa qualitativa com estudo bibliográfico sobre ensino de Probabilidade e Literatura Infantil. O objetivo geral foi analisar as possibilidades de entrelaçamento da Literatura Infantil e o ensino de Probabilidade, por meio do livro *O Diário do Tiranossauro Rex*, produto educacional da dissertação. O enredo explora a rotina do mundo dos dinossauros, integrando os conceitos como eventos possíveis, impossíveis, prováveis e improváveis que fluem em nosso cotidiano. Ao explorar o ensino da Probabilidade por meio da Literatura Infantil apresentamos uma estratégia para ajudar os alunos a construírem gradativamente maneiras diferentes de pensar a Matemática. Portanto, quando os cálculos forem apresentados e ficarem cada vez mais complexos, acredita-se que a compreensão dos conceitos de Probabilidade seja mais fácil, uma vez que foram introduzidos de maneira lúdica.

Palavras-chave: Matemática. Probabilidade. Literatura Infantil. BNCC. Anos Iniciais.

1 Introduction

This article[1] is organized into five sections: in the Introduction, we outline the research structure. The second section focuses on the theoretical frameworks that served as the basis for this study. Then, initially, we direct our attention to the teaching of Probability in Elementary School. Next, it is followed by a discussion on Children's Literature intertwined with Mathematics teaching. The third section comprises the methodological aspects. Moving on to the fourth section, we present the results, that is, the educational product, *The Diary of the Tyrannosaurus Rex*. In the fifth section, we analyze the intersection of probabilistic concepts with the story. Finally, we conclude by recording our considerations on what we achieved in this research, as well as in our studies, outlining the importance and the contributions of this work in light of ongoing concerns and proposals for a teaching process that makes sense to students and offers alternatives for teaching Probability in the Elementary School.

In the family environment, children learn to verbalize small counts, and solve elementary addition and subtraction problems related to meaningful situations: during play in which they need to know how much they gained and lost, or in a specific game in which they are encouraged to make numerical or symbolic records. Hence, from childhood, we bring into the movement of the concept the subjectivity of our experiences, sensations, and perceptions.

> By giving language to the concept, it is provided content and language to the experience of enumerating, measuring, and calculating, thereby developing a unique way of thinking and language to view the world. Under the guidance of educators, this process tends to align, through its own learning movements, with that of science. (Moura, 2003, p. 5).

Probability is also present in the world of children in various ways, such as playing odd or even, games with chips and dice, or flipping coins, examples that appear in children's daily lives. Teaching and learning these ideas in the child's world aim to enable children to observe uncertain situations. Thus, probability is also present in schools; for example, teachers can work on the idea of randomness by drawing the helper of the day or randomly selecting who starts a game.

Taking these issues into account, Vilas Bôas and Miranda (2021, p. 3) emphasize that "it is necessary for every citizen to have a good understanding of the laws of Probability

[1] This article is an excerpt from the Master's thesis defended in the Graduate Program in Education: Teacher Training for Basic Education, at the University of Uberaba, Uberlândia-MG *campus*. It was written by the second author and supervised by the first author. The Master's thesis is available at: http://dspace.uniube.br:8080/jspui/handle/123456789/2469.

because, at every moment, we are making choices". The authors further highlight that we all have "a vague intuition about some situations of random nature, which are present in various moments of our daily lives, that is, making assessments that translate into many situations of uncertainty or chances of events occurring" (Vilas Bôas & Miranda, 2021, p. 3).

In this context, recent Mathematics curricular proposals worldwide emphasize special attention to the subject, which underscores that its study is essential for individuals to understand that not all phenomena are deterministic, as well as that there can be certain events, impossible events, and probable events.

The researchers Conti and Vilas Bôas (2019, p. 397) indicate that approaching the teaching of Probability in the Elementary School from this perspective "requires thinking about a learning context that places children in an environment of mathematical, statistical, and probabilistic activity, allowing them not only to encode and decode mathematical symbols but also to make various interpretations of the world, raise conjectures and validate them, analyze data, and argue".

Just like Probability, Literature is present in our daily lives, in storytelling circles and in bedtime readings, for example. It occupies different virtual environments, library shelves, and bookstores. With this in mind, and aiming to bring the aforementioned into the teaching of Probability, this research proposed to unite Literature and the teaching of Probability as a new suggestion for teaching and learning. This is because working with Children's Literature constitutes an "open, current pedagogical practice that allows the child to experience a non-passive relation between written and spoken language. Literature appears to the child as a manifestation of feelings and knowledge that allows them to invent, renew, and disagree". (Smole, 1996, p. 02).

Believing in the possibility of intertwining the Mathematics curriculum with Children's Literature, we delimited, as the object of study, the *Thematic Unit Probability and Statistics and Children's Literature*. Hence, we outlined the research question: What are the possibilities of intertwining Children's Literature and the teaching of Probability in the teaching and learning process of children attending the Initial Years of Elementary Education?.

In order to address the problem statement of this research, we have chosen the following general objective: to analyze the possibilities of intertwining Children's Literature and the teaching of Probability through a children's book designed for the Initial Years of Elementary Education.

In order to achieve the general objective, we have listed the following specific objectives: to understand the skills and competencies related to the teaching of Mathematics, specifically Probability and Children's Literature, as prescribed in the National Common Curricular Base *(Base Nacional Comum Curricular — BNCC)* (Brazil, 2017); to develop an educational product based on the conducted studies aiming to provide an additional possibility for organizing the teaching of Probability in the Initial Years of Elementary Education.

Once the research context has been presented, we bring forward the theoretical frameworks that have assisted us in constructing the educational product, emphasizing that we have always kept in mind the pressing need to contribute to an environment where children begin to develop probabilistic thinking intertwined with everyday situations.

2 Theoretical framework

The bibliographical study situated the research within the process of knowledge production about Children's Literature and Probability. It helped us to address some questions

raised by Flick (2009, p. 65): what are the traditions, alternatives, and methodological discussions? Are there contradictory paths in the use of methods? Which method could be adopted as a starting point?

Once the literature review and the bibliographical survey of Doctoral dissertations and Master's theses have been conducted, we present in this article a synthesis of excerpts from the references found.

2.1 Children's Literature and its interweaving with the teaching of Mathematics in Elementary School

We begin these reflections by looking at the whirlwind of emotions that a story can provoke in human beings, especially in children. In this regard, we agree with Abramovich (1997, p. 23), who tells us that "reading stories to children allows us to smile, laugh, and burst out laughing at the situations experienced by the characters, at the idea of the tale itself, or at the author's writing style, and, thus, be a part of this moment of humor, playfulness, and enjoyment". We also believe that through stories, one can discover other places, other times, different ways of acting and being, another ethics, another perspective.

In this perspective, we understand that "Children's Literature provides children with a communication channel for their fantasies, feelings, curiosities, sensations, and anxieties, establishing a connection between the child and the story" (Silva, 2022, p. 31). Therefore, we envision that children's stories can be used in teaching with students, and, through them, it is possible to provoke questions throughout the reading, such as: What comes next? How will it end? What are the differences and similarities between this page and the previous one? At the same time as they engage with the story, literature "can be used as a stimulus for listening, reading, thinking, and writing about Mathematics" (Smole & Cândido,1995, p. 22).

In this way, Literature as a practice of reading and writing can help students build a concrete and practical connection to the symbolic language notions of Mathematics, such as organizing, exploring, connecting thoughts, knowledge, and different interpretations from various perspectives. Therefore, activities involving children's storybooks can provide students with simple Mathematics problems whose answers students will see depend on important data contained in the stories they are reading.

When analyzing the advantages of the connection between Literature and Mathematics, Passos, Oliveira, and Gama (2007) underline that this methodology is a

> a new way of approaching the theme of an integrated area of knowledge with a story. This approach to content shifts teaching practice from the act of delivering points and teaching a pre-formulated set of rules to an approach characterized by questioning, narrative conflict leading to reflection, and a focus on discovering Mathematics rather than teaching the Mathematics one already knows. (p. 3).

Given students' inherent ability to interpret and understand stories, the teacher, as one of the mediators in the teaching and learning process, can relate Children's Literature to Mathematics in order to develop new notions about the subject. By promoting this integration, it opens up the possibility of "developing reading comprehension skills and problem-solving strategies, simultaneously fostering language and Mathematics" (Santos, 2021, p. 36). Thus, Literature can be used as a stimulus for listening, reading, thinking, and writing about Mathematics.

Smole (2000) states that establishing connections with Mathematics implies:

> Relating mathematical ideas to reality, making its participation, presence, and utilization in various fields of human activity clear and explicit, thereby valuing the social and cultural use of Mathematics; Connecting mathematical ideas with other subjects or themes from other subjects; Recognizing the relation between different topics in Mathematics by relating various representations of concepts or procedures to each other; Exploring problems and describing results by using models or graphical, numerical, physical, and verbal representations. (pp. 68-69).

In this sense, the teacher can create situations that help students understand and familiarize themselves with mathematical language, real-life concepts, and formal language. An interesting approach is to stimulate and encourage children to explore and formulate problems to be solved by themselves and their peers. When questions come from the children themselves, we find possibilities, encouragement, and autonomy to critically discuss the text and discover various problem-solving strategies, feeling responsible for finding the solution. Hence, we highlight:

> History contributes to students learning and doing Mathematics, as they explore places, characteristics, and events in history. This allows mathematical and language skills to develop together as students read, write, and discuss mathematical ideas that emerge throughout their reading. (Smole & Cândido, 1995, p. 12).

The BNCC (Brazil, 2017) clarifies precisely that the student follows a path of learning development in Mathematics. In this case, such learning "is linked to understanding, that is, grasping the meaning; grasping the meaning of an object or event presupposes seeing it in its relations with other objects and events". The connection between Literature and Mathematics is fruitful not only for familiarizing students with mathematical vocabulary but also for broadening various levels of language and providing children with a moment to learn new knowledge or apply concepts already learned.

Regarding this connection, the National Pact for Literacy at the Right Age emphasizes:

> It is possible to teach Mathematics and textual interpretation simultaneously through the use of playful strategies. It can happen in situations that require knowledge related to quantities and measurements or in identifying data in tables or texts to solve problems. On the other hand, when constructing a mathematical story, for example, the child uses mathematical content by employing resources inherent to language to understand the operation and express its result. (Brazil, 2014, pp. 8-9).

According to Smole (1996), we acknowledge that if a Children's Literature material used in Mathematics classes meets the developmental needs of the child, the problem situations presented to them while manipulating this material generate interest and a sense of challenge in seeking different solutions to the problems posed. "By using children's books, teachers can provoke mathematical thinking through questioning throughout the reading, while the child engages with the story. (Smole, 1996, p. 72).

In this sense, the connection with Literature can facilitate the acquisition of mathematical knowledge, which allows students to experience the imaginary world and understand probability concepts used in the real world. Literature and Mathematics are present in our daily lives in various ways through the abundance of information to which we have access.

Having discussed one of the theoretical frameworks, we reflect sequentially on the teaching of Probability in the Brazilian curricular guiding documents, such as the National

Curriculum Guidelines and the BNCC, as well as on the insights from researchers who study the teaching of Probability.

2.2 The teaching of Probability in the Elementary School

"The idea of chance and indeterminism, once foreign to human thought, gradually received mathematical treatments aimed at constructing plausible explanations for facts, phenomena, and experiments that fall within the realm of randomness, which are presented to us or experienced" (Conti & Vilas Bôas, 2019, p. 378).

Our understanding of the probability of uncertain outcomes plays an extremely important role in our lives. We depend on it, for example, "to decide on the medical treatment we should follow, the insurance we need, the car we buy, and the precautions we must take to protect our families and our homes" (Bryant & Nunes, 2012, p. 10). All these, and many other decisions, depend on our knowledge of possible events that can occur and our understanding of how likely these different events are.

Despite the central importance of randomness and probability in our lives, children — and adults as well — often struggle greatly with thinking rationally about quantifying probability. "In everyday life, 'likely' is one of many words used to describe uncertainty, and it can be replaced by others, such as luck, risk, doubtful, uncertainty, words that heavily depend on the context" (Vilas Bôas & Miranda, 2021, p. 4).

The word *probability* derives from the Latin *probare*, and its concept is quite complex. According to Bryant and Nunes (2012, p. 3), to learn about it, "we have to rely on understanding four different aspects of events and the sequence in which they occur. They are: understanding randomness [addressed in the book], knowing how to determine the sample space, comparing and quantifying probabilities, and understanding and/or reasoning about the correlation between events". The authors clarify this process:

> The first step is to recognize that the problem deals with outcomes that are uncertain because there is a random element in the frequency of its occurrence. The second step is to determine the sample space. In a probability problem, the occurrence of a particular event is uncertain because there are other possible events, and the probability of each event depends on what those alternatives are. Analyzing the sample space resolves this part of the problem. The third step is to calculate probabilities, which involves a proportional analysis of the sample space. The fourth step, which is not always necessary, is to look for associations between variables in the sample space. (Bryant & Nunes, 2012, p. 12).

Regarding Randomness, it is important to promote the understanding that chance is present in various everyday situations. In this sense, it is crucial to comprehend the difference between random and deterministic phenomena as a way to facilitate the classification of random events. Often, a common mistake made by adults and children alike is to overlook the independence of successive events in a random situation. For instance, they may incorrectly assume that after a sequence of one type of outcome, a different outcome is more likely next time, or that the same outcome is more likely to recur. In order to illustrate this type of error, considering a situation involving the flipping of a coin: - After flipping a coin and getting three heads in a row, they believe that the next flip is much more likely to result in tails than heads. This is a mistake, as heads and tails are equally likely on the next flip, regardless of what happened in previous flips.

Fischbein (1975) recommends starting the teaching of Probability when children are young, specifically in the early years of schooling. In the same vein, the National Common

Curricular Base (Brazil, 2017) included the teaching of Probability for the Initial Years of Elementary Education, a topic previously almost exclusively addressed in Secondary Education. Fischbein (1975) also asserts that children can develop correct intuitions about Probability through its teaching, and waiting until adolescence may be too late to educate intuition in Probability.

In order to ensure that the study of Probability is present in Basic Education, the NCCB (Brazil, 2017), within the Mathematics curriculum component, proposes the Thematic Unit Probability and Statistics, which defines the knowledge objects and skills presented in Table 1.

Table 1 - Correlation / Object of knowledge and Skill

Thematic unit / Probability and Statistics	
Object of knowledge	Skill
1st year	
Notion of chance.	(EF01MA20) Classifying events involving chance as "will definitely happen", "might happen", and "is impossible to happen", in everyday situations.
2nd year	
Analysis of the idea of randomness in everyday situations.	(EF02MA21) Classifying outcomes of everyday random events as "unlikely", "very likely", "improbable", and "impossible".
3rd YEAR	
Analysis of the idea of chance in everyday situations: sample space.	(EF03MA25) Identifying all possible outcomes in random everyday events, estimating those with higher or lower chances of occurrence.
4th year	
Analysis of the chances of random events.	(EF04MA26) Identifying, among everyday random events, those with the highest chance of occurring, recognizing characteristics of more probable outcomes without using fractions.
5th year	
Sample space: analysis of the chances of random events.	(EF05MA22) Presenting all possible outcomes of a random experiment, estimating whether these outcomes are equally likely or not.
Calculation of probability of equiprobable events.	(EF05MA23) Determining the probability of occurrence of an outcome in random events when all possible outcomes have the same chance of occurring (equiprobable).

Source: Conti & Vilas Bôas (2019, pp. 386-387)

In Table 1, we observe how important it is to gradually develop, with children, the idea of more or less chance, of sample space, as well as schemes for mapping possibilities. According to Batanero (2005), the teaching of Probability should aim to develop the probabilistic reasoning necessary to confront chance in everyday life and improve students' intuition. In agreement with the author, we emphasize that the context and probabilistic simulations are crucial in reasoning, as they imply meaning and consistency for conclusions.

Castilho *et al*. (2021, p. 110) assert that "the first contact with notions of chance being structured by a methodology that takes into account students' prior knowledge and the context in which they are embedded, can contribute to the satisfactory development of the student in

learning Probability". Furthermore, such learning can "prepare students for reality, as analyzing various situations involving uncertainty promotes the development of critical thinking" (Souza, Lopes, & Oliveira, 2013, p. 76). For this purpose, the Thematic Unit Probability and Statistics suggests approaching concepts, facts, and procedures present in everyday problem situations, focusing on developing the notion of randomness. This helps students understand that there are certain events, impossible events, and probable events.

Thus, the discussion of the notions of certainty, probable, and impossible can be conducted through experiments, such as games (roulette), playful activities (like odd or even), coin flips (heads or tails), dice rolls, draws (colored balls, cards), and simulation problems. These situations are related to the idea of whether an event will occur as expected or not. The examples illustrate "an outcome that is not CERTAIN, and, to have a certain degree of confidence in these outcomes, one must know past facts and events or understand the functioning of the phenomenon's structure" (Vilas Bôas & Miranda, 2021, p. 2).

The studies conducted during the research have allowed us to understand that teaching Probability is not an easy task, primarily because it is not sufficient to merely present different models and demonstrate their applications. It has also enabled us to identify the need for an educational tool that assists teachers in their teaching practice during Mathematics classes.

Furthermore, we observe that the BNCC (Brazil, 2017), in presenting Probability and Statistics as one of its five thematic areas, does not provide teachers with guidance on the teaching possibilities of this theme to develop the knowledge objects described year by year, or how to provide spaces for building the expected skills in the document.

3 Methods

The methodology of this research is qualitative. It is guided by Minayo (2014), who teaches us that qualitative research concerns itself with aspects of reality that cannot be quantified. It works with the universe of meanings, motivations, aspirations, beliefs, values, and attitudes.

Sousa, Oliveira, and Alves (2021) guide us on the stages of a bibliographic research. We emphasize that for our studies, we followed the authors' guidelines, which were based on Gil (2002) and Lakatos and Marconi (2003): 1) choice of topic; 2) bibliographic survey; 3) problem; 4) deepening and expanding the bibliographic survey; 5) text selection; 6) sourcing (primary, tertiary, and secondary sources); 7) note-taking; 8) analysis and interpretation.

These stages were fundamental throughout the research, and their sequence "will influence all stages of a research, providing the theoretical foundation on which the work will be based" (Amaral, 2007, p. 1). In this direction, we emphasize that the study allowed us to deepen our understanding of the research topic, providing us with the necessary foundations. Our studies were also based on the authors presented in Table 2.

We considered it essential to investigate studies that encompassed the two theoretical axes of our research: Children's Literature and the Teaching of Probability in the Elementary School. To do so, we chose the portal of the Brazilian Digital Library of Theses and Dissertations. In the *advanced search* option, we highlighted the keywords: Children's Literature, Probability, and Initial Years of Elementary Education, in the title and in the text, published from 2016 to 2022. For the selection and analysis of the research, we delimited the following categories: type of research, methodologies, objectives, and achieved results. Table 2 presents the studies we found.

Table 2: Bibliographical survey: Doctoral dissertations and Master's theses (from 2016 to 2022)

Keywords	Title and year	Institution and author	Link
Probability Early Years	Educational digital games: a possibility for teaching and learning Probability in the Elementary School (2020)	University of Uberaba Janete Fonseca Miranda	https://repositorio.uniube.br/handle/123456789/1424
Children's Literature, Probability	Diving into the universe of uncertainties: Children's Literature and Probability in the Elementary School (2021)	Federal University of Pernambuco Emilly Rayane Moura Diniz Santos	https://repositorio.ufpe.br/handle/123456789/40936
Probability, Elementary School	The journey of constructing a pedagogical game as a tool for teaching Probability in the Elementary School (2019)	Federal University of ABC Nilceia Datori Barbosa	http://repositorio.utfpr.edu.br/jspui/handle/1/1873
Probability in Elementary School	Virtual learning environment for teaching Probability and Statistics in the Elementary School (2016)	Federal Technological University of Paraná Cristiane de Fátima Budek Dias	http://repositorio.utfpr.edu.br/jspui/handle/1/1873

Source: Gomes (2022, p. 30).

The analyzed studies indicate the importance of using various teaching resources in Probability education during in Elementary School. Given the limited number of studies found, we recognize the need for research focusing on the teaching and learning process aimed at imparting Probability concepts in a playful manner. It can involve games, manipulative materials, software, and Children's Literature books that develop new approaches to teaching Probability.

"Research does not start from ground zero today. [...], somewhere research similar or complementary to certain aspects of the intended research must have already been conducted." (Marconi & Lakatos, 2014, p. 114). Hence, research reflects a way of thinking of those who produce it; therefore, they are not right or wrong, good or bad, but different and even divergent, because they are developed from different theoretical assumptions. (Köche, 2005). In this sense, it was important for our study to conduct this review. This process of investigation allowed for a deeper exploration of our study's inquiry.

Once the theoretical studies were conducted and there was an understanding of the potential of Children's Literature, the knowledge objects, skills, and competencies of the Thematic Unit Probability and Statistics, it was time to intertwine these two elements, which was achieved through the educational product. Hence, we created the Children's Literature book titled *The Diary of the Tyrannosaurus Rex*.

It is in the analysis of the data that we highlight the intertwining presented in the story, crossing the dialogues of the baby Tyrannosaurus Rex and the other characters with the Knowledge Objects of the Thematic Unit Probability and Statistics, which leads us to answer the Research question.

4 The educational product: *The Diary of the Tyrannosaurus Rex*[2]

Considering textual genres as a natural form through which we use language to communicate, we have chosen, to characterize this research, the fable — a genre found in many cultures throughout history. The fable is a short narrative "featuring irrational animals whose

[2] The book is available at: http://dspace.uniube.br:8080/jspui/handle/123456789/2474.

behavior, while preserving their own characteristics, typically conveys a satirical or pedagogical allusion to human beings" (Moisés, 2004, p. 184).

The educational product titled *The Diary of the Tyrannosaurus Rex* presents a pedagogical resource based on Children's Literature aimed at guiding children in Elementary School and teachers who teach Mathematics in this segment to the concept of knowledge object and skills in the Thematic Unit of Probability and Statistics, with a focus on probability.

4.1 Story synopsis

The story aims to present the knowledge objects and skills of the Thematic Unit Probability and Statistics by depicting the daily life of Baby Tyrannosaurus Rex in a way that supports a teaching approach to probabilistic understandings relevant to the childhood context. It is not solely focused on calculation procedures. It is light-hearted, and addresses essential concepts in the construction of mathematical understanding.

The Tyrannosaurus Rex was the most terrifying dinosaur of all time because its prey was easily dominated. It became famous due to its size and frightening profile. The Tyrannosaurus Rex is featured in many adventure films and Literature, enchanting audiences of all ages, especially children.

The story's plot highlights eight species of dinosaurs, including herbivores and carnivores. It details the saga of the apprentice dinosaur's first hunt, with its indecisions and still-developing abilities. It emphasizes values experienced by the baby dinosaur, such as optimism, courage, persistence, and determination in pursuit of its goals, regardless of obstacles along the way.

The Baby Dinosaur is the central character of this story. It is a baby Tyrannosaurus Rex that was left in the nest, still in the egg, while its mother goes off to do something. Described as strong and courageous, it hatches from the egg by itself and fearlessly sets off in search of its mother. While searching for its mother in the forest, it encounters several species of dinosaurs, such as the herbivorous Iguanodon, the Stegosaurus, the Diplodocus, the Apatosaurus, the Ankylosaurus, the Edmontonia, and the Hypsilophodon. These dinosaurs lived in different periods of history, but are presented here together to illustrate the existing diversity and their unique characteristics through simple and informative dialogues.

Upon encountering Mother Tyrannosaurus Rex, the Baby begins a new phase, hunting for food autonomously and independently. Mother T-Rex provides various tips on how to proceed in the hunt by carefully observing the prey. Thus, by the end of the day, after many failed attempts, the young dinosaur manages to capture its first meal, solidifying its confidence in the fearsome and terrifying Tyrannosaurus Rex species.

Throughout the narrative, the knowledge objects of the Unit in question are explored in the routine of the Baby Dinosaur. All of them, pertinent to the child's context, break away from approaches focused solely on calculation procedures, as we emphasize: notion of chance, analysis of the idea of randomness, analysis of the chances of a random event, and calculation of probability in equiprobable events. "The moments experienced by Baby Dinosaur bring situations involving the idea of randomness: will definitely happen, may happen, will never happen, unlikely, very likely, improbable, and impossible" (Gomes, 2022, p. 52).

5 Data analysis: the intertwining

In this section, we present excerpts from the story that illustrate the possibilities of intertwining Children's Literature and the teaching of Probability in the Elementary School. It is done by highlighting the concepts of chance and the ideas of randomness that appear in the

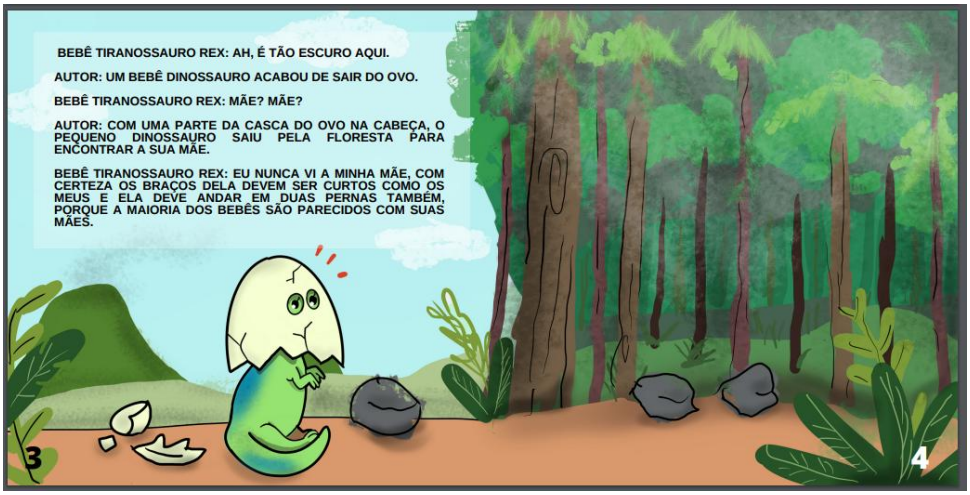
story and, consequently, in the dialogue of the baby Tyrannosaurus Rex with the other dinosaur characters in the story.

We reaffirm that experiences with reading in Mathematics classes, including stories, poems, and other texts, as stated by Ciríaco and Santos (2020, p. 77), "provide contexts that offer multiple possibilities for exploration and development of strategies to resolve the issues presented to enhance learning from the perspective of oral language, written language, and mathematical language".

We begin this analysis by addressing events involving chance as *will definitely happen*, *may happen*, and *will never happen* (Figure 1).

> *Baby Tyrannosaurus Rex:* I have never seen my mom. *Surely* her arms must be short like mine, and she must walk on 2 legs too, because most babies are similar to their moms.

Figure 1: *Surely* mom's arms must be short like mine[3]



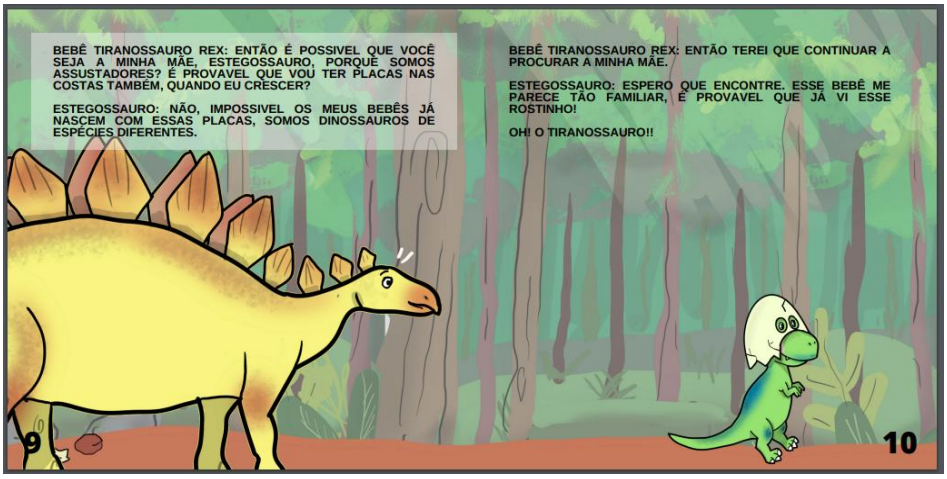
Source: Gomes (2022, p. 54).

Analysis of the idea of randomness in everyday situations such as: *unlikely*, *very likely*, *improbable*, and *impossible* (Figure 2):

> *Baby Tyrannosaurus Rex:* So, is it *possible* that you are my mother, Stegosaurus, because we are scary? Is it *likely* that I will have plates on my back too when I grow up?
>
> *Stegosaurus:* No, *impossible*! My babies are born with those plates already. We are dinosaurs of different species.

[3] Translation: The text in the image can be translated as: *Baby Tyrannosaurus Rex: Ah, it is so dark here. / Author: A baby dinosaur just hatched from the egg. / Baby Tyrannosaurus Rex: Mom? Mom? / Author: With part of the egg shell on its head, the little dinosaur went into the forest to find its mother. / Baby Tyrannosaurus Rex: I have never seen my mom. Surely her arms must be short like mine, and she must walk on 2 legs too, because most babies are similar to their moms.*

Figure 2: It is *possible*? Is it *likely*?[4]

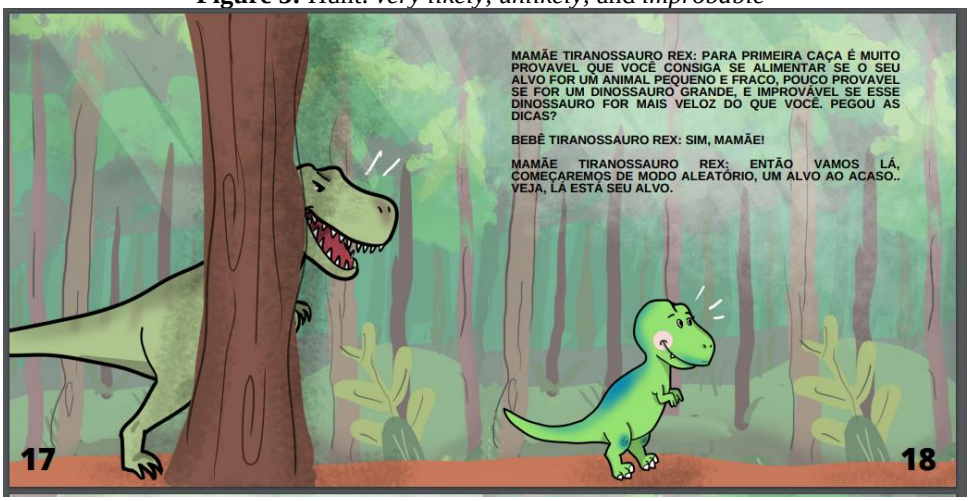


Source: Gomes (2022, p. 55)

Analysis of the idea of chance in everyday situations: sample space, such as random family events, all possible outcomes, estimating those with greater or lesser chances of occurrence (Figure 3).

> *Mom Tyrannosaurus Rex:* For your first hunt, it is *very likely* that you will be able to feed if your target is a small and weak animal, *unlikely* if it is a large dinosaur, and *improbable* if that dinosaur is faster than you. Got it?
>
> *Baby Tyrannosaurus Rex*: Yes, mom.
>
> *Mom Tyrannosaurus Rex*: Alright then, let's go. We will start *randomly*, targeting something *at random*. Look, there is your target.

Figure 3: Hunt: *very likely*, *unlikely*, and *improbable*[5]



Source: Gomes (2022, p. 55)

[4] Translation: The text in the image can be translated as: *Baby Tyrannosaurus Rex: So, is it possible that you are my mother, Stegosaurus, because we are scary? Is it likely that I will have plates on my back too when I grow up? / Stegosaurus: No, impossible! My babies are born with those plates already. We are dinosaurs of different species. / Baby Tyrannosaurus Rex: So, I will have to keep looking for my mom. / Stegosaurus: I hope you find her. This baby looks so familiar to me, I probably have seen that face before! Oh! The Tyrannosaurus!!.*

[5] Translation: The text in the image can be translated as: *Mom Tyrannosaurus Rex: For your first hunt, it is very likely that you will be able to feed if your target is a small and weak animal, unlikely if it is a large dinosaur, and improbable if that dinosaur is faster than you. Got it? / Baby Tyrannosaurus Rex: Yes, mom. / Mom Tyrannosaurus Rex: Alright then, let's go. We will start randomly, targeting something at random. Look, there is your target.*

Analysis of everyday random events with higher chance of occurrence, recognizing characteristics of more probable outcomes without using fractions (Figure 4).

> *Baby Tyrannosaurus Rex:* Come to think of it, I am not so sure anymore. Is it *possible* or *impossible*? I do not want to be trampled by those huge feet or attacked by that long tail. Let's move on. I will hunt something else that is *possible* for me, compatible with my skills and size.

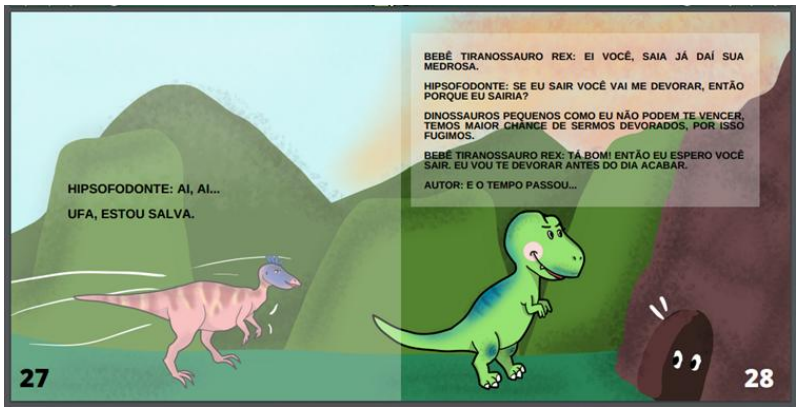
Figure 4: Attacking the Apatosaurus: *possible* or *impossible*?[6]

Source: Gomes (2022, p. 56)

Verification of the sample space by analyzing all possible outcomes of a random experiment and whether these outcomes are equally likely or not (Figure 5).

> *Hypsilophodon:* If I go out, you will devour me, so why would I go out? Small dinosaurs like me, a Hypsilophodon, cannot defeat Tyrannosaurs! We have a *greater chance* of being eaten, that is why we run away.

Figure 5: What is the way to have *higher chance*?[7]



Source: Gomes (2022, p. 56)

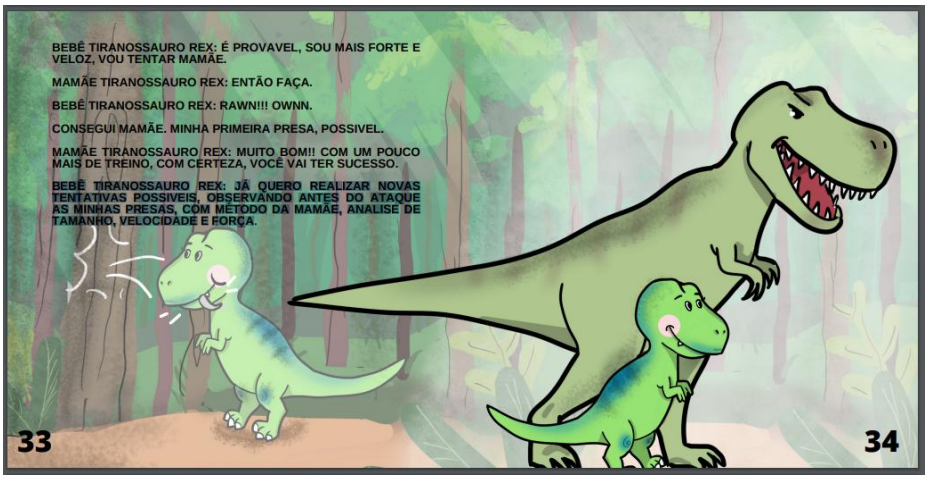
[6] Translation: The text in the image can be translated as: *Baby Tyrannosaurus Rex: Hmm, hmm, this dinosaur is bigger than me. Can I catch it? Of course I can, definitely. I am strong and feared like mom. It will be my first meal! Rawr! / Dinosaur: What? Do you want to devour me? I am an Apatosaurus, impossible!!! My body is enormous! I am an herbivore and I travel in herds, see! You cannot hunt me! / Baby Tyrannosaurus Rex: Come to think of it, I am not so sure anymore. Is it possible or impossible? I do not want to be trampled by those huge feet or attacked by that long tail. Let's move on. I will hunt something else that is possible for me, compatible with my skills and size. / Mom Tyrannosaurus Rex: That is it, focus.*

[7] Translation: The text in the image can be translated as: *Hypsilophodon: Oh, oh...phew, I am saved. / Baby Tyrannosaurus Rex: Hey, you, come out of there, you scaredy-cat. / Hypsilophodon: If I go out, you will devour me, so why would I go out? Small dinosaurs like me, a Hypsilophodon, cannot defeat Tyrannosaurs! We have a greater chance of being eaten, that is why we run away. / Baby Tyrannosaurus Rex: All right! Then, I wait for you to go out. I will devour you before the day is over. / Author: And time passed...*

Execution of the calculation of probability of equiprobable events, in which all possible outcomes have the same chance of occurring (Figure 6):

> *Baby Tyrannosaurus Rex:* I already want to make new possible attempts by observing my prey before the attack, using mom's method: analyzing size, speed, and strength.

Figure 6: New *possible* attempts[8]



Source: Gomes (2022, p. 57)

As demonstrated above, throughout the story, situations involving the notion of chance became evident. For better visualization, we organized the frequency of each event as follows: Definitely (07); Possible (05); Likely (08); Impossible (07); Unlikely (01); Very likely (01); Improbable (02).

Thus, the story enables the development of skills proposed in the BNCC (Brazil, 2017):

> Classifying chance events as "will definitely happen", "might happen", and "impossible to happen" in everyday situations; Classifying results of random everyday events as "unlikely", "very likely", "improbable", and "impossible"; Identifying all possible outcomes in familiar random events, estimating those with higher or lower chances of occurring; Identifying, among everyday random events, those with the highest chance of occurring, recognizing characteristics of more probable outcomes without using fractions; Presenting all possible outcomes of a random experiment, estimating whether these outcomes are equally likely or not; Determining the probability of a result occurring in random events in which all possible outcomes have an equal chance of occurring (equiprobable). (p. 287).

Therefore, we believe that, through the intertwining of Children's Literature with Mathematics, children can grasp the concepts of chance, randomness, and sample space in situations depicted in the story's plot. The educational product proposed here aligns with the recommendations of the researchers Conti and Vilas Bôas (2022, p. 4), who state that "Focusing Mathematics education solely on calculations does not enable students to interpret events that surround us, such as everyday probabilistic events".

It is acceptable to conclude that this is a process that encompasses some crucial

[8] Translation: The text in the image can be translated as: *Baby Tyrannosaurus Rex: It is likely, I am stronger and faster, I will try, mom. / Mom Tyrannosaurus Rex: Then go ahead. / Baby Tyrannosaurus Rex: Rawr!!! Ownn. Got it! I did it, mom. My first possible prey. / Mom Tyrannosaurus Rex: Very good!! With a little more practice, you will surely succeed. / Baby Tyrannosaurus Rex: I already want to make new possible attempts by observing my prey before the attack, using mom's method: analyzing size, speed, and strength*.

elements, such as: *knowing the curriculum* — which constitutes the first step for working with Children's Literature, since when proposing contents and concepts, they must align with what is common to all students and constitute rights that need to be ensured as provided for in the BNCC (Brazil, 2017); *knowing the content* — which allows activities to be developed according to the peculiarities of probabilistic knowledge; this knowledge combined with pedagogical knowledge allows teaching proposals to be formulated; *knowledge of teaching practice* — which is fundamental in the relations between what should be worked on and what should be addressed in the classroom. This work is possible with the inclusion of the Children's Literature book The *Diary of the Tyrannosaurus Rex* in Mathematics classes.

6 Final Considerations

Since early childhood, children's stories have represented a source of pleasure and have fostered the expansion of creativity, imagination, and logical reasoning for children. With this research, we add to these benefits the intertwining of Mathematics through Probability and Children's Literature, which allows for the development of mathematical and language skills from the same perspective. Bridging the gap between these two areas of knowledge — Mathematics and Children's Literature — is promoting the teaching and learning process, reinforcing the development of skills and competencies related to both areas simultaneously.

The plot of the story *The Diary of the Tyrannosaurus Rex* is a short, dynamic, and reflective narrative with a direct connection to everyday events. It can promote the development of reading, oral skills, and writing, as well as explore the ability of students to reflect critically on the concepts presented in the plot. It addresses concepts that are often underexplored and may pose difficulties for both students and teachers. Furthermore, it opens possibilities for educators to, through reading the story, bring a focus on notions of chance *(will definitely happen, might happen,* and *impossible to happen)*; Analysis of the idea of randomness *(unlikely, very likely, improbable*, and *impossible)*; Estimating events with higher or lower chances of occurrence; and Recognizing characteristics of more probable outcomes.

Finally, we address the research problem: considering official documents and theoretical approaches, What are the possibilities of intertwining Children's Literature and the teaching of Probability in the teaching and learning process of children attending Elementary School?.

Finally, we consider that, by exploring the teaching of Probability through Children's Literature, we present a strategy to help students gradually develop different ways of thinking about Mathematics. Therefore, when calculations become more complex over time, it is expected that understanding Probability concepts will be easier, as they were introduced to them in a playful manner.

References

Abramovich, F. (1997). *Literatura infantil: gostosuras e bobices* (4ª ed.). Scipione.

Amaral, J. J. F. (2007). *Como fazer uma pesquisa bibliográfica*. Universidade Federal do Ceará.

Barbosa, N. D. (2019). *O trilhar da construção de um jogo pedagógico como ferramenta para o ensino de probabilidade nos Anos Iniciais do Ensino Fundamental* (Dissertação de Mestrado). Universidade Federal do ABC, Santo André, SP.

Batanero, C. (2005). Significados de La Probabilidad en la Educación Secundaria. *Revista Latinoamericana de Investigación en Matemática Educativa, 8*(3), 247-263.

Brasil. Ministério da Educação. Secretaria de Educação Básica. (2017). *Base Nacional Comum Curricular: Educação Infantil e Ensino Fundamental*. MEC/SEB.

Brasil. Ministério da Educação. Secretaria de Educação Básica. (2014). *Pacto Nacional pela Alfabetização na Idade Certa: apresentação*. MEC/SEB.

Bryant, P. & Nunes, T. (2012). *Children's understanding of probability: A literature review*. Nuffield Foundation.

Castilho, C. R., et al. (2021). As noções de acaso no ensino de Probabilidade pautado na BNCC: Uma proposta para o Primeiro Ano do Ensino Fundamental. *Revista Brasileira de Educação Matemática, 10*(1).

Ciríaco, K. T. & Santos, F. A. P. (2020). Acervo paradidático do PNAIC e as possibilidades da Literatura Infantil em aulas de Matemática nos Primeiros Anos. *Revista Interações, 53*.

Conti, K. C. & Vilas Bôas, S. G. (2019). Acaso e probabilidades nos anos iniciais: Potencial dos jogos como mediadores na construção do conhecimento. *Revista Brasileira de Educação Matemática, 3*(2.22625).

Dias, C. F. B. (2016). *Ambiente Virtual de Aprendizagem para o ensino de Probabilidade e Estatística nos Anos Iniciais do Ensino Fundamental* (Dissertação de Mestrado). Universidade Tecnológica Federal do Paraná, Ponta Grossa, PR.

Fischbein, E. (1975). *The intuitive sources of probabilistic thinking in children*. Reidel.

Flick, U. (2009). Pesquisa qualitativa e quantitativa. In U. Flick, *Introdução à pesquisa qualitativa* (3ª ed.). Artmed.

Gil, A. C. (2002). *Como elaborar projetos de pesquisa*. Atlas.

Gomes, J. A. D. (2022). *Probabilidade e Literatura Infantil: Um entrelaçamento possível para ensinar e aprender Probabilidade nos Anos Iniciais do Ensino Fundamental* (Dissertação de Mestrado). Universidade de Uberaba, Uberlândia, MG.

Köche, J. C. (2005). *Fundamentos de Metodologia Científica: Teoria da Ciência e Iniciação à pesquisa* (22ª ed.). Vozes.

Lakatos, E. M. & Marconi, M. A. (2003). *Fundamentos de Metodologia Científica*. Atlas.

Marconi, M. A. & Lakatos, E. M. (2014). *Fundamentos de Metodologia Científica* (9ª ed.). Atlas.

Minayo, M. C. S. (Ed.). (2014). *O desafio do conhecimento: Pesquisa qualitativa em saúde* (14ª ed.). Hucitec.

Miranda, J. F. (2020). *Jogos digitais educacionais: Uma possibilidade para ensinar e aprender Probabilidade nos Anos Iniciais do Ensino Fundamental* (Dissertação de Mestrado). Universidade de Uberaba, Uberlândia, MG.

Moisés, M. (2004). *Dicionário de termos literários*. Cultrix.

Moura, A. R. L. (2003). Prefácio. In C. A. E. Lopes & A. R. L. Moura (Orgs.), *As crianças e as ideias de número, espaço, formas, representações gráficas, estimativa e acaso*. Editora Graf.

Passos, C. L. B., Oliveira, R. M. M. A. & Gama, R. P. (2007). Grupo de estudo colaborativo: Matemática conectada com histórias infantis promovendo desenvolvimento profissional. In *Encontro Nacional de Educação Matemática: Diálogos Entre A Pesquisa E A Prática Educativa, 9*. Belo Horizonte, MG.

Santos, E. R. M. D. (2021). *Mergulhando no universo das incertezas: Literatura Infantil e Probabilidade nos Anos Iniciais do Ensino Fundamental* (Dissertação de Mestrado).

Universidade Federal de Pernambuco, Recife, PE.

Silva, I. C. B. (2022). *Ensino e aprendizagem de estatística nos anos iniciais do ensino fundamental: Literatura infantil e história em quadrinhos como recursos pedagógicos* (Dissertação de Mestrado). Universidade Federal de Pernambuco, Recife, PE.

Smole, K. C. S. (2000). *A Matemática na Educação Infantil: A teoria das inteligências múltiplas na prática escolar*.

Smole, K. C. S. (1996). *A Matemática na Educação Infantil: A teoria das inteligências múltiplas na prática escolar*. Editora Artes Médicas.

Smole, K. C. S. & Candido, P. T. (1995). *Matemática e Literatura Infantil* (4ª ed.). Editora Lê.

Sousa, A. S., Oliveira, S. O. & Alves, L. H. (2021). A Pesquisa Bibliográfica: Princípios e fundamentos. *Cadernos da Fucamp, 20*(43), 64-83.

Souza, A. C., Lopes, C. & Oliveira, D. (2013). A análise exploratória de dados na infância: Uma conexão entre educação estatística e a literatura infantil. In C. Coutinho (Org.), *Discussões sobre o ensino e a aprendizagem da probabilidade e da estatística na escola básica*. Mercado das Letras.

Vilas Bôas, S. G. & Miranda, J. F. (2021). Jogos digitais educacionais e o ensino de Probabilidade: Uma conexão para os Anos Iniciais do Ensino Fundamental. *Revista Educação Matemática, 1*(1), 1-21.