

Research science teaching: reading contributions to scientific literacy in the early years

ABSTRACT

This text is part of a research developed in the Professional Master degree in Science and Mathematics Teaching. It starts from the idea of a Science Teaching that offers students the possibility of using their scientific knowledge on understanding and interacting with the world around them. The research consisted of the development of an Investigative Teaching Sequence (SEI), entitled “How is a rainbow formed in the sky?”, in a 5th grade elementary school class at Arapiraca-AL. The objective was to analyze the contributions of reading of the text genre legend for the promotion of Scientific Literacy for a 5th grade elementary school, through the didactic approach of inquiry-based teaching. To guide the research, we started from the following problem: What are the contributions of the reading of the text genre legend in promoting the Scientific Literacy of students in a 5th grade elementary school through investigative teaching? Thus, the Qualitative Approach sought the methodological assumptions that consisted of an applied research, using as data collection instrument the application of the Sequence Teaching followed by open-ended questions. The results show that reading texts in science education allowed the inclusion of students in scientific culture through learning concepts, expanding vocabulary, understanding the nature of science and training critical citizens who are aware of their rights and duties in society.

KEYWORDS: Scientific Literacy. Inquiry-Based Teaching of Science. Investigative Teaching Sequence. Early years.

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INTRODUCTION

Since the early school years, when the child is inserted in the school environment, it is important to teach Science directed to the Scientific Literacy of students. After all, in various social contexts in which Science and Technology are present, so it is important for citizens to have access to scientific knowledge, keeping themselves informed and aware of their attitudes towards the world.

In this sense, Science Teaching should provide students with not only an understanding of the physical world, but also a recognition of their role as participants of the individual and collective decisions in the society (SILVA; SÁ; BATINGA, 2019).

To teach Sciences consists in working the involvement of students with the scientific world from discussions about the historical and philosophical aspects of Science associated with the use of investigative activities (SASSERON; MACHADO, 2017). Science classes should be designed and planned with the major goal of providing the students' Scientific Literacy. It should be the objective because "Scientific literacy of students means providing conditions for them to make conscious decisions about the problems of their life and society related to scientific knowledge" (SASSERON, 2013, p. 45). So, what is expected is train citizens to give them the skills to make decisions concerning science from a critical analysis of a problem, and it may even lead to a scientific investigation, not only through a simple process related only to the expression of opinion.

In this study we defend the Inquiry-Based Teaching of Science (ENCI) (CARVALHO, 2013), (SASSERON, 2013) as a didactic approach to be used since the early years of elementary school to promote the Scientific Literacy of students. In inquiry-based teaching, teachers plan their Science classes by constructing the Investigative Teaching Sequence (SEI), providing conditions for students to transform their spontaneous concepts into scientific knowledge by planning activities research, and by using texts of systematization of scientific knowledge treated in the experiments (CARVALHO, 1998, 2013), (SEDANO, 2010, 2013). Such texts are important in Science education by providing students an approach to scientific knowledge, leading them to think critically, take a stand, and broaden their understanding of the world.

In a search for a better understanding about the benefits of using texts in ENCI, this research starts from the following problem: What are the contributions of reading the text genre legend in promoting the Scientific Literacy of students in a 5th grade elementary school, through inquiry-based teaching?

This research aims to analyze the contributions of reading texts of the text genre legend for the promotion of Scientific Literacy for a 5th grade elementary school class, through the didactic approach of the inquiry-based teaching.

We will start the discussions by addressing the theoretical assumptions that deal with Scientific Literacy, research teaching and reading in Science Teaching process. Soon after, the SEI, "How is a rainbow formed in the sky?", will be presented, as well as the method used in research analysis and research results.

READING IN RESEARCH SCIENCE TEACHING: A PROPOSAL FOR TEACHING

Currently, there is a redirection of pedagogical practices that aims at teaching and learning in different instances. Regarding to the construction of knowledge, there is a need to know how to deal with the possibilities of using these knowledges to meet the needs of everyday life, then work with scientific production is necessary. The knowledge of the world of Science and Technology has been gaining more and more space in our daily lives, in several diverse social practices. They are often considered indispensable in the life of the modern society, where everything happens quickly and keeping informed becomes indispensable for the formation of a critical subject conscious of his/her decisions.

According to Krasilchik and Marandino (2004, p. 8):

[...] citizens need to be able, based on well-informed information and analysis, to participate in decisions that affect their lives, organizing a set of values mediated in the awareness of the importance of their role in individual improvement and in social relationships.

The authors consider as competencies for the formation of critical subjects who: have the ability to make conscious decisions, communicating their ideas and knowingly listen to the ideas of others; look at a situation from the other's point of view, understanding their reasons and arguments; and the recognition that everyone has rights and duties to fulfill (KRASILCHIK; MARANDINO, 2004).

The formation of critical subjects who understand how much the Science and Technology interfere in their lives, in society and in the environment that they live in becomes a necessity of humanity, because, as stressed by Lorenzetti and Delizoicov (2001, p. 49):

Raising the level of public understanding about Science is today a necessity, not only as an intellectual pleasure, but also as a necessity for human being's survival. It is a cultural necessity to expand the universe of scientific knowledge, considering that today we live more intensely with Science, Technology and their artifacts than ever.

Studies in the area of Science Didactics by Sasseron and Carvalho (2011) point to variations in the nomenclatures used by researchers to define a Science Teaching concerned with the formation of critical citizens aware of the scientific knowledge around them. In foreign literature, the authors found the use of the terms: "Alfabetización Científica" (MEMBIELA, 2007), (DÍAZ; ALONSO; MAS, 2003), (CAJAS, 2001) and (GIL-PÉREZ; VILCHES-PEÑA, 2001), in the works of the authors of the Spanish language; "Scientific Literacy" (NORRIS; PHILLIPS, 2003), (LAUGKSCH, 2000), (HURD, 1998), (BYBEE, 1995), (BINGLE; GASKELL, 1994) and (BYBEE; DEBOER, 1994) in the researches of the English language; and "Alphabétisation Scientifique" (FOUREZ, 2000, 1994) and (ASTOLFI, 1995), in the studies of the authors of the French language (SASSERON; CARVALHO, 2011).

In Brazil, researchers they have difficulties in translating the terms presented earlier, because the English expression "Scientific Literacy" is translated as "Letramento Científico" while the Spanish and French expressions, "Alfabetización Científico" and "Alphabétisation Scientifique", are translated as "Alfabetização Científica" (SASSERON; CARVALHO, 2011).

To Sasseron and Carvalho (2011), this plurality of expressions used to define a Science Teaching concerned with the citizen formation of students to act in society, makes the Brazilian researchers use of the terms: Alfabetização Científica, Letramento Científico, Enculturação Científica e Alfabetização Científica e Tecnológica in their works.

Regardless of the nomenclature to be used, it is important to understand that all these expressions have the same concern with Science Teaching. A teaching and learning that is capable to provide students with a formation that allows them understanding and intervening in the present society (LORENZETTI; SIEMSEN; OLIVEIRA, 2017).

In this study, we chose to use the term Scientific Literacy. Scientific Literacy, according to Lorenzetti and Delizoicov (2001, p. 52-53), proposed is:

[...] the proposed scientific literacy is concerned with scientific knowledge, and its approach, which being conveyed in the first grades of elementary school as ally for the students be able to read and understand their universe. Thinking and transforming the world around us presupposes to know the scientific, technological contributions, as well as the social and political reality. Therefore, scientific literacy in the teaching of Natural Sciences in the early grades is understood here as the process by which the language of the Natural Sciences acquires meanings, constituting means for the individual to expand their universe of knowledge, their culture, as a citizen inserted in society.

When planning their Science classes to promote scientific literacy, teachers should think about teaching strategies that allow students to properly understand and use basic terms and fundamental scientific concepts in their daily lives. These actions should lead us to think about the formation of critical subjects that think, question and analyze scientific research through experiments, as well as the social and human aspects that interfere with the investigation.

About the Science Teaching, Carvalho (2005, p. 62) states:

[...] it is not enough, and in fact we have empirical data showing it, that there is no point in teaching reduced to a collection of facts, concepts, laws and theories as traditionally was presented to the students, because in this way at best what really remains in the students at the end of middle school is a reductionist and neutral view of what knowledge production is for humanity.

To Carvalho (2005, p. 63), "It is necessary to teach students to 'do science' and 'to speak science'". The teacher, considering the level and needs of the class, does not give to students finished scientific theories. Students need to build their understanding of the content worked through dialogue and exchange of experience with their classmates and the teacher. Through the teacher, contents of Science Teaching allow the development of didactic proposals directed to many activities developed by scientists, such as research and the construction of hypotheses (Oldoni; Lima, 2017).

According to Brito and Fireman (2016, p. 129):

In these terms, students not only "make science" but also learns "about science". The students not only learn concepts through argumentation and reasoning, but also learn to discuss and make value judgment upon the studied contents. As a result, they start to understand the phenomena of

the natural world in a way that they become able to make a more conscious reading of the world, that is, became science-literate.

Thinking about students' Scientific Literacy and considering the importance of creating an investigative environment in Science classes, Carvalho (1998, 2013), Sasseron (2013, 2015), Sedano (2010, 2013) propose a Science Teaching based on the didactic approach of research teaching with the development by teachers of SEI in order to provide students a better understanding of scientific activity.

Inquiry-based teaching, according to Sasseron (2015, p. 58):

Taking it as an activity associated with the teacher's work and not just a specific strategy, inquiry-based teaching is defined as a didactic approach, so it can be linked to any teaching recourse as long as the research process is put into practice and performed by the students from and through the teacher's guidance.

In inquiry-based teaching, during every moment of the investigative activity, there is an exchange between teacher and student. In ENCI it is duty of the teacher to help, through interaction between classmates or manipulating the materials used in the investigation, students in solving problems that they present. Students' prior knowledge and small actions during the activities should also be valued in order to they feel safe and confident to solve the proposed problem (SASSERON, 2015).

As reported by Sasseron (2013, p. 43):

Regarding the classroom, planning an investigation should take into consideration the materials offered and / or requested to students, the prior knowledge important to start the discussion, the problems that will guide the investigation and, of course, the management of the class which includes, above all, encouraging student participation in activities and discussions.

In view of this discussion, the teacher has the role to organize and problematize the content and material to be used in the classroom since students need to be motivated to discuss their own ideas and, then, transform their spontaneous concepts into scientific knowledge.

In order to create a favorable environment for building students' scientific knowledge, Carvalho (2013, p. 9) proposes the construction of SEI by teachers, as we can see below:

[...] we propose investigative teaching sequences (SEIs), that is, sequences of activities (classes) about a topic of the school program in which each activity is planned from the point of view of material and didactic interactions, aiming to provide students: conditions to bring their prior knowledge to start new ones, to have their own ideas and to be able to discuss them with their classmates and the teacher, moving from spontaneous to scientific knowledge, and acquiring conditions to understand the knowledge structured by previous generations.

SEI is a sequence of activities and classes prepared by the teacher in order to work in the classroom a topic of the school program through an investigative

activity. When teachers plan a SEI, they must keep in mind the problem, the materials to be used, and possible didactic interactions.

And, about the elaboration of the problem, “[...] we must work with real problems that students can discuss and propose solutions compatible with their development and worldview, in a sense that will lead them, later, to scientific knowledge” (CARVALHO, 1998, p. 13).

This problem that should be used in a SEI, the teachers must evaluate the problematic proposed to the children, and if it is in their level of development. The situation/problem have to motivate, challenge and stimulate the interest of the students to solve that investigative activity. During the discussion, students will have the interest to talk about what they did, such as the hypotheses tested, its explanation and discuss the event itself.

In relation with the didactic material used in SEI, Carvalho (2013, p. 11) states:

The didactic material should allow student to solve the problem and to diversify their actions, because when they are able to diversify the action and observe corresponding changes in the reaction of the object that they have the opportunity to structure these regularities.

The didactic material should, also, be organized by the teacher aware of the needing of stimulate curiosity of the students, making them solve the problem. The action of manipulate the materials and students' prior knowledge become important tools when they are testing hypotheses and seeking a solution to the problem in the investigative activity.

Regarding the discussion in the Sciences classes, Brito and Fireman (2016, p. 129) argument:

It is necessary to provide time and space to the students discuss about the studied events, to think about their statements, to build their own conclusions from the change of experience in group, and to they got the habit to work with refutations until an evolution of concepts related to the event.

During the discussion, paradigms are overcome, new concepts are built by students, because there is an exchange of experiences among the students all the time. The hypothesis that worked and the ones that did not work must be remembered by the students. This discussion contributes to the development of the prior knowledge of the students to the point of better understanding the concept of the studied event. At this moment, the spontaneous concepts become scientific knowledge.

Carvalho (2013) also proposes, at the conclusion of the SEI, the reading of texts for the systematization of knowledge worked in the didactic sequence. The systematization text should be thought of as a complementary activity to the problem in order to deepen the content worked in the Science class.

According Carvalho (2013, p. 15):

In the first years of the elementary school, the text could be read by the teachers themselves, because the students do not master the reading skill of a text with several paragraphs yet. In the following school years, the

students are responsible for reading, but the teacher have to certificate that all students understood the text by discussion or well-organized questions.

At the lesson planning, the teacher must to certificate if the text systematization is in the level of the students and if it is relevant for them. Must, also, observe if the students are able to do the reading by themselves or if they need the teacher's help. After the reading of the text, more discussions between the students and the teacher about the text are necessary. The teacher should organize questions about the investigative activity and the text systematization that will contribute to the realization of scientific concepts related to SEI that was worked during the Science class.

To Nigro (2007, p. 51), related to the use of texts in Science Teaching:

[...] the texts should not have their valor belittled. It is often underestimated the value of writing, ignoring that writing can be considered the oldest and possibly the most efficient information transfer technology used by mankind until this day.

In the actual Science Teaching the text does not receive its importance. Usually, when using reading or writing of text in these classes, its use is realized in a traditional way, does not considering students reflection or comprehension of the written text (NIGRO, 2007).

Nigro (2007, p.52), defending the use of reading and writing in the texts Science Teaching, states:

[...] Nowadays we believe that texts enable more than just the 'transmission' of predefined messages: they are seen as resources that are intrinsically related to thought and cognition.

When the use of texts in Science Teaching is proposed, it is intended to bring students closer to scientific knowledge. Through students' prior knowledge about the worked content and the textual genre that is used on in the classroom, students are led to think critically, take a stand and broaden their understanding of the world.

In this work we believe in teaching in which reading, writing and investigation are present in the activities planned by the science teacher. Sedano (2010) argued that reading combined with experimentation in Science classes allows the understanding of the concepts studied from the relation that the student establishes between these two practices: reading and experimentation.

Still according to Nigro (2007, p. 55-56):

[...] We could not avoid privileging the reading and writing if we think in promote the scientific literacy of citizens. That is, in order to students not being limited to discuss only current issues, to have the opportunity to appreciate the nature of scientific knowledge and scientific activity, to have access to the culture of science, we must deal with the question of how the text, writing and reading, is worked in science education.

When we think of science classes, which seek to promote Scientific Literacy (CARVALHO, 1998, 2013), (SASSERON, 2013, 2015), (LORENZETTI; DELIZOICOV, 2001), we cannot ignore teaching from the use of written texts and, consequently, of reading and writing practices. We believe that the greater the

access to a diversity of textual genres, whether in Nature Sciences or in any other area of education, better will be the reader's understanding of the social use of the text, as well as their understanding of the text read and the content worked in the Science class.

INVESTIGATIVE TEACHING SEQUENCE: HOW IS A RAINBOW FORMED IN THE SKY?

The SEI “How is a rainbow formed in the sky?” was formulated to a 5th grade elementary school class. The activity was organized to be developed in about 5 lessons of 4 hours each. Also, it was based on the SEI “Where does rainbow come from?”, by the authors Brito and Fireman (2014, 2016).

So, the SEI “How is a rainbow formed in the sky?” is constituted by 4 activities linked with the theme: Rainbow. In this paper, we gave more attention to the last activity, which is about a reading the legend “The rainbow dance: the spectacle of nature in the Indian view” by João Anzanello Carrascoza.

In the Table 1 are described the 4 activities of this SEI and their respective objectives.

Table 1 – SEI “How is a rainbow formed in the sky?” – Activities

Lessons	Content	Activities	Objective
Lesson 01	How is a rainbow formed in the sky?	Initial survey activity	<ul style="list-style-type: none"> Identify students' prior knowledge about rainbow formation. Organize and record information through drawings and short texts.
Lesson 02	How is a rainbow formed in the sky?	Investigative activity about rainbow	<ul style="list-style-type: none"> Research and realize experimentation activities. Develop the habit of observing, thinking the observed subject and asking misunderstood questions about the phenomena of nature. Understand significantly the causes and effects of the rainbow from a scientific view. Situate the natural phenomenon “rainbow” in everyday life with logical and coherent explanations. Organize and record information through drawings and short texts.
Lesson 03	How is a rainbow formed in the sky? The composition of the white light	Investigative activity about Newton disk	<ul style="list-style-type: none"> Work concepts involved in learning rainbow formation through educational videos. In this case, the video “Where does the rainbow come from?”. Available at: https://www.youtube.com/watch?v=tW819inM4hg .

Lessons	Content	Activities	Objective
			<ul style="list-style-type: none"> • Research and realize experimentation activities. • Develop the habit of observing, thinking the observed subject and asking misunderstood questions about the phenomena of nature. • Understand significantly the causes and effects of the rainbow from a scientific view. • Situate the natural phenomenon "rainbow" in everyday life with logical and coherent explanations. • Organize and record information through drawings and short texts.
Lesson 04 e 05	How is a rainbow formed in the sky? The legend: "The rainbow dance: the spectacle of nature in the Indian view"	Reading activity: "The rainbow dance: the spectacle of nature in the Indian view".	<ul style="list-style-type: none"> • Develop the reading and writing through scientific contents • Interpret and understand the social function of different textual genres. • Understand the occurrence of the "rainbow" from the scientific view, in other words, abandoning magical ideas about this natural phenomenon. • Situate the natural phenomenon "rainbow" in everyday life with logical and coherent explanations. • Organize and record information through drawings and short texts.

Source: Own authorship (2019).

As we can observe in Table 1, the activities realized was: an initial survey to identify the prior knowledges of the students about the rainbow formation; 2 investigative activities related to rainbow formation and the composition of the white light; and an activity of reading the legend "The rainbow dance: the spectacle of nature in the Indian view" to systematize the content about rainbow worked in the teaching sequence.

Lessons 4 and 5 are related to the reading of the legend "The rainbow dance: the spectacle of nature in the Indian view". The lesson plan of this activity is recorded on the following Table 2:

Table 2 – Activity: Reading of the legend “The rainbow dance: the spectacle of nature in the Indian view”

Lessons 4 and 5: Legend Reading Activity	
Content	How is a rainbow formed in the sky? The legend: “The rainbow dance: the spectacle of nature in the Indian view”
Objectives	<ul style="list-style-type: none"> • Develop the reading and writing through scientific contents • Interpret and understand the social function of different textual genres. • Understand the occurrence of the "rainbow" from the scientific view, in other words, abandoning magical ideas about this natural phenomenon. • Situate the natural phenomenon “rainbow” in everyday life with logical and coherent explanations. • Organize and record information through drawings and short texts.
Methodology	<ul style="list-style-type: none"> • Individual and silent reading of the legend “The rainbow dance: the spectacle of nature in the Indian view”. • Collective reading of the legend “The rainbow dance: the spectacle of nature in the Indian view”. • Research and making a poster with words found in the text that students do not know their meaning. • Socialization about the understading of the legend “The rainbow dance: the spectacle of nature in the Indian view”. • Application of activity 4, that is regarding of reading and interpretation of the legend, and also questions about the how rainbow formation appears along the history.
Materials	<ul style="list-style-type: none"> • Cardstock. • Whiteboard marker. • Printed activity.
Evaluation	Formative evaluation: recording of the students' development throughout the lesson, observing their learning of scientific concepts, terms and notions, as well as the students' actions and attitudes during the activities (CARVALHO, 2013).

Source: Our own authorship (2019).

The lessons about legend tried to develop reading and writing skills in the students through Science content; to make them interpret and understand the social function of different textual genres, in special the text genre legend; understand the occurrence of the "rainbow" from the scientific view, in other words, abandoning magical ideas about this natural phenomenon; situate the natural phenomenon “rainbow” in everyday life with logical and coherent explanations; organize and record information through drawings and short texts. (BRITO; FIREMAN, 2014).

At this stage of the teaching sequence, the teacher asked to the students to do an individual and silent reading of the legend because, according to Rangel (2005, p. 39):

Individual reading is one of the strategies to consider. Silent reading, before oral or group reading, is an essential preparatory moment for the reader to adapt to the author's ideas and to establish curious and creative reading in the first place.

After the individual reading, the teacher hand in Portuguese language dictionaries to the students, asking them to take notes of the word that they did not understand and its meaning. At the end of this task, a collective poster was constructed in the classroom containing the words highlighted by the students and their meanings for a better understanding of the text.

Following the lesson, the teacher started a group reading of the legend “The rainbow dance: the spectacle of nature in the Indian view”, allowing the students to ask questions or to comment the most relevant parts of the story. At this moment, the teacher was in charge to mediate the reading and the discussion of the entire class.

The legend ends when an Indian hunter make a rainbow with a crystal and sunbeams in a rainy day. This rainbow unites two worlds in the plot of the story, the rain’s world and the earth’s world.

The students, during the activity 4, the one related to the reading and comprehension of the legend, were asked to answer some text comprehension questions, and questions to associate the events of the legend with scientific explanations about the rainbow phenomena. The questions were: How did the Indian make the rainbow in the sky? Can you explain how he did it using the investigative activities worked in class?

Before we discuss about the analysis and the results of this investigative research, we are going to present the methodology in the next section, for matter of understanding about this research process. We will discuss the approach and type of research, the data collection instruments, the subjects involved and the *locus* of the investigation.

METHODOLOGY

The methodology that organizes this research is a qualitative research approach. We are not going to quantify collected date, instead we are going to give value to the understanding of the subjects about their reality, from the personal point of view of the researcher (SAMPIERI; COLLADO; LUCIO, 2013). This work is classified as an applied research. For Teixeira and Neto (2017, p. 1068), the applied research is defined as “[...] investigations based on projects in which the research priorities are fully defined by researchers”. In the area of education, an objective applied research contributes to the generation of knowledge in the teacher training and in issues related to teaching and learning processes (TEIXEIRA; NETO, 2017).

For the investigation, we used as data collection instrument the development of SEI itself and questionnaires with open-ended questions. The texts produced during the investigation, the *corpus* of this study, were significant material to the researcher attribute sense and meaning for a better understanding of the studied phenomenon.

The research was realized at Arapiraca-AL, in a municipal school, specifically in a 5th grade elementary school class. This class consisted of 29 children, aged between 10 and 11 years old. In the class was developed the SEI “How is a rainbow formed in the sky?”, by the researcher who is also the class teacher.

This investigation was conducted with the approval of the Ethics and Research Committee of the Federal University of Alagoas (UFAL) on October 18, 2018. Approval Number: 2.970.583.

RESULTS AND DISCUSSIONS

The last activity of the SEI “How is a rainbow formed in the sky?” was the reading of the legend “The rainbow dance: the spectacle of nature in the Indian view”. The texts produced by the students in the previous activity, 4, were fragmented and rearranged into categories of analysis for a better understanding of the children about the rainbow phenomenon, through investigative activities realized and the reading of the legend.

The categories found were: Category 1 - The children presented conceptual elements of explaining about how the formation of the rainbow was scientifically made in the legend; Category 2 - The children recalled moments of the legend and the materials used in the investigative activities, but without understanding how the formation of the rainbow in a scientific way occurred in history.

In the students' written answers were only corrected mis-spelling, so only the errors of coherence and cohesion were exposed. To keep the confidentiality of the subjects involved in the research we used the letter "E" accompanied by the numbers from 01 to 29 to identify the participants when dealing with the students' statements.

Category 1 - The children presented conceptual elements of explaining about how the formation of the rainbow was scientifically made in the legend.

In order to understand how was the children's understanding of the activity of the legend, we should begin the analysis from the students' questions, such as: “How did the Indian make the rainbow in the sky?”, and “Can you explain how he did it using the investigative activities worked in class?”.

Answering the question “How did the Indian make the rainbow in the sky?”, Student E04 wrote the following situation: “He needed three things: the rain, the sun and the prism, first he needed the rain and the sun, when it stopped raining appeared the sun, and when the sun crossed in the prism that the rainbow appeared”. The child E04, as observed in the passage above, recalled the elements present in the text that contributed to the formation of the rainbow: the rain, the sun and the prism. Next, E04 pointed out that the rainbow formed when the rain stopped and the sun's rays crossed the prism.

The child E04 brought in the text the understanding of the concept of the formation of the rainbow, because even if it does not presenting the scientific terms “dispersion” and/or “refraction” to explain how the formation of the rainbow happened in the legend, E04 pointed out that the rainbow appeared when the sun's rays crossed the prism, in other words, presenting an understanding of the concept of this phenomenon of nature.

Facing this appointment, it is important to emphasize that at no time was it intended that students present attitudes and behavior of a scientist. We understand that children are not old enough, neither have scientific knowledge enough for such thing, but that students can gradually be inserted in scientific

culture, acquiring a scientific language in everyday life (SASSERON; CARVALHO, 2008).

Explaining how the Indian managed to make the rainbow in the sky through the investigative activities that were worked in the class, the same child, student E04, presented in his text the following justification:

Yes. My group and I did it by the following way: first we used 1 aquarium, 1 flashlight, 1 white sheet and water. First we put water in the aquarium, after we positioned the white sheet in front of the aquarium and put the flashlight next to the aquarium and then the rainbow came up and was something like this the way that the Indian made the rainbow appear in the sky, but he only used the prism to make the rainbow to appear. The first person to test the prism was one of the world's greatest inventors (Isaac Newton).

Student E04 began the explanation with the formation of the rainbow in legend by writing the hypotheses tested by E04 own group in the investigative activity of the rainbow. E04 showed in this way how the group formed the rainbow in the class. By bringing the way how E04 was able to form a rainbow, using the materials of the investigative activity and remembering the discussion that the group had in the classroom, this child constructed the concept of rainbow formation, as previously presented: “[...] when it stopped raining appeared the sun, and when the sun crossed in the prism that the rainbow appeared”(E04).

The construction of the concept about the formation of the rainbow by the student E04 dialogues with the understanding of Moraes (1992), because, according to this researcher, the construction of scientific concepts in children occurs through the manipulation of materials, active and reflective participation in activities related to this concept.

E04 also wrote how the way the Indian of the legend was able to make the rainbow is closer to the way that the scientist Isaac Newton performed his experiment, that is, using a prism. The student also pointed out that the first person to perform this experiment was the scientist Isaac Newton. We observe in the text, produced by student E04, a learning related to the history of Science. These data were presented in the video “Where does the rainbow come from?” and the student also remembered that the Indian uses the crystal to form the rainbow in the sky in the legend.

Continuing the analysis, for student E20, the Indian managed to form the rainbow in the sky in the following way:

He could do it because he placed the crystal towards the sun and the sun's rays pierced the crystal and reflected a beautiful rainbow and he realized that if he changed the crystal the rainbow would change the direction, he realized that it was the solution to his and his beloved problems.

Student E20 pointed out in his text that the Indian was able to form the rainbow in the sky, because he placed the crystal that he was holding towards the sun, reflecting a beautiful rainbow. This student remembered that this gesture was important in history, because by changing the hand that held the crystal the rainbow also changed its direction, then the Indian can solve the problem of the ups and downs of the people who lived on earth and in the sky.

According to the same child, student E20, the investigative activities realized in the classroom were able to explain why the Indian could form the rainbow in the sky, because “[...] Because the crystal in my research is the prism but the two somehow are glass, then when the sun's rays pass through the crystal or prism it forms a beautiful rainbow of seven colors wonderful to see”. This child was able to associate the experience performed by the character of the legend with the observations throughout the SEI “How is a rainbow formed in the sky?”, presenting the concept of rainbow formation in nature. For student E20, the Indian was able to form the rainbow, because the crystal and the prism (observed in the video) consist of the same material, in this case, glass. Thus, when the sun's rays pass through the crystal or prism, the rainbow forms, as observed in the video presented to the class during the development of this teaching sequence.

Student E19 presented the following opinion: "the Indian was able to form the rainbow because he had the crystal and the sunbeam passed through the crystal". In writing activity this student, when asked if the investigative activities worked in the class helped explain how the Indian managed to make a rainbow in the sky, this student gave the following justification:

Yes. The sun that passed through the crystal was the lantern we used, and the Indian crystal was like the aquarium, and the white sheet is like the sky, that's how it formed the rainbow and so it was the same. Like Isaac Newton, he pierced the window and a ray of sunshine appeared and entered in the prism and formed the rainbow.

E19 wrote a text about the learning acquired through the investigative activity of the rainbow and the video presented to the class. The student began to explain by relating the materials used in the experiment with those ones presented in the legend to the rainbow appears in nature. E19 stated that the lantern represented the sun that appeared in the story, the aquarium represented the crystal, and the white sheet of paper represented the sky. After writing it, this child wrote about the experiment of the prism by scientist Isaac Newton, an experience presented in the video "Where does the rainbow come from?". For bringing in the text the experiment of the prism by Isaac Newton, student E19 remembered a Science important historical event, showing us a learning directed to a strand of thinking of the Scientific Literacy which consists in understanding the nature of science and ethical and political factors surrounding their practice (SASSERON, 2013).

Responding to the same questions, student E11 said that the Indian was able to make the rainbow by the following way: “With the prism when sunlight hit it and reflected, that was when the refraction began and the rainbow appeared”. This child used the terms “prism” and “refraction” in the text to explain how the formation of the rainbow in the legend happened. In this passage, we can observe evidence of vocabulary expansion of student E11, because when E11 wrote prism, E11 is referring to the crystal used by the character of the story. In addition, the word refraction was used when the child presented the concept about the rainbow, in other words, E11 was talking about the moment when sunlight “hit” the prism and reflected the colors of the rainbow.

When explaining if the investigative activities in the classroom helped to understand how the Indian was able to form the rainbow, student E11 wrote the following situation: “With the prism and the lantern, the lantern is like the light of

the sun and the prism like rainwater and he used the sunlight and the prism to make the rainbow, they both do the same thing." Child E11 understood that the Indian formed the rainbow using sunlight and prism (crystal). This student also remembered the experiments performed in the classroom, and E11 own observations of daily life by associating the lantern with sunlight and rainwater to the prism, showing that is possible to form a rainbow by both natural elements and by materials of the experiment.

The children who participated in the description of this category presented in their textual productions the understanding of how the formation of the rainbow occurs in nature. We observe that students expose scientifically the concept of rainbow formation through the association of the reading of the legend "The rainbow dance: the spectacle of nature in the Indian view" with the investigative activities worked in the classroom. These children understood the concept of the scientific term "refraction", what is a demonstration of vocabulary extension; they recalled the experiments conducted by scientist Isaac Newton and how important this experiment was to the history of Science; and presented the understanding that scientific knowledge interferes with their lives, society and the environment in which they live.

Category 02: The children recalled moments of the legend and the materials used in the investigative activities, but without understanding how the formation of the rainbow in a scientific way occurred in history.

In this category, children did not present the concept of rainbow formation in nature, but established relationships between the two events. The students wrote about moments in the history of science as well as made comparisons between the experiences in the classroom and those performed by the character of the story, but without yet presenting a scientific understanding of how the Indian was able to make a rainbow using the crystal and the sun's rays.

Trying to answer the question "How did the Indian manage to make the rainbow in the sky?" Student E09 presented the following answer: "Well, he had the crystal and the sunbeam hit the crystal and formed the beautiful rainbow. " Student E09 wrote that the rainbow was evoked in the story when the sun's rays "hit" the crystal that the Indian held.

When explaining if the investigative activities conducted in the classroom helped to understand why the Indian was able to make the rainbow using sunbeams and crystal, child E09 provided the following justification:

[...] the hunter used the crystal that was the same as Isaac Newton's and he was playing with it and formed it and an experience that was similar to the aquarium and CD Newton's disc but it was not very similar because it was using a disc and the hunter was the crystal.

In the textual production, the child reported that the experience performed by the Indian (hunter) was similar to that of scientist Isaac Newton, because in the story the character also used a crystal and in Isaac Newton's experience, he used a prism. Student E09 highlighted the experience of the aquarium and the CD (investigative rainbow activity) and related it to the story event. However, it did not show the common points between the two experiences and history, nor the concept of rainbow formation in nature.

Student E18 wrote that the Indian was able to form the rainbow by "setting the crystal in the sun." To justify if the investigative activities worked in the classroom helped to understand why the Indian was able to form the rainbow using sunbeams and crystal, he provided the following explanation:

Well, the things we got were an aquarium, a lantern, a white sheet and water, those were the first activity things. In the 2nd activity we used the battery, jumper cables, a fan, Newton's disc and a switch. [...] He used only the instruments of nature, he does not used all the thing we used, he used he used only the crystal, the sun's rays and the rainwater.

The report presented highlighted the materials used in the two investigative activities worked in SEI. E18 also commented that to form the rainbow in the sky, the Indian used the elements of nature, highlighting: the crystal, the sun's rays and the rainwater. The child E18 did not bring in textual production the reason why the Indian managed to make a rainbow in the legend, and failed to associate the investigative activities performed in the lesson with the experience presented in the story.

The textual productions presented in this category, we understand that students E09 and E18 did not present conceptual elements capable of explaining how the formation of the rainbow in a scientific way occurred in the legend. The children remembered some moments of the story, the materials used in the investigative activities worked in SEI, but they were unable to relate the scientific explanation to how the character of the story managed to make a rainbow in nature, using the crystal and the sun's rays.

CONCLUSION

From the application of the SEI "How is a rainbow formed in the sky?", we could observe the contributions of reading the text genre legend in Science Teaching after applying two investigative activities in a 5th grade elementary school class.

The children participating in the research could be divided into two groups. In the first group are the students who understood the concept of rainbow formation. These children presented conceptual elements that could explain how the formation of the rainbow was scientifically made in the legend. It can be observed that these students scientifically showed the concept of rainbow formation through the relationship between the reading of legend and the investigative activities performed in the classroom. The children, also, understood the concept of the scientific term "refraction", demonstrating vocabulary expansion; remembered aspects of the history of Science from experiments conducted by scientist Isaac Newton; and presented the understanding that scientific knowledge interferes with their lives, society and the environment in which they live.

In the second group are children who did not understand the concept of rainbow formation. The children recalled some moments of the story, the materials used in the investigative activities worked in SEI, but unable to explain, scientifically, how the character of the story was able to form a rainbow in nature

using the crystal and sunbeams in their texts. This does not mean that the children did not understand nothing of the studied content.

However, based on the theoretical assumptions and results of this study, the reading of texts in Science education allows the inclusion of students in scientific culture. Among the contributions of reading in Science Teaching that we observed in this research, we highlight: expansion of students' view of this constantly changing world; construction of the understanding of concepts and scientific vocabulary in the reader; understanding of the nature of the Sciences, demystifying inappropriate conceptions of this knowledge; and, finally, the training critical citizens who are aware of their rights and duties in society based on the understanding that scientific knowledge interferes with their lives, society and the environment in which they live.

Ensino de ciências por investigação: contribuições da leitura para a alfabetização científica nos anos iniciais

RESUMO

Esse texto é um recorte da pesquisa desenvolvida no Mestrado profissional em Ensino de Ciências e Matemática. Ele parte da ideia de um Ensino de Ciências que ofereça aos estudantes a possibilidade de utilização dos seus conhecimentos científicos na compreensão e na interação com o mundo a sua volta. A investigação consistiu no desenvolvimento de uma Sequência de Ensino Investigativa (SEI), intitulada “Como se forma um arco-íris no céu?”, junto a uma turma de 5º ano do Ensino Fundamental da rede municipal de Arapiraca-AL. O objetivo consistiu em analisar as contribuições da leitura de textos do gênero textual lenda para a promoção da Alfabetização Científica em uma turma do 5º ano do Ensino Fundamental, por meio da abordagem didática do ensino por investigação. Para nortear a pesquisa, partiu-se da seguinte problemática: Quais as contribuições da leitura do gênero textual lenda na promoção da Alfabetização Científica de estudantes de uma turma do 5º ano do Ensino Fundamental, por meio do ensino por investigação? Assim, buscou-se na Abordagem Qualitativa os pressupostos metodológicos que consistiu em uma pesquisa de aplicação, utilizando como instrumento de coleta de dados o desenvolvimento da Sequência Didática composta por questões abertas. Os resultados apontam que a leitura de textos, no ensino de Ciências, permitiu a inclusão dos estudantes na cultura científica por meio da aprendizagem de conceitos, ampliação de vocabulário, compreensão da natureza das Ciências e formação de cidadãos críticos e conhecedores de seus direitos e deveres na sociedade.

PALAVRAS-CHAVE: Alfabetização Científica. Ensino de Ciências por Investigação. Sequência de Ensino Investigativa. Anos iniciais.

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