Nuances
Estudos sobre Educação

CHILD WRITTEN RECORDS AND SCIENTIFIC LITERACY: FOCUS ON INQUIRY BASED SCIENCE TEACHING

OS REGISTROS ESCRITOS INFANTIS E ALFABETIZAÇÃO CIENTÍFICA: EM FOCO, O ENSINO DE CIÊNCIAS POR INVESTIGAÇÃO

REGISTROS ESCRITOS INFANTILES Y ALFABETIZACIÓN CIENTÍFICA: ENFOQUE EN LA ENSEÑANZA DE LA INVESTIGACIÓN EN CIENCIAS

Tatiana Schneider Vieira de MORAES[1]
Cyntia Graziella Guizelim Simões GIROTTO[2]
Bárbara Cortella Pereira de OLIVEIRA[3]

ABSTRACT: Inquiry Based Science Teaching in the early years of schooling contributes to the development of the Scientific Literacy process. In the exhibition of part of research results, the collaborating children and teachers on stage are located in a public school of medium-sized city, in the West region of São Paulo. This is a third year Elementary School group that, in cooperative action, participated in activities resulting from the organization of an Investigative Teaching Sequence entitled "Photosynthesis and Food Chain". In it, in the immersion of the culture produced by humanity, written and scientific language activities intertwine and contribute to the formation of children's intelligence and personality, highlighting how this teaching practice involving problem solving, hypothesis raising and discussions brings positive impacts to the production of authorial texts, in which the child, when recording what he thinks and learned in class, expands his desire to express himself in his project of saying, and appropriates specifically human abilities related to writing and science. Thus, investigative activities may be a possible way to enhance the literacy process, as well as the student's involvement with the scientific culture.

KEYWORDS: Elementary School Cycle I. Scientific literacy. Inquiry based Science teaching. Written culture.

RESUMO*: O Ensino de Ciências por Investigação nos anos iniciais da escolarização contribui para o desenvolvimento do processo de Alfabetização Científica. Na exposição de parte dos resultados de pesquisa, crianças e professoras colaboradoras em cena, se situam em uma escola da rede pública de um município de médio porte, no oeste paulista. Trata-se de uma turma de terceiro ano do Ensino Fundamental que, em ação cooperativa, participou de atividades decorrentes da organização de uma Sequência de Ensino Investigativa, intitulada "Fotossíntese e cadeia alimentar". Na imersão da cultura produzida pela humanidade,*

[1] São Paulo State University (UNESP), Marília – SP – Brazil. Assistant Professor. Department of Didactics. PhD in Education. ORCID: https://orcid.org/0000-0001-6255-5843. E-mail: tatiana.moraes@unesp.br
[2] São Paulo State University (UNESP), Marília – SP – Brazil. Full Professor. Department of Didactics. Professor of Reading and Writing (UNESP). ORCID: https://orcid.org/0000-0003-0620-4613. E-mail: cyntia.girotto@unesp.br
[3] Federal University of Mato Grosso (UFTM), Cuiabá – MT – Brazil. Adjunct Professor. Department of Teaching and School Organization of the Institute of Education. PhD in Education. ORCID: https://orcid.org/0000-0003-4068-6417. E-mail: barbaracortella@gmail.com

atividades de linguagens escrita e científica se entrelaçam e contribuem para a formação da inteligência e personalidade infantis, evidenciando o quanto essa prática de ensino – envolvendo resolução de problemas, levantamento de hipóteses e discussões – traz impactos positivos na produção de textos autorais, nos quais a criança, ao registrar o que pensa e aprendeu em aula, amplia o desejo de se expressar em seu projeto de dizer e se apropria de capacidades especificamente humanas, relativas à escrita e à ciência. Sendo assim, as atividades investigativas podem ser um caminho possível para potencializar o processo de alfabetização, bem como o envolvimento do aluno com a cultura científica.

***PALAVRAS-CHAVE**: Ensino Fundamental I. Alfabetização científica. Ensino de ciências baseado em pesquisas. Cultura de escrita.*

***RESUMEN**: La Enseñanza de la Investigación en Ciencias en los primeros años de escolaridad contribuye para el desarrollo del proceso de Alfabetización Científica. En la exhibición de parte de los resultados de la investigación, los niños y maestros colaboradores en el escenario se encuentran en una escuela pública en un municipio de tamaño mediano, en el oeste de São Paulo. Este es un grupo de tercer año de escuela primaria que, en acción cooperativa, participó en actividades resultantes de la organización de una secuencia de enseñanza investigativa titulada "Fotosíntesis y cadena alimentaria". En él, en la inmersión de la cultura producida por la humanidad, las actividades lingüísticas escritas y científicas se entrelazan y contribuyen a la formación de la inteligencia y la personalidad de los niños, destacando cómo esta práctica de enseñanza que involucra la resolución de problemas, la formulación de hipótesis y las discusiones trae impactos positivos en la producción de textos de autor, en los que el niño, al registrar lo que piensa y aprende en clase, expande su deseo de expresarse en su proyecto de decir y se apropia específicamente de las habilidades humanas relacionadas con la escritura y la ciencia. Por lo tanto, las actividades de investigación pueden ser una posible forma de mejorar el proceso de alfabetización, así como la participación del estudiante en la cultura científica.*

***PALABRAS CLAVE**: Escuela Primaria Ciclo I. Alfabetización científica. Enseñanza de las ciencias por investigación. Cultura escrita.*

Initial words and theoretical anchoring

The text thematizes part of the actions developed within the scope of a research project, whose adopted framework is included in the field of the training of science teachers, as well as discusses a direct relationship with the promotion of Scientific Literacy (AC), from the methodological approach of Teaching Science by Research (ENCI) and the contribution to the production of author of texts for children of a third year of an elementary school (EF) from a school municipal public network.

National and international researchers have been dedicated to the research of the term Scientific Literacy, correlated to other denominations such as *scientific literacy, scientific*

literacy, alphabétisation scientifique, scientific literacy and scientific enculturation. In all these variations, the use has a direct relationship with teaching directed to learning and development of human capacities that enable the participation of learners in the decision-making processes of daily life, bringing implications for their citizen education (SASSERON; OAK, 2011).

The specialized literature points to the Teaching of Sciences (EC) as a possibility of a tool for the insertion and promotion of AC already in the initial years of schooling, so that the child can reflect, at the same time, on scientific knowledge and social reality, as well as to sophisticated their attitudes and capabilities specifically human. To this end, there is a broad consensus on the need for an AC that is promoting the preparation and involvement of citizens with scientific culture.

With this perspective, didactic-pedagogical actions addressed to the performance of problematizing activities, whose dynamics between the contents of the Sciences and the significant situations experienced by children in their daily lives need to be in focus. Understanding the world through the relationships between the knowledge of the scientific and technological phenomena present in its surroundings becomes a priority goal (CACHAPUZ *et al*., 2005; Gil; VILCHES, 2001).

We understand that the insertion of the child in the world of written and scientific culture can be carried out from early childhood. However, in the early years of the school life, literacy has a prominent place and is directed to the appropriation of written language and not merely written code, as many pedagogical practices do, without effectively contributing to the achievement of the ability and attitude of reading and writing with autonomy. This concept of literacy, when related to the CSEC seeks to consider the processes of understanding and expression of meanings that involve scientific knowledge in a proposal of AC (LORENZETTI; DELIZOICOV, 2001).

In this research, the methodological strategy of Teaching Science by Research gains prominence as an essential tool for the promotion of AC.

The investigative activities, when considered as a source of possibilities for the EC in the early years, guarantee the infantile protagonism in written and scientific languages. Azevedo and Abib (2013) assert, in their research, the power and scope of an investigative orientation for this teaching in the education of our children, provided that the problem-situation and research are valued and conceived as essential elements in the children's activities created by the teacher, focused on human learning and development, aimed at the formation of intelligence and personality since childhood.

In research teaching activities, the learning of procedural and analytical content is as important as that of theoretical constructs (AZEVEDO, 2006; OAK; SASSERON, 2012), to the point that the research activities seek to propose: the problem, preferably in the form of a question that stimulates the scientific curiosity of the student; survey of hypotheses, which should be issued by students through discussions; data collection and analysis, in which graphs and texts can be used so that students can explain this data; conclusion, when students formulate answers to the initial problem, based on the data obtained and analyzed.

Zompero and Laburú (2011) praise investigative activities as contributors to children's intellectual development, based on procedures such as: elaboration of hypotheses; annotation; data analysis and development of argumentation capacity.

In addition to the investigative activities being developed based on problematizing questions, being in line with aspects of the apprentice's life becomes vital in this process; as much as they constitute themselves as real and challenging problems, under the guidance of the teacher. If, through the problem of investigation, the child is led to the elaboration of his hypotheses (ZANON; FREITAS, 2007), continuing to ensure conditions for being engaged to the problem to be investigated and solved is also fundamental (ZOMPERO; LABURU, 2011), without which the guiding bases for a Scientific Education are not created.

It is certain that contexts and processes related to teaching and learning in science are extremely diverse, as Bastos *et al* (2004) emphasizes and, consequently, the authors warn about the unfeasible use of the same approach for everything that is intended to be taught. Notably, Carvalho and Sasseron (2012) point out that some EC themes are appropriate for this conception of teaching by research, while others would have to be worked with other didactic strategies and resources. The ENCI would be an option, among others, that the teacher could select when seeking to diversify his practice in an innovative way.

With the perspective of the ENCI, Carvalho and Sasseron (2012) defend the organization of teaching in the classroom for the development of Investigative Teaching Sequences (SEIs) that aim to systematize the pedagogical work related to scientific processes with children. The aim is to develop proposals congruent to the renewal of Scientific Education, so that school culture – already so guarded in deformed visions of science and technology – opens space for children not to grow up in an environment in which science is considered an area of knowledge reserved for geniuses in their sophisticated laboratories, as well as a knowledge that holds absolute and inexorable truths. Thus, Carvalho and Sasseron (2012, p. 153) point out some aspects that can be contemplated in the organization of these proposals:

(a) solving the problem in a small group;

(b) Teacher/class discussion with two focuses: the answer to 'how' solved the problem and "why it worked";

(c) Application of knowledge constructed in the reality of students, through the questions related by the teacher with simple questions; and

(d) Preparation of text written by students individually about what they learned in class.

Azevedo (2006) warns that the essence of teaching by research lies in collaborative action, that is, in ensuring the co-participation of all: children stop having a passive posture and start to learn to think, to elaborate reasoning, to verbalize, to write, to exchange and justify their ideas. In turn, the teacher, knowing the subject well, proposes challenging questions, besides presenting an active and open attitude, always attentive to the answers, valuing them, without being to applaud the assertions or to counter the so-called inappropriate and/or inappropriate – far from the always provisional scientific evidence – but including all children in the process.

In the context of the immersion of childhood in the world of written and scientific culture, the articulation between the appropriation of written and scientific languages, presents itself as an essential element. Chassot (2000) shows that a person's misunderstandings when reading a text of the mother tongue can be compared to the misunderstandings of people who do not master the language of science, that is, the one who does not master scientific language does not know how to read what nature is written in, so it does not significantly understand the natural world in which he lives.

The understanding of written language and literacy adopted by us, it is important to highlight, is supported by the research of the Bakhtinian Circle and the Vygotski School. Not without reason, Smolka's statement (1999, p. 58 and 68) that only literacy from the point of view of Vygotsky psychology (and, for us, also from the Bakhtinian perspective) can really account for the issue of the acquisition of oral and written languages as a process of social interaction. Vygotsky analyzes writing as a form of language, taking into account the discursive dimension and, for this reason, it cannot be something mechanical and meaningless to the child. On the contrary, language is a system that the child assimilates from its social context, internalizing it, resignifying it and then externalizing it full of meaning and social meaning. There is the domain of social discourse by the child.

However, if literacy does not consist merely in learning the writing of letters, words and prayers, it does not involve only a relationship between the child and the writing "[...] implies, since its genesis, the 'constitution of meaning' [...] a form of interaction with the other through the work of scripture" (SMOLKA, 1999, p. 69). Then, the importance of the interlocutor figure

arises in the discursive process that favors the construction of knowledge in a dialogical and discursive practice with literacy.

This is, according to Smolka (1999), the role (of interlocutor) – for us, here, we would add – of the teacher of literacy of written language and scientific language who intends to work with children a process of appropriation of reading and writing in a meaningful, interdiscursive and social way, as well as scientific language, enabling children to constitute and perceive themselves as readers and writers autonomous of their own history and the history of their reality-nature and sociocultural surroundings, so as to expand more and more also in its Scientific Literacy, expanding its human abilities and capacities.

The following is a clipping of the field search.

Course of investigative actions

The research presents a predominantly qualitative approach, since in education it is appropriate when it is intended, among other reasons, to understand processes and, in them, the nuances of subjective understanding that motivates the various participants (ERICKSON, 1998).

Lüdke and André (2018, p. 12) point out that qualitative research "has the natural environment as its direct source of data and the researcher as its main instrument", as well as is rich in descriptive data, has an open and flexible plan and focuses reality in a complex and contextualized way.

The data generated and selected here for analysis, in the context of the investigation, circumscribe a qualitative approach, therefore, regarding the search for understanding detailed observation in cooperation with the participants (BOGDAN; BIKLEN, 1994). They allow the analysis and interpretation of facts and phenomena exactly as they occur in the real, derived from the production of data, based on a consistent theoretical foundation, aiming to understand and explain the problem researched, as guided by Lüdke and André (2018).

Carvalho (2011) points out that any scientific work must be replicable, in similar situations, so that its results can be generalized. With this perspective, this paper presents a methodological proposal aimed at understanding the teaching and learning processes in science, but not of any teaching, but from a SEI previously planned by the researcher with the collaboration of the teaching teacher and based on theoretical and leading references.

The classroom, in its natural environment, constitutes a predominantly descriptive data source, aiming at the description of phenomena related to THE, which lead students to AC

processes. It is important to highlight that "the process is as important as the product" (CARVALHO, 2011, p. 25), as it is intended to characterize and understand the teaching process, considering the learning of students a product, from the perspective that there is only teaching, if there is learning.

The methodological path is part of the organization and offering of a course of Teaching Science by Research, a continuous training, in the context of the research groups in which the researchers are inserted. The data from the course will not be discussed in full, within the scope of this article, but it should be noted that its implementation and development resulted in subsequent actions, as enriching as it is renewing in the promotion for new research actions. Among these actions, as well as others related to the execution of the project, we highlight the participation of researchers in Collective Meeting Schedules (HECs), in an elementary school of the municipal network of Marília. In one of these actions was taught the training course mentioned above. In the unfolding of the activities, a pedagogical intervention was structured aiming to work with the approach of Science Teaching by Research.

It should be noted that the project was submitted to the Research Ethics Committee of the university and approved under no. 57864116.4.0000.5406.

From the application of SEI, data were obtained in the form of children's records (drawing and writing), analyzed based on thematic axes, i.e.: 1 - Recording of hypotheses; 2- Record of experimental-investigative activity; and 3- Registration of other activities.

Discussing the process of construction of the Investigative Teaching Sequence

The proposal for pedagogical intervention began with specific meetings for a more detailed understanding of the methodological approach to be used. Four meetings were held with this perspective, including:

1st meeting (15/02/18): meeting for presentation of the proposal and presentation of the annual planning of the teachers of the 3rd year. Forwarding: reading text to be discussed at the next meeting;

2nd meeting (22/02/18): meeting to discuss the text on the proposition of Investigative Sequences (CARVALHO, 2013), through theoretical presentation and collective discussion. Referral: systematize central elements for the proposition of a SEI with the theme photosynthesis (theme of interest of teachers);

3rd meeting (15/03/18): discussion about the elements of the SEI, considering the insertions of the teachers. Establishment of approximations between the textbook used and

other materials, as well as selection of activities. Forwarding: review the prepared document and suggest suppression or insertion of activities;

4th meeting (22/03/18): closure of SEI and establishment of collective combinations for its application in the four classes of 3rd year.

After this fruitful moment of collaboration between researchers and teachers, SEI was proposed, entitled "Photosynthesis and food chain", with the objective of understanding how the Teaching of Science by Research, based on Scientific Literacy, can contribute to the improvement of the production of written texts. The sequence was structured in eight meetings, including:

1. Initial problematization on "Where does food come from? ";
2. Readings of texts;
3. Experimental and investigative activities: bean planting and photosynthesis; work with data and variables;
4. Playful experiences, such as the game of the food chain;
5. Individual and collective records;
6. Discussions on the subject, and;
7. Closing situation with the construction of birdseed dolls.

We selected records from a class of the teachers participating in the research in order to analyze and discuss them.

The category "Hypotheses records" was evident in the writing produced by the children after the assembly of the bean planting experiment. The variables used by the teacher for the organization of investigative activity were:

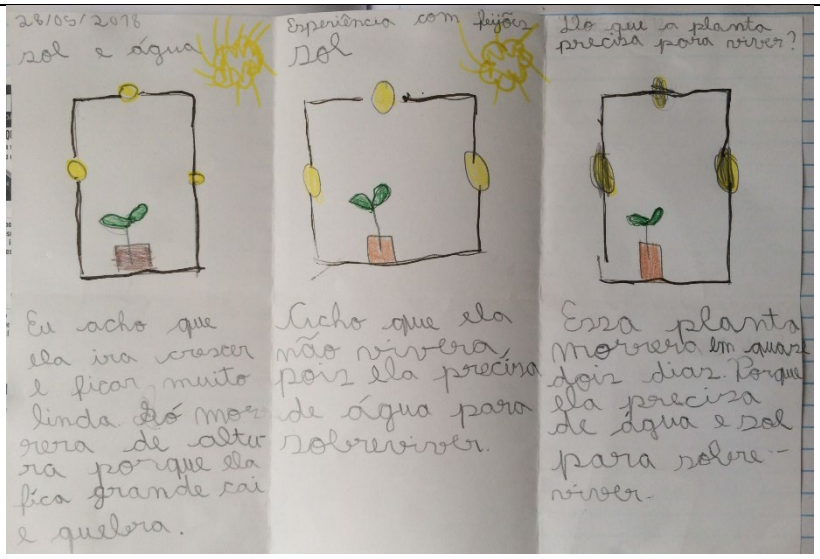
1st condition: planting of the seed with water and sun supply;

2nd condition: planting of the seed with sun supply (without water);

3rd condition: planting the seed without water and sun (closed box).

Figures 1 and 2 present the hypotheses and narratives/discourses provided by the children at the time.

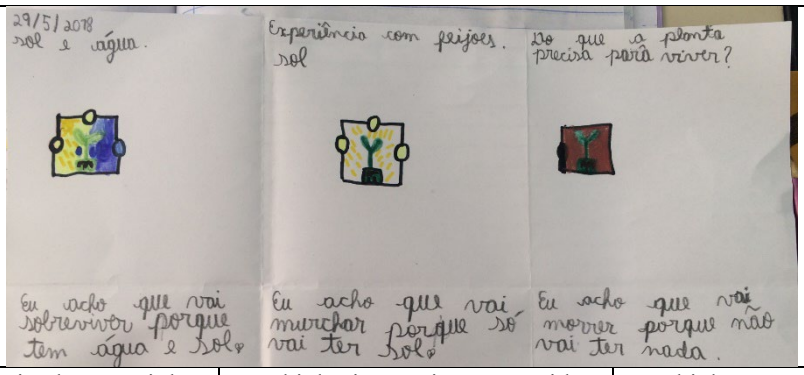
Figure 1 – Child record "A" containing the hypotheses of the elaborated experiment: Variables



"I think she will grow up and look very beautiful. She will only die tall because she gets big falls and breaks."	"I don't think she's going to live because she needs water to survive."	"This plant will die in almost two days. Because she needs water and sun to survive."

Source: Search data (2018)

Figure 2 – Record of child "B" containing the hypotheses of the elaborate experiment: Planting the beans under different conditions (variables)



"I think it will survive because it has water and sun."	"I think it's going to wither because there's only going to be sun."	"I think you're going to die because there's not going to be anything."

Source: Search data (2018)

The opening moment of the box for the visualization of the vase that ran out of water and light was long awaited by the children. Next, B draws the conditions in which the plants are found, after the final analysis of the data, including the observation and verification that the vegetable was closed (Figure 3).

Figure 3 – Continuation of the register containing the observations, after data analysis

		
"strong."	"survived."	"mucho [sic]."

Source: Search data (2018)

After recording the hypotheses and narratives/discourses of the children and observing the experiment, the text "Understand the problem" was read.

The analysis of the data indicates that, among the hypotheses of children, there is the idea of need for water and sun as a condition for plant survival, as well as the belief that the absence of these elements can impair their growth and even lead to death.

If the process of surveying hypotheses is an essential element for the development of an investigation, as Sasseron and Carvalho (2008) argue, it is also, therefore, an indicator of scientific literacy in construction, specifically related to the understanding of the situation analyzed. As punctuated by the authors, children A and B also explained, through their project of saying in writing, the ability to infer and make assumptions about observed situations, both in the situation of affirmation or questioning.

Lorenzetti and Delizoicov (2011) point out how much teaching by research should not be restricted to learning only vocabulary, information and facts linked to science; on the contrary, it should promote the development of skills of the processes through which scientific knowledge is constructed, including the survey of hypotheses. For authors:

> The development of procedural content sat in fundamental importance during the practical classes. To observe carefully the phenomenon under study, establish hypotheses, test them via experiment, record the results, allow students to act actively on the object of study, enabling a better understanding of the experiment (LORENZETTI; DELIZOICOV, 2011, p. 12).

These authors defend the idea that Scientific alphabetization in science teaching in the early years should be understood as a process by which the language of science acquires meanings, enabling the individual to expand his universe of knowledge, his culture and his/her performance as a citizen inserted in society.

Following the actions, it was proposed to perform an experimental and investigative activity, starting from the following question: Where does the oxygen we breathe come from? This activity was carried out after the teacher made a synthesis with the students about the

stages previously experienced, including a relationship about the need for the plant to produce its own food, as another condition for its survival, besides water and sun.

The realization of the experiment on photosynthesis aroused many doubts in the students, as well as the appropriation of a new vocabulary and expansion of their repertoire. Figure 4 shows the moment when the activity was carried out in the groups, highlighting the importance of the organization in small groups, as pointed out by Carvalho (2013), as fundamental for everyone to have the opportunity to speak and express their ideas before colleagues. In this environment of discursive interactions, mediated by the teacher, everyone has the possibility to learn and develop.

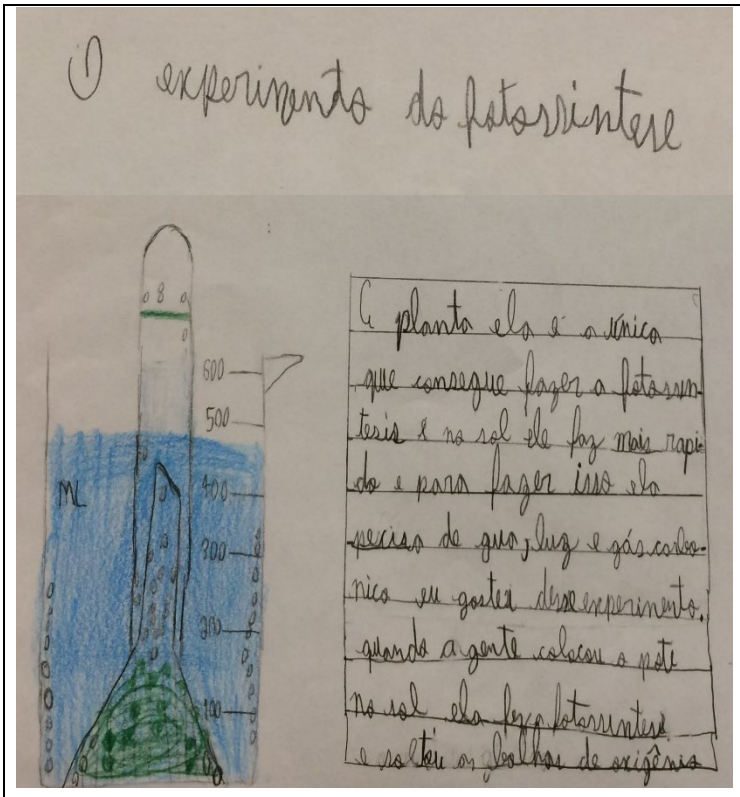
The central idea is that, when elaborating hypotheses, annotating and analyzing data to solve problem situations, dialogue with peers, cooperate with each other, through the sharing of their rediscoveries, children improve their cognitive abilities and, also, the capacity for argumentation is gradually complexing, ensuring the development of their intelligence and personality.

Figure 4 – Moment of experimental and investigative activity: Photosynthesis

Source**:** Search data (2018)

After performing the investigative activity, the children were asked to register individually for the composition of a portfolio. Figure 5 presents the "Record of experimental-investigative activity" of student C.

Figure 5 – Record elaborated after the photosynthesis experiment



Transcript:
"The photosynthesis experiment.

The plant she is the only one who can do the fotossintesis [sic] and in the sun it does faster and to do that she needs water [sic], light and carbon dioxide I liked this experiment. When we put the pot in the sun she did the photosynthesis and released the oxygen bubbles."

Source: Search data (2018)

Oliveira and Carvalho (2005), after analysis of productions of children in the 3rd year of the EF, concluded that most of the texts they have written include illustrations as a resource to help understand the ideas presented. These observations were also extracted from reports prepared at the end of science classes, after the performance of an investigated problem.

Similarly, Sasseron and Carvalho (2010) also state that children of the EF use the drawing as an auxiliary way, to expose the meanings they build in science classes, as well as to reinforce the statements made or, then, to complement the meaning of some ideas that still cannot express by the written text.

The analysis of the record of experimental-investigative activity, presented in Figure 4, points to the relationship between drawing and text written as complementary languages. The student draws the assembly of the experiment on one side, including elements that are not highlighted in the text, presenting the "signature of his name in each of these human acts" (BAKHTIN, 2005) that of drawing and reading; authorship in his project of saying through written language and visual language enunciating his "words" (BAKHTIN, 1995; 2003; SMOLKA, 1999; VYGOTSKI, 1993, 1995). In these terms, the text presents a narrative about the realization of the experiment rich in a graphic-discursive semantics. The child, when

writing, provides his interlocutor-recipient, establishes what, how and why he enunciates. Thus, it elects gender and its content, makes choices, establishes relationships, inferences, reviews and rereads its acts of writing and illustration and dialogue with its internal discourse, concretizing different cognitive and metacognitive actions, and, unbelievably, expanding its functions and psychic capacities, as well as its mental structures. By working with written and scientific languages, in symbolic essences, they make qualitative leaps in their human development.

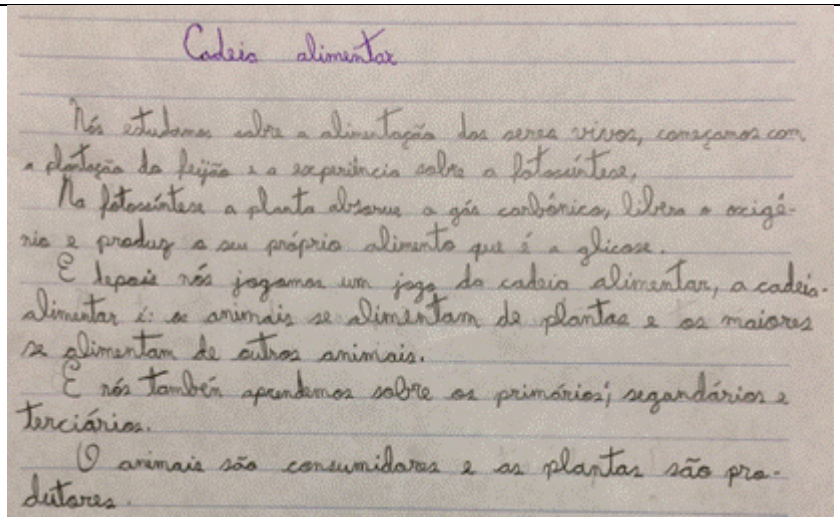
Finally, we read the texts "Aquatic and terrestrial food chain" and "Inside the food chains", as well as the development of the game "Food Chain", in which the groups of children received a material containing images of living beings (glued to pieces of wood) and arrows plasticized to represent the flow of energy (Figure 5).

Figure 5 – Moment of the game "Food Chain"

Source: Search data (2018)

After performing the playful activity, they were asked to register in the form of a report. This proposal differs from the previous one, because it aims to present a narrative in which the arguments are chained by the students, in different ways, from the appeal to the temporal resource in which the activities were carried out, as well as their understanding of the situations experienced. In this sense, the axis "*Registration of other activities*" was evident in the report of student D (Figure 6).

Figure 6 – Registration performed after the execution of the game "Food Chain"



Cadeia alimentar

Nós estudamos sobre a alimentação dos seres vivos, começamos com a plantação do feijão e a experiência sobre a fotossíntese.

Na fotossíntese a planta absorve o gás carbônico, libera o oxigênio e produz o seu próprio alimento que é a glicose.

E depois nós jogamos um jogo da cadeia alimentar, a cadeia alimentar é: os animais se alimentam de plantas e os maiores se alimentam de outros animais.

E nós também aprendemos sobre os primários, segundários e terciários.

Os animais são consumidores e as plantas são produtores.

Transcript: "Food chain

We studied about feeding living things, started with bean planting and experience about photosynthesis.

In photosynthesis the plant absorbs carbon dioxide, releases oxygen and produces its own food which is glucose.

And then we play a game of the food chain, the food chain is: animals feed on plants and the larger ones feed on other animals.

And we also learn about primary, secondary and tertiary.

Animals are consumers and plants are producers."

Source: Search data (2018)

From the analysis of the records presented above, as well as an adaptation of the categories of analysis of Moraes (2015), it is possible to infer that the students "describe *the materials used in the research*"; " *present an understanding of what photosynthesis is*" and "present *an understanding of what the food chain is*."

From this perspective, it is also possible to infer that the preliminary analysis of these data showed how much the children were able to communicate, report and appropriate the activities performed by attributing their own senses, but at the same time, based on scientific evidence. The activities developed allowed the development of skills associated with scientific making (manipulation of experimental materials, survey and hypothesis testing, work with data and evidence, formation of scientific concepts), which are powerful tools of insertion of the child in scientific culture and, consequently, contributes to the promotion of Scientific Literacy.

Moreover, these data indicate possibilities of integration between the disciplines of Portuguese Science and Language, in the context of The Teaching of Science by Research and Scientific Literacy.

Gabini and Diniz's (2012) research pointed out that teachers from the early years, in the process of continuing education, argued that the preparation of the reports produced by the

students, based on investigative activities, contributed to the writing process (literacy). Bertola and Moraes (2021), in the context of the Pedagogical Residency Program, also point to the power of written records, coming from investigative actions, which may favor the child's need to write and communicate their findings, understood as an activity inherent to investigative work.

Brandi and Gurgel (2002) highlight the importance of the reading and writing process in the EC, with a view to introducing the child into scientific culture. They rely on several researchers to present a model of development of the science curriculum, on which they consider some theoretical elements as fundamental components in this process, namely: critical thinking; collective activities between disciplines; students' problem-solving skills; persuasive communication; students' prior view on scientific, technological and social topics; ideal schooling environment for teaching-learning; teachers' knowledge and skills on the issue; among others.

For the authors, teacher education is an essential element for the insertion of AC in the initial years of the EF. In addition, they present other studies with children in this segment that initially aimed only to focus on the development of EC. However, they realized, during the work, that the learning of the Portuguese language developed concomitantly.

This "new" way of working the process of literacy of written and scientific languages necessarily imposes a new form of "teaching gestures", based on a practice of reading and discursive writing, of great verbal interaction, rich moments of dialogue, reciprocal teacher-child relationship, in which the teacher is constantly innovating, from the organization of the physical space of the classroom and available materials to the selection of methodologies and dynamics to be used. Working in this way, in which everyone has a turn and voice, the school will not be excluding or marginalizing students from different social contexts. On the contrary, it will be the opportunity for everyone to exercise their rights and free will within a school that is said to be democratic, but which has often been extremely traditionalist and exclusionary. And, as literacy forms the basis and beginning of the school process of the student's life, we believe that democratic teaching must start from this, in order to spread and reach the collective.

Final considerations

The perspective of this article was to discuss about the potential of Science Teaching by Research, both in the context of the formation of scientific concepts by children and in the interface with the area of languages. The hypothesis that underlies this investigation allows us to infer that the ENCI has the potential to contribute to effective processes of Scientific Literacy of children and, therefore, presents itself as an innovative methodological approach.

To this end, one of the paths chosen in this investigation to verify the skills associated with the AC process, from the proposition of a SEI, focuses on elements such as oral and written/designer language of children.

The activities proposed in the Investigative Teaching Sequences allowed students to engage with scientific culture through problem solving, survey and hypothesis testing, material exploration, data collection, oral discussions and information recording. By experiencing this process of investigation and making use of different languages of science, the child begins to develop essential skills for scientific doing, which have a direct relationship with AC processes, as well as enable the formation of new scientific concepts (MORAES; OAK, 2017).

Data analysis also allows us to infer about the contribution of the ENCI to the processes of appropriation of written language, reading and writing, that is, literacy as an integrating element between areas of knowledge and that allows a renewal of Scientific Education in the context of the classroom, as pointed out in the researches of Brandi and Gurgel (2002), Gabini and Diniz (2012) and Bertola and Moraes (2021).

In this sense, the development of these skills has a direct implication for the EC and should be fostered since the initial years of the EF, aiming at the construction of new concepts and scientific tools and the increasing involvement of children in scientific literacy processes.

Finally, it is necessary, also, to highlight the urgency that the teacher, especially in the early years, review his praxis, in order to better provide children with spaces for discussions, elaboration of their own ideas; that they mediate and strengthen the process of growth and apprehension of written language in the child, considering the pre-existing knowledge to the school, his previous knowledge, becoming a subject that teaches and a subject who learns, partner of a social process that will lead to the growth of both, surpassing the mechanical knowledge passed on by the school, still, in contemporaneity.

It is important to emphasize, however, that the teaching action lacks scientific bases, without which there will never be mediated reflection – on the part of the teacher of his own practice – in appropriate theories departing from works, whose contents are precious in order

to indicate ways to be followed by those who intend to translate a critical, humanizing and conscious educational praxis; theoretical-methodological works that do not require detailed and in-depth study by the teacher, whether in his initial or continuing education.

However, much has yet to be done to achieve this goal, because we know that the problem of school is not only methodological, but also mainly political and social. Many transformations will be made in the social context and in the school, because the process of discursive literacy itself, full and genuine, will only occur in conditions suitable and adequate for its implementation, which is greatly hindered, given the current operating conditions of the Brazilian public school, characterized by the overcrowding of students in the classes, overload of teachers' working hours, low wages and insufficient, fragile and precarious training – which does not prevent us from innovating in research and didactic interventions capable of producing pedagogical and social implications at the same time, causing the necessary and welcome changes, overcoming and revolutionizing commitments in the knowledge, feeling, thinking and acting teachers. From this point of view, assuming the task of proceeding to the work of literacy of written and scientific languages, on new bases, necessarily implies assuming a political conduct of social transformation.

ACKNOWLEDGMENT: Prograd - UNESP (Core Teaching Program).

REFERENCES

AZEVEDO, M. C. P. S. Ensino por investigação: Problematizando as atividades em sala de aula. *In*: CARVALHO, A. M. P. C. (org.) **Ensino de ciências:** Unindo a pesquisa e a prática. São Paulo: Thomson, 2006.

AZEVEDO, M. N.; ABIB, M. L. V. S. Pesquisa-ação e a elaboração de saberes docentes em Ciências. **Investigações em Ensino de Ciências**, v. 18, n. 1, p. 55-75, 2013. Available: https://www.proquest.com/openview/626b2c675b275065287beb1f75e0f511/1?pq-origsite=gscholar&cbl=2032603. Access: 17 Apr. 2021.

BAKHTIN, M. **Marxismo e filosofia da linguagem.** São Paulo: Hucitec, 1995.

BAKHTIN, M. **Estética da criação verbal.** São Paulo: Martins Fontes, 2003.

BASTOS, F. *et al*. Da necessidade de uma pluralidade de interpretações acerca do proceso de ensino e aprendizagem em Ciências. *In*: NARDI, R.; BASTOS, F.; DINIZ, R. E. S. (org.). **Pesquisas em ensino de Ciências**: Contribuições para a formação de profesores. 5 ed. São Paulo: Escrituras Editora, 2004.

BERTOLA, A. H.; MORAES, T. S. V. Os registros gráficos no contexto do Ensino de Ciências por Investigação: Em foco o Programa de Residência Pedagógica. **Revista Brasileira de Ensino de Ciências e Matemática**, Passo Fundo, v. 4, n. 2, p. 753-775, 2021. Available: http://seer.upf.br/index.php/rbecm/article/view/11157. Access: 18 July 2021.

BOGDAN, R. C.; BIKLEN, S. K. **Investigação qualitativa em educação**: Uma introdução à teoria e aos métodos. Porto: Porto editora, 1994.

BRANDI, A. T. E.; GURGEL, C. M. A. A alfabetização científica e o processo de ler e escrever em séries iniciais: Emergências de um estudo de investigação-ação. **Ciência & Educação**, v. 8, n. 1, p. 113-125, 2002. Available: https://www.scielo.br/j/ciedu/a/G8X4LjgpH7GTyTFZv5pHZDg/abstract/?lang=pt. Access: 25 Feb. 2021.

CACHAPUZ, A. *et al.* (org.). **A Necessária Renovação do Ensino de Ciências**. São Paulo: Cortez, 2005.

CARVALHO, A. M. P. O ensino de ciências e a proposição de sequências de ensino investigativas. *In*: CARVALHO, A. M. P. **Ensino de ciências por investigação**: Condições para a implementação na sala de aula. São Paulo: Cengage Learning, 2013.

CARVALHO, A. M. P.; SASSERON, L. H. Sequências de Ensino Investigativas (SEIs): O que os alunos aprendem? *In*: TAUCHEN, G.; SILVA, J. A. (org.). **Educação em ciências**: Epistemologias, princípios e ações educativas. 1. ed. Curitiba, PR: CRV, 2012.

CHASSOT, A. **Alfabetização científica**: Questões e desafios para a educação. Rio Grande do Sul: Unijuí, 2000

ERICKSON, F. Qualitative research methods for science education. *In*: FRASER, B. J.; TOBIN, K. G. (org.), **International handbook of science education, part one**. Massachusetts: Kluwer Academic Publishers, 1998.

GABINI, W. S.; DINIZ, R. E. S. A formação continuada, o uso do computador e as aulas de ciências nos anos iniciais do ensino fundamental. **Revista Ensaio**, Belo Horizonte, v. 14, n. 3, p. 333-348, 2012. Available: https://www.scielo.br/j/epec/a/7kFsrDbW6fCHtv6STJxVWhb/abstract/?lang=pt. Access: 25 June 2021.

GIL, D.; VILCHES, A. Una Alfabetización Científica para el Siglo XXI: Obstáculos y Propuestas de Actuación. **Investigación en la Escuela**, v. 43, n. 1, p. 27-37, 2001. Available: https://revistascientificas.us.es/index.php/IE/article/view/7667. Access: 18 May 2021.

LORENZETTI, L.; DELIZOICOV, D. Alfabetização científica no contexto das séries iniciais. **Ensaio – Pesquisa em Educação em Ciências**, v. 3, n. 1, p. 37-50, mar. 2001. Available: https://periodicos.ufmg.br/index.php/ensaio/article/view/10055. Access: 08 Apr. 2021.

LÜDKE, M.; ANDRÉ, M. E. D. A. **Pesquisa em educação**: Abordagens qualitativas. São Paulo: EPU, 2018.

MORAES, T. S. V. **O desenvolvimento de processos de investigação científica para o 1º ano do Ensino Fundamental**. 2015. Tese (Doutorado em Educação) – Faculdade de Educação, Universidade de São Paulo, São Paulo, 2015. Available: https://www.teses.usp.br/teses/disponiveis/48/48134/tde-15062015-142924/en.php. Access: 08 Aug. 2021.

MORAES, T. S. V.; CARVALHO, A. M. P. Investigação científica para o 1º ano do ensino fundamental: Uma articulação entre falas e representações gráficas dos alunos. **Ciência & Educação***,* v. 23, n. 4, p. 941-961, 2017. Available: https://www.scielo.br/j/ciedu/a/LSn7zcrpsZ6ZwKLLy6P3fSt/?lang=pt&format=html. Access: 10 Feb. 2021.

OLIVEIRA, C. M. A.; CARVALHO, A. M. P. Escrevendo em aulas de Ciências. **Ciência e Educação**, v. 11, n. 3, p. 147-166, 2005. Available: https://www.scielo.br/j/ciedu/a/N6NJx3jrYjm5XFsqpBhJT3C/?lang=pt&format=html. Access: 13 Mar. 2021.

SASSERON, L. H.; CARVALHO, A. M. P. Almejando a alfabetização científica no ensino fundamental: A proposição e a procura de indicadores do processo. **Investigações em ensino de ciências**, v. 13, n. 3, p. 333-352, 2008. Available: https://edisciplinas.usp.br/pluginfile.php/2799007/mod_resource/content/1/Almejando%20a%20alfabetização%20científica%20no%20ensino%20fundamental%20a%20proposição%20e%20a%20procura%20de%20indicadores%20do%20processo.pdf. Access: 06 Apr. 2021.

SASSERON, L. H.; CARVALHO, A. M. P. Escrita e Desenho: Análise de registros elaborados por alunos do Ensino Fundamental em aulas de Ciências. **Revista Brasileira de Pesquisa em Educação em Ciências**, v. 10, n. 2, 2010. Available: https://periodicos.ufmg.br/index.php/rbpec/article/view/3977. Access: 12 May 2021.

SASSERON, L. H.; CARVALHO, A. M. P. Alfabetização Científica: Uma revisão bibliográfica. **Investigações em Ensino de Ciências**, v. 16, n. 1, p. 59-77, 2011. Available: https://edisciplinas.usp.br/pluginfile.php/844768/mod_resource/content/1/SASSERON_CARVALHO_AC_uma_revisão_bibliográfica.pdf. Access: 23 May 2021.

SMOLKA, A. L. B. **A criança na fase inicial da escrita:** A alfabetização como processo discursivo. 8. ed. São Paulo: Cortez; 1999.

VYGOTSKI, L. S. **Obras escogidas**. Madrid: Visor, 1993.

VYGOTSKI, L. S. **Obras escogidas**. Madrid: Visor, 1995.

ZANON, D. A. V.; FREITAS, D. A aula de ciências nas séries iniciais do ensino fundamental: ações que favorecem a sua aprendizagem. **Ciências & Cognição**,v. 10, p. 93-103, 2007. Available: http://www.cienciasecognicao.org/revista/index.php/cec/article/view/622. Access: 16 mar. 2021

ZOMPERO, A. F.; LABURU, C. E. Atividades investigativas no ensino de ciências: Aspectos históricos e diferentes abordagens. **Ensaio – Pesquisa em Educação em Ciências**, Belo Horizonte, v. 13, n. 03, p. 67-80, set./dez. 2011. Available:

https://www.scielo.br/j/epec/a/LQnxWqSrmzNsrRzHh3KJYbQ/abstract/?lang=pt. Access: 12 Feb. 2021.

How to reference this article

MORAES, T. S. V.; GIROTTO, C. G. G. S.; OLIVEIRA, B. C. P. Child written records and scientific literacy: Focus on inquiry based science teaching. **Nuances Est. Sobre Educ.,** Presidente Prudente, v. 33, e022018, Jan./Dec. 2022. e-ISSN: 2236-0441. DOI: https://doi.org/10.32930/nuances.v33i00.9496

Submitted: 25/08/2021
Revisions required: 19/10/2021
Approved: 08/02/2022
Published: 31/03/2022