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A study on scientific literacy in the training and practice of teachers in the early years of elementary school

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ABSTRACT

This research aimed to investigate approaches to scientific literacy in the initial and continuing education of teachers and its manifestation in the practice of teachers in the early years of elementary school. The methodology consisted of a survey of works defended between 2014 and 2018 published in the catalog of theses and dissertations on Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and on Biblioteca Digital de Teses e Dissertações (BDTD). Thesis/dissertation were collected, selected, and organized in accordance with specific research criteria. Five monographs were included on the study and were analyzed with the technique of content analysis. The five selected monographs highlighted the importance of scientific literacy in the initial and continuing education of teachers of initial years from elementary school. In the defined period that this survey was carried out, it was found a reduced number of monographs covering the scientific literacy and its relationship with the teacher's education and with the teacher's performance on the initial years of elementary school. Therefore, there is a need of more studies focusing on the scientific literacy theme, so the scientific literacy may become a reality at classrooms, and consequently contribute to generate a solid foundation in the scientific education of students and teachers. In conclusion, there is a great need of reformulating the bachelor's in education programs, through the elaboration of purposes that may potentially contribute to the scientific education of teachers, extensive to their continuing education and with related research, aiming to improve their performance at classrooms, which will directly result in the scientific literacy of their students.

KEYWORDS: Scientific literacy. Teacher education. Teaching practice.

INTRODUCTION

This research was developed in the context of the project "Mathematical and Scientific Literacy in the training and practice of teachers in the early years of elementary school", which proposed to organize a database of scientific research, articulating the training of teachers in the early years and the perspective of scientific literacy, analyzing what approaches there are in these experiences for learning the scientific concepts of the early years and whether these concepts are contextualized to situations of physical and / or sociocultural reality. This is a project linked to the Programa Institucional de Bolsas de Iniciação Científica (PIBIC), funded by the Pró-reitoria de Pesquisa e Pós-Graduação da Universidade Federal do Pará, since April 2019.

In this text, preliminary results of the work plan, part of the aforementioned research, are presented, which fulfilled the objective of investigating approaches to scientific literacy in initial and continuing teacher education and the expression in their practice in the early years of elementary school, with a research developed between 2014 and 2018.

The research began in August 2019 through a survey of research works in the databases of the catalog of theses and dissertations on Coordenação de Aperfeiçoamento de Pessoal do Nível Superior (CAPES) and on Biblioteca Digital de Teses e Dissertações (BDTD). Defended and published works were sought between the years 2014 and 2018 that dealt with scientific literacy in the training and practice of teachers in the early years of elementary school to achieve the objective outlined.

The theoretical framework is based on Chassot (2003), when it addresses scientific literacy in a perspective interpreted as analogous to what is understood and assumes in this study as scientific literacy that, based on Santos (2007) and in the other references, advocates as a scientific and citizen education. Campos and Campos (2016) are also studied, on the importance of initial teacher training in the early years in relation to scientific knowledge; to Lorenzetti and Delizoicov (2001), with emphasis on the role of the teacher in school science teaching and scientific literacy in the early years of schooling; Mamede and Zimmermann (2005), who emphasize scientific literacy with approaches focused on Science, Technology and Society (CTS); Mesquita (2019) defending that through scientific literacy students tend to position themselves with social responsibility exercising citizenship, an idea similar to that of Araújo and Leite (2019), and Mesquita and Manfredo (2019) that they recommend, through a scientific schooling identified as scientific literacy, a global, interdisciplinary, social, historical and human formation to the student who needs to interact and act as a planetary citizen.

The text was developed dealing with scientific literacy and scientific literacy bulletin in relation to the teacher education of the early years, in which concepts of authors are presented that support the use of perspectives and defenses assumed in both terms and that seem to converge to a proposal of citizen scientific education anchored in a perspective of scientific literacy that does not dispense with scientific literacy embedded in it, or vice versa, as two sides of the same coin. Then, the methodological processes adopted for the organization, the construction of the data and their analysis are described. Finally, the results achieved in the

research are presented, focusing on their relevance, with the development of reflections pertinent to the context and the objective defined in the article.

LINKS BETWEEN SCIENTIFIC ALPHABETIZATION AND SCIENTIFIC LETRACY

The terms scientific alphabetization and scientific literacy are usually taken and used separately, with definitions that lead to suggest dichotomies and provoke questions (CUNHA, 2017, 2018) about positions taken regarding the conceptualization in productions of reference authors in science education in Brazil such as Lorenzetti and Delizoicov (2001), Chassot (2003), Santos (2007). The terms can be admitted as complementary, or even interwoven in conceptual terms when seeking consensus or a synthetic and functional position for their use in the field under discussion. Therefore, they are understood in this article as inseparable from the educational point of view, since both are important to the promotion of a quality and socially referenced scientific education.

Santos (2007, p. 479) points out that "in the school tradition, scientific alphabetization has been considered within the meaning of the domain of scientific language, while scientific literacy, in the sense of the use of social practice". This is a unanimity perceived in the references consulted when considering language studies such as Soares (1998) and those cited by Cunha (2017, 2018), which are taken up by Lorenzetti and Delizoicov (2001) and Santos (2007).

Sometimes these concepts mix or complement each other, given that scientific alphabetization implies the mastery of concepts in the scientific fields and their language, concepts, symbols and nomenclatures expressed in the written language, this being the link with the term alphabetization in the field of language; and when advancing in the use of this knowledge in the social environment, it starts to assume the status of scientific literacy. In a relational understanding, this makes them indissoluble and everything that is thought to dichotomize will bring limitations to the process of citizen science education defended as the purpose of school science teaching. Hence the education of the student becomes limited, which is limited to understanding and employing scientific concepts detached from an objective reality, circumscribing these capacities to the school or academic context. The socio-historical reality requires it to expand this school knowledge of the sciences and this is possible when there are channels of articulations, contextualizations, interdisciplinary dialogues that allow it to extrapolate scientific alphabetization, experiencing it now as scientific literacy.

When recognizing the imbrication between the two concepts for science teaching, it should be emphasized that education in the terms mentioned should not be limited to the memorization of concepts, definitions and symbologies related to school science knowledge without meaning and apart from school and social experiences of the student. Away from this split, it is important that the subjects perceive, apprehend and understand how to use this knowledge in their daily lives so that this appropriation can make them improve the world around them.

It is based on this statement that it is worth considering the interpreted similarity of the reading by Chassot (2003), in terms of the conceptual confluence

between the scientific literacy and scientific literacy nomenclatures and allows the author to be taken as a reference in the sense of scientific literacy adopted in the text. This same interpretation made it possible to read Lorenzetti and Delizoicov (2001) when associating the term scientific literacy to issues involving CTS and science literacy, as will be discussed below.

Chassot (2003, p. 96) affirms that science teaching should allow the student not only to read the world, but also to see the possibilities of transforming it for the better. He considers science as a language to facilitate the reading of the natural world (the world visible to all), and the mastery of this knowledge that describes this reality helps in the individual's understanding of himself and the surrounding environment. Alphabetization literacy would then make it possible to understand the language through which science is known, it would be "the set of knowledge that would make it easier for men and women to read the world where they live" (CHASSOT, 2000, p. 19).

In defending science as a language to be understood, the author says that the intention is to collaborate so that these transformations involving daily life are conducted in favor of better living conditions. Thus, he defends scientific literacy as a form of social inclusion. Such perspectives defended by him allow to perceive his perception of scientific alphabetization as scientific literacy, including in addition his understanding of Science as "facilitator of being part of the world". (CHASSOT, 2003 p. 93).

This is corroborated by the author when mentioning the requirement that literate people in their mother tongue are critical citizens and not illiterate politicians, and that likewise, scientifically literate people, in addition to facilitating the reading of the world in which they live, need to understand the needs to transform it for the better, something that reiterates the role of

> [...] scientific alphabetization in providing the understanding of knowledge, procedures and values that allow students to make decisions and realize both the many uses of science and its applications in improving the quality of life, as well as the limitations and negative consequences of its development. " (CHASSOT, 2003, p. 99).

Lorenzetti and Delizoicov (2001), using the same term "alphabetization literacy" also approach its meaning to scientific literacy when they contest, as Chassot (2003), the reproductive teaching of scientific concepts, devoid of meanings, senses and applicability in reality of the individual and defending the development of the critical and creative spirit of the teacher, with active involvement in the community in which he is inserted.

In this sense, they argue that, since the beginning of schooling, there is the possibility of scientific literacy, independent of the domain of reading and writing. They point to the definition of scientific alphabetization as the individual's ability to read, understand and express an opinion on matters involving science, but they question that for that he needs to have mastered the written code[2]. Considering, thus, be possible a scientific alphabetization of the students in the early years, even before children mastered the written skill and including "this scientific alphabetization could highly help the process of acquisition of the written code, providing conditions for students to expand their culture". (LORENZETTI; DELIZOICOV, 2001, p. 47 e 48).

Thus, they reaffirm the possibility of scientifically literating the subject even before their appropriation of the written language, that is, since the beginning of school education. For them, such appropriation will lead the individual to be "scientifically literate in the subjects involving Science and Technology, going beyond the mere reproduction of scientific concepts, devoid of meanings, senses and applicability." (LORENZETTI; DELIZOICOV, 2001, p. 48). Therefore, the intention would be to train subjects capable of understanding the meaning of what they are learning and making use of that knowledge in the spaces where they live. When dealing with literacy and associating it with the scientific term, it is noted that the authors reaffirm the sense of scientific alphabetization defended by them and advance in the incorporation of aspects involving literacy, especially scientific literacy. Based on this concept, the authors consider that:

> It can be said that literacy is the use that people make of reading and writing in their social context. Living with a wide variety of information, it is hoped that people will be able to understand the meanings that the texts provide, incorporating them in their social practice. The individual will be able to make competent and frequent use of reading and writing at work, at home, at leisure, etc. (...) The category Literacy in Sciences refers to the way people will use scientific knowledge, either in their work or in their personal and social life, improving their life or assisting in decision-making in the face of a constantly changing world. (LORENZETTI; DELIZOICOV, 2001, p. 52).

Santos (2007, p. 479), expanding the discussion around scientific literacy, he says that "by using the term literacy, we seek to emphasize the social function of scientific education, in contrast to the restricted meaning of school alphabetization". It is noticed that the author is in line with the other mentioned authors, considering it important that scientific education is directed to the social use of scientific knowledge. It also emphasizes that "one cannot think about teaching its contents in a neutral way, without contextualizing its social character." (SANTOS, 2007, p. 478). Likewise, one cannot discuss the social function of scientific knowledge without understanding its content. Therefore, it is necessary to contextualize the taught content, containing meaning for the student, in a constant dialogue with reality.

Given what has been presented, it is understood that scientific alphabetization and scientific literacy - whether using the two terms separately or using only scientific literacy in the sense of both or vice versa - are intertwined and are domains of the same scientific education, an education capable of combining diverse knowledge in favor of the formation of a subject to live and act in a society in constant change and which requires complex and adaptive thinking. In the face of this scientific formation that induces a citizen practice, Mesquita (2019, p. 314) reiterates scientific education as a continuous "process that occurs not only in the school context, but outside it as well, and that involves, in addition to knowledge related to scientific terms and concepts, responsible decision making that enhances the social participation of individuals".

Araújo e Leite (2019, p. 169) share these ideas when they bring scientific literacy closer to scientific literacy advocated and employed at work, stating that it "involves understandings of a social, political and historical nature in the action of the individual in his daily life, based on the knowledge about Sciences learned in the school environment or in the schools. digital media".

Finally, the authors brought up in this section bet on a scientific education whose results are significant to the training of students. This will be possible if there is the necessary contextualization with the social practice of those involved, since it involves cognitive processes and domains to form meanings and senses of the school knowledge involved, being quite dynamic processes.

Thus, according to the aspects involving scientific alphabetization and scientific literacy, the meaning and use of scientific literacy is assumed as a term that brings with it the meaning of scientific alphabetization elsewhere addressed in this text, expanding its own also presented. In other words, scientific literacy will be employed as the sense of scientific alphabetization in its binomial aspects is already incorporated in it, as well as the reference of authors who use scientific alphabetization in the same terms brought in their texts will be maintained, since our understanding and arguments have made them congruent with the understanding of scientific literacy assumed in this article.

That said, the importance of the presence of scientific literacy from the basis of teaching is reinforced so that the subjects can learn the scientific contents together with their senses, meanings and use in the society of which they are participants, being able to make use of them in the different events of its practice in society, understanding common phenomena in the light of scientific and technological explanations and their social and environmental implications.

SCIENTIFIC LITERACY AND ITS IMPORTANCE IN TEACHING TRAINING

Another important aspect to consider in this debate on scientific literacy, when it comes to citizen science education, concerns the interaction between students and the teacher, as well as the active participation of the former in the construction of this knowledge, which must be monitored and conducted by the teacher. Mesquita e Manfredo (2019, p. 35) point out that “providing speech events, especially to students in the early years, is fundamental and develops the critical sense important to their school progress”. In this perspective, it is worth emphasizing the importance of the teacher creating meanings for the use of this scientific knowledge by students in their life in society.

In this perspective, Mesquita and Manfredo (2019, p. 35) point out that “there is special attention to the students' orality, since at different times they are asked to position themselves in relation to the subject addressed; in others, conversation circles or socializations are proposed”. This is one of the ways of favoring the student's expression, so that it is possible for the teacher to perceive how this knowledge is being understood, that is, through the positions, she/he can better follow the advances in understanding the scientific knowledge involved and provide significant advances.

Thus, it is up to the teacher's attention on the way such knowledge contributes significantly to develop students' autonomy, since they can thus be led “to assume the position of subjects in front of knowledge, as they start to question it.” (MAMEDE; ZIMMERMANN, 2005, p. 3). It is essential, therefore, that the teacher can also reflect on the importance of scientific literacy, since the initial years in the education of the student, given the need to train critical and conscious subjects in relation to science and its relations in the natural and social environment.

As already mentioned, the role of the teacher in this teaching-learning process is essential, in the sense of literacy and of a truly scientific education. Chassot (2003, p. 55) stresses that systematizing knowledge is undoubtedly "one of the fundamental tasks of the school and of the teaching performance so that this process of literacy occurs in order to provide meaning and sense to the knowledge that is being appropriate", and the mediation of the teacher in this process essential. The author also points out that the teacher is a transformative agent from whom it is demanded:

> [...] new technical and instrumental skills to properly perform their educational function in line with the demands of this literacy perspective, the teacher needs to both develop critical thinking and creativity, as well as be actively involved with his community, being an opinion maker. (CHASSOT, 2003, p. 57).

And this refers to the relevant initial and continuing training of these education professionals, being necessary to be scientifically literate so that they can think and develop teaching strategies that articulate the desired context of science education and the student's reality, so that they can perceive how this knowledge can be used in their daily life. This is an important training need, as the excerpt below expresses:

> School science education, in general, has been developed in a totally decontextualized way, through the ritualistic resolution of exercises and school problems that do not require a broader conceptual understanding. This corresponds to superficial literacy in the sense of the strict vocabulary domain of scientific terms. (SANTOS, 2007, p. 486).

The contextualization of science education with the students' daily lives is fundamental to facilitate their understanding of how to use this scientific knowledge in their personal and social relationships, contributing to the formation of a world in which they have a voice and a time to position themselves in front of decisions that benefit society as a whole. The contextualization of science education with the students' daily lives is fundamental to facilitate their understanding of how to use this scientific knowledge in their personal and social relationships, contributing to the formation of a world in which they have a voice and a time to position themselves in front of decisions that benefit society as a whole" (CAMPOS; CAMPOS, 2016, p. 143). In this way, this teacher will be able to favor mediation in the construction of the scientific knowledge of his students, so that they can understand the world around them and have autonomy in decision making.

The way in which the teacher will be able to conduct this process of scientific education is something to be discussed and alternatives must be sought in this regard. Araújo e Leite (2019), in a recent study in official documents guiding the curriculum of the early years, they consider that, although there is defense and guidance relevant to the work and the approach to conducting the practice of scientific alphabetization in the official documents analyzed, teachers are unable to develop a proposal due to the reduced time available to work on science content in the school environment. Nevertheless, they highlight the document Caderno de Ciências da Natureza in Ciclo de Alfabetização do Pacto Nacional pela Alfabetização na Idade Certa (PNAIC) who evaluate it as a "good work alternative for continuing

education in Science Teaching, conceptualizing Scientific Literacy and bringing suggestions for teaching practice". (ARAÚJO; LEITE, 2019, p. 165).

The document points to a more democratic distribution of content in school curricula in terms of workload and recommends working around the CTSA approach with a view to "a citizen and global education that promotes the formation of subjects aware of their rights and duties and that respect the environment". (ARAÚJO; LEITE, 2019, 177).

For Mesquita (2019, p. 310), the school is delegated responsibility not only for the development of the contents, but for their social use in the practical lives of the students, and teaching professionals need knowledge and skills that are beyond the curricula of subjects to be taught. in order to develop in students the ability to use this knowledge in events of daily life.

Thinking about the issues dealt with on scientific alphabetization, scientific literacy and the role of the teacher and his education through the aspects addressed, this study sought to investigate approaches to scientific literacy in the initial and continuing education of teachers and the manifestation in the practice of teachers of the early years of the elementary education, with the time cut in research developed between 2014 and 2018. The following are the methodological delineations guiding the study.

METHODOLOGY FOR THE BUILDING OF DATA IN RESEARCH DEVELOPMENT

The data analyzed in this study, for the purpose of reaching its objective, come from a survey of theses and dissertations published from 2014 to 2018 on CAPES and on BDTD and were collected between September and October 2019, and the research started with theoretical studies in August of the same year.

The on-screen review was developed in five stages. In the first stage, all the theses and dissertations were raised in the databases mentioned above. The search term used was "Scientific Literacy". As a result, 110 papers, including theses and dissertations, appeared on the CAPES and 59 on the BDTD. After refinement for the delimitation of the years 2014 to 2018, the result on CAPES decreased to 83. This same process was not possible on BDTD, since the platform does not have this option to delimit the year.

With refinement, using the criteria of teacher training and basic education, the result on CAPES after the filter was 22 works. Of those, 18 are dissertations and 4 are theses. On BDTD, the filter selected 15 works, 12 of which are dissertations and 3 are theses.

In the second stage, the initial selection was refined by reading the abstracts and verifying the adequacy of the content of the theses and dissertations to the objective of the proposed survey. The process resulted in 11 works from the CAPES portal and 6 from the BDTD, with 1 duplication in the result, having the same dissertation both on CAPES and on BDTD.

After this selection, a more in-depth reading was carried out in the abstracts and parts of the complete texts to see if all the works were meeting the requirements of the research with delimitation in the training and practice of teachers in the early years of elementary school and the perspective of scientific

literacy. From this reading, a new selection was made, obtaining a total of 5 works of the master's thesis type, as shown in table 1:

Table 1 - Selected works for analysis after applied filters

Nº	Author/year	Title and objective	Database
1	Anna Carolina Santos Reis Dalamura (2016)	Language and Science Teaching: A Study on the Textual Gender Entry and its Transposition in the Early Years **Objective:** To analyze the relationship between the teaching of mother tongue and science, in an interdisciplinary perspective.	CAPES
2	Cristiane Reis Barcelos Silva (2016)	Scientific Literacy under the Teaching Initiation Program (PIBID): An Analysis of Scientific Production in the Science Teaching Area **Objective**: To analyze in scientific productions in the area of science education, how the Scientific Literacy proposal is addressed in the subprojects of the Institutional Program for Teaching Initiation Scholarships (PIBID).	CAPES
3	Genivaldo Gomes Candido (2017)	Science Teaching in the Early Years at a Full-Time School: Introducing Notions of Acoustics Through Music **Objective:** To try the use of alternative strategies to teach science to students from 7 to 8 years old from the first segment of elementary school.	CAPES
4	Mateus Lorenzon (2018)	The Investigative Spiral as a Strategy for the Development of Scientific Literacy in the Early Years of Elementary School **Objective:** To analyze how participation in research projects fosters the development of Scientific Literacy in children in the 3rd year of Elementary School.	CAPES
5	Adriano Santos de Mesquita (2018)	Teachers' Perceptions of Human Sexuality from the Perspective of Scientific Literacy in the Early Years of Elementary School **Objective:** to investigate ways for teachers to approach the theme of human sexuality, considering scientific literacy and evidencing new perceptions of them about their approaches based on training processes promoted in the contexts of performance in the early years of elementary school.	CAPES

Source: Own authorship (2020).

As shown in chart 1, 5 (five) works met the scope of the research, being they from the CAPES database; it is also noteworthy that no thesis was selected for analysis, due to the non-compliance with the filtering criteria[3].

In the third stage, it was necessary to have a floating reading - moment when the researcher has contact with the collected documents, access to its content and makes the choice of the material to be analyzed - to systematize the initial ideas, with the organization of the material to be analyzed with the aim of making it operational. With that, it was possible to carry out the categorization that started from the following more specific questions related to the analyzed works: which approaches on scientific alphabetization and scientific literacy? What are the approaches to scientific literacy in initial teacher education in the early years of elementary school? What are the approaches of scientific literacy in the continuing education of teachers in the early years of elementary school? How is scientific literacy approached in the teacher's practice in the early years? How is scientific literacy reflected in students' learning, according to the authors of these works?

The fourth stage took place from the construction of the corpus, that is, material collected from the detailed reading for the construction of the data to be analyzed according to the research objective, from the documents collected and which were the object of the analysis, according to the content analysis technique, by Bardin (1977, p. 42) which, according to the author, is

> A set of techniques for analyzing communications in order to obtain (by systematic and objective procedures for describing the content of messages) indicators (quantitative or not) that allow the inference of knowledge related to the production / reception conditions (inferred variables) of these messages.

Content analysis seeks to know what is behind the words observed by the analyst, seeking other realities through what is being exposed in the messages.

> Document analysis allows you to move from a primary (raw) document to a secondary document (representation of the first). They are, for example, abstracts (condensations of the document according to certain rules); or indexing, which allows, by classification in keywords, descriptors or indexes, to classify the information elements of the documents, in a very restricted way. (BARDIN, 1977, p. 46).

This process aims to organize the material to be analyzed, assessing its relevance to respond to the research objectives, coding the registration unit within the context unit, with emphasis on the most important passages, to then perform the categorization of the data. All the description and the condensation of the analyzed documents facilitate the researcher's work when making the inference of meanings, which constitutes the effective concretization of the content analysis (BARDIN, 1977). Thus, in the fifth and last stage, analyzes and inferences of the constructed data are produced. Such constructs will be presented in the following topic.

SOME RESULTS ACCORDING TO THE ISSUES OBSERVED IN THE WORK

Category 1 - Approaches to the concepts of scientific alphabetization and scientific literacy

In this first category, based on the question about scientific alphabetization and scientific literacy approaches, it was possible to highlight some fragments of the analyzed texts that justify it.

In Lorenzon's research (2018, p. 45), scientific alphabetization is placed as the subject's use of "scientific information to carry out a critical reading and intervention of the environment in which he is inserted, resulting in the adoption of new attitudes aimed at improving their living conditions." It can be inferred that he uses the term scientific alphabetization in the perspective of scientific literacy, as did Lorenzetti and Delizoicov (2001), Chassot (2003) and Araújo and Leite (2019). Such understanding is similar to what Santos (2007) defends when dealing with scientific literacy. These authors point out the validity of science teaching, when they highlight how the appropriation of critical and contextualized scientific knowledge is able to influence students to seek improvements to transform their reality.

This is also the perspective of the approach observed in Silva's work (2016, p. 33), according to which scientific literacy is defined as "a science teaching proposition that aims to contribute to the formation of citizens capable of understanding and using critically basic scientific concepts in their social context". For this to happen, students would need to have access to this knowledge which would be under the responsibility of the school as an important place in the dissemination of scientific knowledge. Thus, Silva (2016) agrees with the idea that "citizenship can only be fully exercised if the citizens have access to knowledge [not reduced to information] and it is up to educators to do this scientific education" (CHASSOT, 2003, p. 49). Therefore, it is necessary to select information in order to promote students' scientific training.

In the research by Dalamura (2016, p. 15), the author defines scientific literacy as "a dimension that goes beyond the domain of literacy by promoting a certain autonomy of individuals regarding the use of reading and writing in social relationships and in different communicative spheres". Agrees with the criticism of Santos (2017) about a science teaching that prunes this autonomy as it is developed by overvaluing the "memorization of words, classificatory systems and formulas through didactic strategies in which students learn scientific terms, but they are not able to extract the meaning of their language " (SANTOS, 2017, p. 484). It is noted that the Dalamura allows dialogue with this author, but the conclusion that comes is close to what Lorenzetti and Delizoicov (2001) and Chassot (2003) defend as teaching Science for citizenship. In front of the featured authors, it is possible to say that scientific literacy needs to overcome the transmissive and decontextualized way of teaching Science, in order to bring more meaning to the student, so that he can make use of this knowledge in his social practices.

Candido (2017), in his approach, highlights the importance of associating the knowledge of reality with Science, Technology and Society (STS), emphasizing the

need for science teaching to develop in students “in addition to scientific concepts and experimentation, the concern with the environment in which they live, the quality of life of people and, consequently, the association of contemporary practices through the STS perspective” (CANDIDO, 2017, p.25). The association of science education with STS is configured in broadening the student's view of the nature of science and its role in society. According to Mamede and Zimmermann (2005, p. 2), “science education, within this perspective, constitutes an important strategy for the inclusion of the individual in social life, in an active way and not merely as a spectator”. In this perspective, this teaching will enable the social use of this scientific knowledge in the student's daily life, as well as the performance of this scientifically literate subject in society, transforming it and improving everyone's life.

In the work of Mesquita (2018), there is a constant presence from the perspective of scientific literacy, when he affirms: “I understand the social situations experienced by each of us as fundamental scientific practices that help in the understanding of the science-technology-society relationship.” (MESQUITA, 2018, p. 50). It also emphasizes that the development of this knowledge should be encouraged and be present in the initial training experiences of the teacher who will work in the early years of elementary school.

In view of what the studies have shown, it can be highlighted that scientific alphabetization approaches are related to the perspective of scientific literacy, although some refer to alphabetization and non-literacy. They emphasize the social use of the knowledge involved in the teaching of Science, which means that there is an effort to mark the character of approximation of a scientific education with the contextualization of knowledge in the school context. In their approach to scientific literacy, the authors point out the importance of scientific knowledge for the promotion of student autonomy for the exercise of citizenship, aiming at what is best for the whole of society. This allows us to infer that in these works there is a concern of the authors not only with the teaching of scientific concepts, but they are allied with a perspective that advances to the level of a broader and more situated and transformative education that advocates relating everyday phenomena of daily life scientific and technological explanations and their social and environmental implications, as mentioned here in terms of the meaning of scientific literacy.

Category 2 - Approaches to scientific literacy in the initial training of teachers in the early years of elementary school

In this second category, which deals with approaches to scientific literacy in the initial training of teachers in the early years, few fragments related to this aspect were highlighted in the studies analyzed, which signals a lack of this approach in research within the defined period.

Silva (2016, p.15) points out that science teacher training courses “should promote spaces for discussion and reflection on issues related to the production of knowledge in science education and how this knowledge can be used in pedagogical practice”. Thus, it emphasizes the need to reflect on the training of science teachers for the production of scientific knowledge, since, in practice, if the teacher does not have adequate training, he will not be able to see the

possibilities of teaching science in a contextualized way, taking advantage of the knowledge and experiences of its students. With the research it was possible to infer that there is not a clearly defined approach on scientific literacy in the curricula of the initial teacher training courses of the works analyzed in the study of the author.

In the work of Candido (2017), it is emphasized that the initial training of teachers is essential for reflection and encouragement to address the various strategies in science teaching, exploring all the possibilities of the environment around them. Inadequate teacher training makes it difficult for students to develop scientific knowledge, as well as the lack of appreciation of students' daily lives in science education is an aggravating factor that needs to be resolved in order to promote scientific literacy.

In the work of Mesquita (2018, p. 29), it is pointed out that teachers from the early years of elementary school need to reflexively and critically mediate the processes of social transformation and human formation of students; and for that, it is necessary that teacher training courses value the discussion of themes that involve the students' daily lives.

Therefore, it is necessary that the teacher has access to adequate initial professional training that qualifies him to play his role as a people-forming agent, so that he, together with his students, can transform the reality around them.

Category 3 - Approaches to scientific literacy in continuing education for teachers in the early years of elementary school

This category deals with the approaches of scientific literacy in the continuing education of teachers and brings some important fragments about this aspect in the texts of the studies done.

The papers presented some propositions about the need for the association of initial and continuing teacher education linked to scientific literacy. According to Silva (2016, p. 79), “this combination will allow teachers, in addition to incorporating discussions about these objectives, to provide the development of their autonomy in the search for information in order to transform their classes”. In order for this knowledge to develop in the teacher's practice, it is important that the teacher training is linked to scientific literacy in a continuous way, since the beginning of their training, to enable the practice of the teacher in the classroom. The author stresses the importance of articulation in the following terms:

> [...] reformulation of degrees and the implementation of programs that contribute to initial and continuing teacher education are essential, as they help to remedy the deficiencies of training courses by providing subsidies capable of preparing Science educators for the scientific literacy of their students. (SILVA, 2016, p. 38).

The main objective of this reformulation in undergraduate courses is to promote training for teachers in the early years of elementary school, which will allow them to identify the need and possibilities of using this scientific knowledge in their classroom practices in order to develop the scientific literacy of their students. students. It is believed that this training process is continuous, and it is

up to the teacher to reflect on his own practice and seek to improve every day (CAMPOS; CAMPOS, 2016). Therefore, it will only be possible to scientifically literate the student if the teacher is scientifically prepared.

In his research, Mesquita (2018) mentions the search and the importance of continuing education, when he states: "I have sought, together with colleagues in my profession, continuing education courses that can contribute to overcoming training gaps so that I can insert the students in the scientific culture since the first years of schooling." (MESQUITA, 2018, p. 27). He adds that the objective would be to alleviate the limitations of the initial teacher training in relation to the contents on scientific literacy.

The works, therefore, denote the importance of the scientific training of teachers in the early years and the need to develop this knowledge in pedagogical practices in basic education, in an articulation between knowledge of initial training that complement each other in the moments of professional practice in a continuous training course and teaching development.

Category 4 - Approaches to scientific literacy in the practice of teachers in the early years of elementary school

In this category, the analyzes refer to the approaches of scientific literacy in the practice of teachers of the early years, according to the selected works which portray the need for approaches in the teaching of Sciences that have social relevance for students, in order to promote reflection and critical positioning of them. According to Silva (2016, p. 103), it is important to make this contextual through:

> [...] insertion of teaching activities that, in addition to promoting students' reflective engagement on scientific subjects of interest, allow students to articulate scientific knowledge with the ability to seek solutions to daily problems, helping them to understand and transform the world for the better. your return. (SILVA, 2016, p.103).

This transformative capacity to form people capable of transforming the reality in which they live is defended in Chassot (2003, p. 97), who points out "we have to educate citizens who not only know how to read the world where they are inserted, but also, and mainly to be able to transform this world for the better". Such thinking was observed in Mamede and Zimmermann (2005) with changes made in future teachers of the early years in terms of teaching physics. A produção reflexiva de textos oriunda das práticas vivenciadas possibilitou-lhes a problematização de conhecimentos e a consolidação de uma postura ativa frente à própria aprendizagem, de maneira criativa e autônoma, facilitando a aproximação de conteúdos de física. A autoras pontuam ainda que "a perspectiva CTS possibilitou-lhes compreender a relação da física com questões sociais mais amplas e a inserção do conhecimento científico e tecnológico na vida cotidiana". (MAMEDE; ZIMMERMANN, 2005, p. 3-4).

It is understood with this discussion that scientific education is important, both for the subject's personal growth, as well as for his participation in the social sphere, enabling him to become active in society, as the framework adopted in this article recommends.

The contextualization emphasized in Silva (2016) is also defended by Dalamura (2016, p. 27), when saying that "this allows the teacher not to be restricted only to the teaching of genres based on the textbook, so that, thus, reading and writing are developed starting from real situations of interaction" [...]. As in Mesquita (2018), which reflects on the perceptions of teachers in their study on the topic of human sexuality, previously aligned with biologizing and out-of-context discourses of students' practice and which, after formative moments, demonstrated the construction of new knowledge about sexuality in new parameters according to which scientific literacy is linked to new ways of thinking about the practice developed with students in the early years of elementary school.

In order for this to actually extend to a larger group of teachers, with greater coverage, it is necessary to better plan and develop practices in the classroom, to investigate them, as well as to disclose the results obtained and to promote developments that reach not only the student and teacher in the intra-school context, but that their benefits reach society as a whole.

Lorenzon (2018), in line with this perspective, points out that it is through scientific alphabetization in the sense of investigating everyday phenomena and seeking to explain them more rigorously, that the child will be able to develop his / her criticality and carry out new readings of the world in which it's inserted. For this, there is a need for teacher planning for the teaching-learning process, exploring dialogue, imagination and reflection.

The analyzed works show the need for teachers to use strategies to articulate the teaching of Science to the daily life of the school and the classroom towards students, in order to implement a pedagogical practice that encourages students to make use of this knowledge in their social practices, endowing them with ways of reflecting on their responsibilities as citizens.

Category 5 - The reflection of scientific literacy in student learning

In this last category, it was analyzed how scientific literacy can be reflected in students' learning, inferring some propositions of fragments extracted from the analyzed texts.

For Silva (2016), students' scientific literacy is important so that they "[...] transform themselves, through the teaching of scientific contents, into more critical people, who are able to collaborate with the transformation of the environment in the face of their conditions where they live." (SILVA, 2016, p. 33). This means that, through scientific literacy, it is possible to train more critical and active people in society, with the capacity to transform it.

The contextualization of scientific concepts in the student's daily life is a strategy used to give meaning to the use of this acquired knowledge. According to Candido,

> [...] science learning is a process that is built and must seek meanings in order to produce new knowledge, it is necessary that we seek alternative strategies in the field of arts to teach science to our students and lead them to question and perceive how much it is interesting to do science. (CANDIDO, 2017, p. 30).

The benefits that this knowledge provides to the students' lives are valuable and allow thinking and acting according to society as highlighted throughout the other categories and reaffirmed by Dalamura (2016, p. 116) who says that scientific literacy is a possible path to the student to read and understand the "scientific concepts that circulate in society, as this way he can position himself consciously in face of events related to Science and its consequences and social impacts".

This is corroborated by Lorenzon (2018, p. 48) when referring that scientific literacy favors the teaching-learning process, because "it makes it possible for children to understand the ethical responsibilities of their actions and intervene in the environment in which they are inserted more critical" (LORENZON, 2018, p. 48).

In turn, Mesquita (2018) addresses the positive reflexes of scientific literacy in teaching-learning, pointing out that in the early years this relationship is vital, since it is at that moment that students are in full development of their intellectual faculties and, therefore, susceptible to learning. The author considers that for there to be scientific literacy in the teaching-learning process of sciences, that is, for the student to be scientifically literate, he must be enabled to teach scientific contents that start from everyday facts and, in an articulated way, can converge to reflect on possible social uses, including being able to express themselves through scientific vocabulary (MESQUITA, 2018).

According to the analysis of the selected works and in view of the purpose of the research survey carried out, it appears that the concepts of scientific alphabetization and scientific literacy are related to each other, being taken in the works as imbricated and sometimes receiving a denomination from another term, according to the theoretical framework adopted, and in all works there is an inseparable delimitation of the meaning that integrates the unquestionable need for the appropriation of scientific knowledge in science education that cannot happen apart from dialogue with the sociocultural reality in which the students are inserted. The reason is that the sense with which both are approached portrays the importance of scientific education from the teaching base, highlighting the social use of this knowledge by students in favor of changes in relationships within society that will allow the valorization of the knowledge produced by science and its democratization.

The analysis of the works also demonstrated the need for a reformulation of undergraduate courses with the creation of proposals that encourage scientific literacy in initial education, as well as this being extended to the continuing education programs of teachers in the early years of elementary school.

Such initiatives tend to promote teacher training whose results may bring significant improvements to the practice of teachers and the learning of students, contributing in fact to the desired scientific education, which consolidates the individual in society as a critical citizen and aware of his rights and duties facing the natural and social world. In the same way that it is envisaged to encourage and promote these formative proposals, it is necessary to further encourage studies that have as their object the formation of teachers in the perspective of scientific literacy, as their approaches were observed throughout the study. There is a predominant focus on teaching and on processes involving scientific alphabetization and literacy, but little is yet directed and intensified research

aimed at teacher education to act in this reality of literacy in school education, especially in science teaching.

FINAL CONSIDERATIONS

The research brought partial results of a bibliographic survey on scientific literacy in the training and practice of teachers in the early years and shows its relevance by enabling the investigation of approaches to this theme in the initial and continuing education of teachers in the early years of elementary school in published works academic research.

The survey and analysis of the studies showed a lack of research on formative content involving scientific literacy in undergraduate courses that train teachers to work in the initial years of schooling, as well as in continuing education. This data may be reflected in the future practices in the classroom of future professionals, directly implying in the scientific literacy of students, with the absence of this direction and of their approach. Related to this, there is a need to create proposals for the continuing education of teachers to include this knowledge essential to the training or scientific education of teachers to act successfully in the early years of primary education.

The set of works showed scientific literacy as fundamental for the scientific training of subjects, as it influences their autonomy and decision-making in the social sphere, stimulating the sense of responsibility as a citizen, from the base of education, enabling a more critical look in relation to the world you live in. In the works, in one way or another, there is the defense of a science teaching that makes the subject more involved with the knowledge of science and the resulting scientific situations, using the relevant language, recognizing its importance and implications in people's lives, society, the environment.

Therefore, there is a profusion of guiding principles and practical suggestions in the works that are combined with those collated in the referential framework. Despite this, the number of studies surveyed and their focus still indicates that there is still a lot to be done for scientific literacy to become a reality in the training and practice of teachers in the early years, as well as in the scientific education of students. The challenge is great, but necessary in order to transform the world for the better, through schooling with current scientific training that further leverages the contributions of science education.

Therefore, it is recommended that research be encouraged in the initial and continuing education of teachers in the early years and that they may take into account the following questions: what is the teacher's role in mediating scientific literacy, in proposing experiences in which students relate school experiences in science with problems in their daily lives, developing interest in science and seeking to transform attitudes and thoughts in their social life? What didactic-pedagogical actions will best allow the teacher to stimulate students' communication and argumentation in order to appropriate the scientific language and value it? How to enable the teacher to have an initial and continuing education in which he can understand scientific concepts and aspects related to the nature of science, in the sense of his own training and mediation in the learning of students in the early years?

If there is research that can answer these questions, it is believed that it is possible to make significant progress in productions dealing with scientific literacy and teacher training with a view to a scientific education capable of transforming the new generations of citizens in Brazil and in the world.

Um estudo sobre a alfabetização científica na formação e prática de professores nos anos iniciais do ensino fundamental

RESUMO

Esta pesquisa teve como objetivo investigar as abordagens da alfabetização científica na formação inicial e continuada de professores e sua manifestação na prática docente nos anos iniciais do ensino fundamental. A metodologia consistiu no levantamento das obras defendidas entre 2014 e 2018 publicadas no catálogo de teses e dissertações da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) e da Biblioteca Digital de Teses e Dissertações (BDTD). As teses / dissertações foram coletadas, selecionadas e organizadas de acordo com critérios específicos de pesquisa. Cinco monografias foram incluídas no estudo e analisadas com a técnica de análise de conteúdo. As cinco monografias selecionadas destacaram a importância da alfabetização científica na formação inicial e continuada de professores dos anos iniciais do ensino fundamental. No período definido em que esta pesquisa foi realizada, constatou-se um número reduzido de monografias abordando a alfabetização científica e sua relação com a formação do professor e com o desempenho do professor nos anos iniciais do ensino fundamental. Portanto, são necessários mais estudos voltados para a temática da alfabetização científica, para que a alfabetização científica possa se tornar uma realidade em sala de aula e, consequentemente, contribuir para gerar uma base sólida na formação científica de alunos e professores. Em conclusão, existe uma grande necessidade de reformulação dos programas de licenciatura em educação, através da elaboração de propostas que possam potencialmente contribuir para a formação científica de professores, extensiva à sua formação continuada e com pesquisas afins, visando a melhoria do seu desempenho em sala de aula, o que resultará diretamente na alfabetização científica de seus alunos.

PALAVRAS-CHAVE: Alfabetização científica. Formação de professores. Prática de ensino.

NOTES

1. Responsible for translating the article: Maurício Oliveira Coelho Marques. Tel.: +5591981156041, e-mail: moccoelho@gmail.com.

2. Written code refers to the acquisition and mastery of the Alphabetical Writing System (SEA) of the mother tongue, Portuguese. Even though the authors used this term "written code" there is an understanding that learning the mother tongue corresponds to the learning or appropriation of the "Alphabetical Writing System" and not a simple code, which could incur the false idea that the The reading and writing process could be taken as a mere decoding or deciphering of this system, which is not the case, considering the current discussions on the teaching of the mother tongue. (ALBUQUERQUE, 2007).

3. It should be noted that in the works filtered in the search for the term "scientific literacy", the term does not appear exclusively in the title, but is also located in the abstract or in the keywords. For this reason, the term does not appear in the titles of Dalamura (2016), Candido (2017) and Lorenzon (2018).

REFERENCES

ALBUQUERQUE, E. B. C. de. Conceituando alfabetização e letramento. In: SANTOS, C. F.; MENDONÇA, M. **Alfabetização e letramento:** conceitos e relações. 1ª ed., 1ª reimp. Belo Horizonte: Autêntica, 2007.

ARAÚJO, M. A. O. A. de; LEITE, R. C. M. Alfabetização científica nos anos iniciais do ensino fundamental: o que nos dizem os documentos oficiais. **ACTIO**, Curitiba, v. 4, n. 3, p. 165-184, set./dez. 2019. Disponível em: https://periodicos.utfpr.edu.br/actio/article/view/10428. Acesso em: 05 nov. 2020.

BARDIN, L. **Análise de conteúdo**. Tradução Luís Antero Reto e Augusto Pinheiro. São Paulo: Edições 70, 3. reimp. da edição de 1977.

CANDIDO, G. G. **O Ensino de Ciências nos Anos Iniciais em uma Escola de Tempo Integral:** introduzindo noções de acústica por meio da música. 88 f. 2017. Dissertação (Mestrado profissional em ensino de ciências) - Instituto Federal de Educação, Ciência e Tecnologia do Rio De Janeiro, IFRJ - Campus Nilópolis, Rio de Janeiro, 2017.

CAMPOS, R. S. P. de; CAMPOS, L. M. L. A Formação do Professor de Ciências nos anos iniciais do Ensino Fundamental e a compreensão de saberes Científicos. **Revista Amazônia**, v. 13, 2016, p. 135-146.

CHASSOT, A. I. Alfabetização científica: uma possibilidade para a inclusão social. **Revista Brasileira de Educação**, São Paulo, v. 23, n. 22, p. 89-100, 2003. Disponível em: http://www.scielo.br/pdf/rbedu/n22/n22a09.pdf. Acesso em: 03 mar. 2020.

CUNHA, R. B. Alfabetização Científica ou Letramento Científico? Interesses envolvidos nas interpretações da noção de scientific literacy. **Revista Brasileira de Educação**, v. 22, n. 68, 2017.

CUNHA, R. B. O que significa alfabetização ou letramento para os pesquisadores da educação científica e qual o impacto desses conceitos no ensino de ciências. **Ciência & Educação**, v. 24, n. 1, 2018.

DALAMURA, A. C. S. R. **Linguagem e Ensino de Ciências:** um estudo sobre o gênero textual verbete e sua transposição nos anos iniciais. 140 f. 2016. Dissertação (Mestrado Em Educação). Universidade Federal de Juiz de Fora-UFJF, Juiz de Fora, 2016.

LORENZETTI, L.; DELIZOICOV, D. Alfabetização científica no contexto das séries iniciais. **Ensaio – Pesquisa em Educação em Ciências**, v. 3, n. 1, jun. 2001. Disponível em: https://www.scielo.br/pdf/epec/v3n1/1983-2117-epec-3-01-00045.pdf. Acesso em: 12 ago. 2019.

LORENZON, M. **A Espiral Investigativa como uma Estratégia de Desenvolvimento da Alfabetização Científica nos anos iniciais do ensino fundamental**. 232 f.2018. Dissertação (Mestrado em Ensino). Fundação Vale do Taquari de Educação e Desenvolvimento Social – FUVATES. Biblioteca Digital da Univates. Lajeado, 2018.

MAMEDE, M.; ZIMMERMANN, E. Letramento Científico e CTS na Formação de Professores para o Ensino de Ciências. **Enseñanza de Las Ciencias**, 2005. Número extra. VII Congresso UnB – Faculdade de Educação. Disponível em: https://ddd.uab.cat/pub/edlc/edlc_a2005nEXTRA/edlc_a2005nEXTRAp320letcie.pdf. Acesso em: 28 jan. 2020.

MESQUITA, A. S. de. Ação social responsável: práticas de letramento científico e matemático nos anos iniciais do ensino fundamental. **ACTIO**, Curitiba, v. 4, n. 3, p. 309-326, set./dez. 2019. Disponível em: https://periodicos.utfpr.edu.br/actio/article/view/10522. Acesso em: 15 fev. 2020.

MESQUITA, A. S. de. **Percepções Docentes sobre Sexualidade Humana na Perspectiva do Letramento Científico nos Anos Iniciais do Ensino Fundamental.** 154 f. 2018. Dissertação (Mestrado Profissional em Docência em Educação em Ciências e Matemáticas) Universidade Federal do Pará, UFPA-IEMCI. Belém, 2018

MESQUITA, A. S. de; MANFREDO, E. C. G. Sugestões para abordagem de temas relativos à Sexualidade Humana nos anos iniciais do ensino fundamental. **Revista de Estudos e Pesquisas sobre Ensino Tecnológico** (EDUCITEC), 5(10), 2019.

SANTOS, L. P. dos. Educação Científica na Perspectiva de Letramento como prática social: funções, princípios e desafios. **Revista Brasileira de Educação**, v. 12, n. 36, set./dez.2007. Disponível em: https://www.scielo.br/pdf/rbedu/v12n36/a07v1236.pdf. Acesso em: 23 set. 2019.

SILVA, C. R. B. **Letramento Científico no Âmbito do Programa de Iniciação à Docência (PIBID):** uma análise de produção científica na área de ensino de ciências. 121 f. 2016. Dissertação (Mestrado Profissional em Educação). Universidade Federal de Lavras-Biblioteca Universitária da UFLA, Lavras, 2016.

SOARES, M. B. **Letramento:** um tema em três gêneros. Belo Horizonte: Autêntica, 1998.

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