


THE CHALLENGES OF ENVIRONMENTAL HEALTH ON THE SCIENCE CURRICULUM ON THE LAST YEARS OF ELEMENTARY EDUCATION, IN THE STATE OF TOCANTINS

OS DESAFIOS DA SAÚDE AMBIENTAL NO CURRÍCULO DE CIÊNCIAS DO ENSINO FUNDAMENTAL ANOS FINAIS, NO ESTADO DO TOCANTINS
LOS DESAFÍOS DE LA SALUD AMBIENTAL EN EL CURRÍCULO DE CIENCIAS EN LOS ÚLTIMOS AÑOS DE LA ESCUELA PRIMARIA EN EL ESTADO DE TOCANTINS


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ABSTRACT:

Environmental Health is an area of knowledge that goes through many curricular components, especially in the Natural Sciences, an important field to develop it. It should be related to the teachers' preparation to work in a critical way with a bias towards scientific literacy. This study aimed to evaluate the challenges faced by teachers in the area of Natural Sciences to implement Environmental Health in the Final Years of Elementary School, in the state of Tocantins. A quantitative and qualitative research identified a high percentage of young teachers, with higher prevalence to teach expository lessons and little appropriation of scientific literacy. Although the teachers indicated little difficulty in working with the themes of Environmental Health, they reported the need for continued education.

KEYWORDS: Scientific literacy; Teacher; Continuing education.

Introduction

Environmental Health refers to problems connected to physical, chemical, biological and ecological components that make up the natural world and interfere with human health (ORDOÑEZ, 2000; WEIHS; MERTENS, 2013).

Until the 1970s, this area of knowledge centered around the toxicological view such as: environmental toxins, lead levels, mercury, particulates, asbestos, molds, pesticides, i.e., human biomonitoring (BURS; DUNN; SATTler, 2002). After the environmental movement and the conferences held on environment and health promotion, Environmental Health gained greater notoriety. Today, it is focused on the "planetary health" paradigm, which also encompasses digital, psychosocial, political, socioeconomic and cultural determinants (VIRGOLINO *et al.*, 2020). It can be inferred that Environmental Health is a two-way street, because the relationships that man establishes, when

implementing his professional, industrial, recreational activities, interfere with the environment, which, in turn, interfere with human health (WEXLER, 2013).

In the educational curriculum, since 1932, the Natural Sciences have been a prominent field for Environmental Health. However, it was after the LDB/1971, with the mandatory nature of the discipline of Science in all Basic Education, that there was curricular consolidation of Environmental Health, always based on hygienist and biologist discussions (MAGALHÃES JÚNIOR *et al.*, 2011).

The National Curriculum Parameters (PCN) (Ministry of Education [MEC], 1998), through the Cross-Cutting Themes "Health" and "Environment", brought guidelines for an integrated understanding of natural phenomena, with an interdisciplinary perspective. Furthermore, they established conceptual links between different sciences such as Astronomy, Biology, Physics, Geosciences and Chemistry, in addition to technological knowledge, to counteract the school scenario, still dominated by the traditional curriculum. However, little progress was observed due to the teachers' lack of involvement in the discussions, a dynamic that was made possible in the continuing education moments.

Although the Natural Sciences curriculum is a favorable field to discuss Environmental Health, because the themes are pertinent to its curriculum, the teachers' lack of preparation may be a limiting factor. However, this factor can be improved by providing training focused on scientific literacy. Scientific literacy develops self-learning skills related to the interpretation of scientific information and promotes connection with other areas that are essential to broaden the understanding of Environmental Health (CACHAPUZ *et al.*, 2005; CHOI; LEE; SHIN, 2011; NASCIMENTO; COSTA, 2009; SASSERON; CARVALHO, 2008).

In Tocantins, the work with Environmental Health in the curriculum has not been different from the reality of other states in Brazil. Studies show punctual actions, such as those present in the School Health Program or in Environmental Education, in which the focus predominates in some events or projects and a critical-historical pedagogy is not addressed (FERNANDES; SOUSA, 2020).

The Common National Curricular Base (BNCC) and the Tocantins Curricular Document (DCT), currently, have been references for the elaboration of school curricula in the state (MEC, 2020; SECRETARIAT OF EDUCATION, YOUTH AND SPORTS [SEDUC], 2019). In these documents, Environmental Health is presented in the Contemporary Themes, in the General and Specific Competencies, in the Thematic Units, in the Knowledge Objects, and are in line with the Sustainable Development Goals (SDGs).

However, it is recognized that, to give visibility to the theme in the curriculum, greater knowledge and discussion is imperative.

Therefore, this work aimed to evaluate the difficulties of teachers in the area of Natural Sciences to work with Environmental Health in Elementary School 6th to 9th grade, in the state of Tocantins, Brazil.

Methodological procedures

A total of 134 semi-structured questionnaires were sent (via Google Forms) to the email of Nature Science teachers, who worked with students from 6th to 9th grade, in schools located in the municipalities headquartered in the thirteen Regional Education Directorates (DREs) of the state of Tocantins, in the year 2019.

The questionnaire was prepared with nineteen questions, divided into two stages. The first was organized with objective questions and was intended to know the profile of the teaching staff: gender; age range; time of experience in Elementary Education; time of experience as a teacher; area of training in graduation; training in public or private institution; specialization or post-graduation. The results were tabulated in Excel for descriptive analysis.

The second stage focused on issues related to Environmental Health, to understand conceptions of this approach in teaching practice in the area of Natural Sciences. The questionnaire included closed and open questions. In the closed questions, we used a Likert scale with four items, being two questions with "High Importance, Moderate Importance, Low Importance and No Importance"; another question with "High Frequency, Moderate Frequency, Low Frequency, No Frequency"; and, finally, one with "High Difficulty, Moderate Difficulty, Low Difficulty and No Difficulty". The open-ended questions gave teachers the opportunity to describe topics they would not have mentioned spontaneously in the closed-ended questions (FLICK, 2013) and are useful for understanding teachers' ways of thinking in this context.

The content analysis, proposed by Bardin (2007), was used as a methodological procedure. The text corpus was built based on the answers to the questionnaire. Following the author's procedures, the pre-analysis phase was started, with floating reading to get to know and explore the material, treat, infer and interpret the results. With the range of information collected, the rule of "completeness" was accepted, when analyzing all items that comprised the questions; the rule of "representativeness", when inserting in the sample science teachers representing various regions of the state; the rule of "homogeneity", by not running away from the proposed theme, asking questions to understand the Environmental Health in the area of Nature Sciences in Elementary

School; and the rule of "pertinence, when adapting the documents as a source of information" (BARDIN, 2007, p. 91).

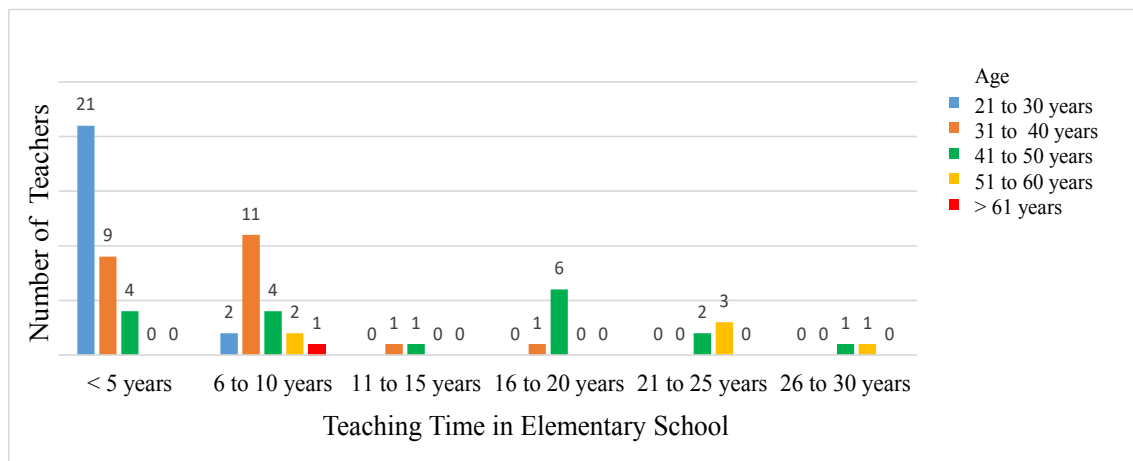
In the presentation of results, it was performed the "cut of the text in comparable units of categorization for thematic analysis and coding modality for the registration of data" (BARDIN, 2007, p. 94). With this methodological view, the questions that make up the questionnaire are presented and then the units of records are listed for coding, aiming at categorization and frequency counting.

Results and discussion

134 semi-structured questionnaires were sent out (via Google Forms) and, with the help of the technicians responsible for the area of Natural Sciences, 70 questionnaires were returned, which are part of this analysis.

According to the results of the first stage of the questionnaire, 46 teachers (66%) were female and 24 (34%) were male. Of these, 23 teachers (33%) reported being between the ages of 21 and 30. Only 2 teachers (3%) had between 6 and 10 years of teaching experience in Elementary Education, the others (20 teachers; 29%) had less than 5 years of experience. The high percentage of teachers with up to 5 years teaching experience at this level (28 teachers; 40%) is noteworthy. Moreover, more than half of the participants in this research (43 teachers; 61%) did not have more than 10 years of experience in elementary school. It is worth noting that of the 70 teachers interviewed, only 5 (7%) had 21 to 25 years of experience, and only 2 (3%) had more than 25 years in elementary school (Graph 1).

Graph 1 Age range and teaching time of Natural Science teachers in the Final Years of Elementary School (6th to 9th grade). Data collected from May to September 2019, for the state of Tocantins.



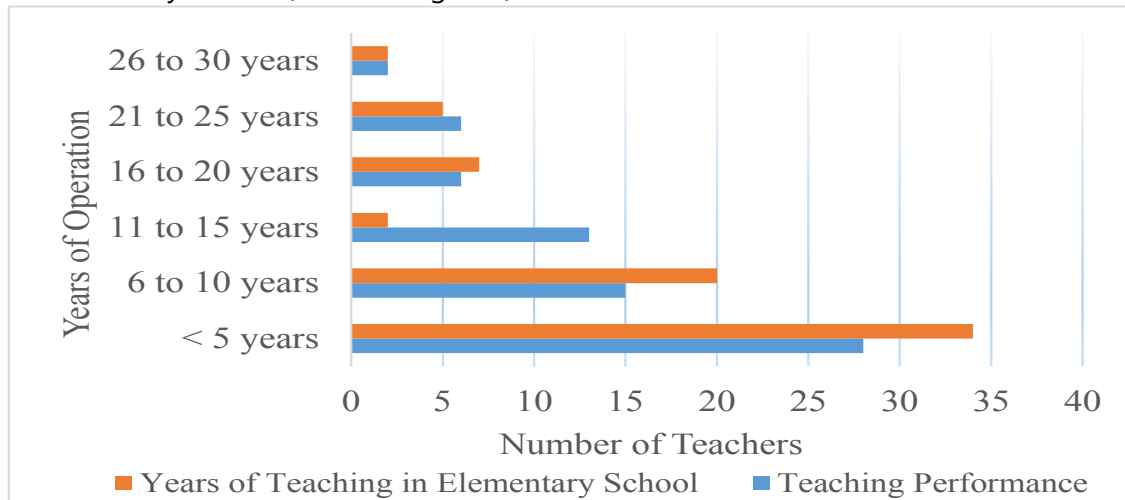
Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

Graph 2 shows that the teaching experience of the teachers who participated in this research is not only linked to the Elementary School Final Years. It can be observed that 7 teachers (10%) stated that they had less than 5 years of experience only in Elementary School, but that they have a longer career in other levels of education. This is due to the fact that many schools offer more than one teaching modality, and teachers can work in Elementary and High School at the same time.

These results highlight a group of teachers young in career (21 teachers; 30% up to 30 years old) and with little teaching experience (27 teachers; 30% with up to 5 years of experience). This young group may be related to the turnover of these professionals in schools, since the last public competition for permanent teachers in Tocantins took place in 2008. Over these years, with the retirement and or the relocation of teachers from classrooms due to health problems, the vacancies were filled by teachers, often recent graduates, with temporary contracts. In 2019, in the state of Tocantins, 31% of the teachers working in Nature Sciences were concurrent, the rest tied to temporary contracts (SEDUC, 2019). The large percentage of temporary contracts increases the transit of teachers between schools, between one school year and another, and prevents the continuity of the work developed in the school. The lack of professional stability also hinders the successful implementation of training policies for teachers to deal appropriately with educational issues and those related to Environmental Health.

The policy of valuing the teaching career and continuing education with support from universities has been adopted by the countries that bring the best scores in international assessments focused on youth education, such as the Program for International Student Assessment (PISA). These nations continually evaluate the quality of their students' education, require teachers to work in their area of training, encourage professional development, and foster the continuing education of younger teachers with the participation of teachers with more professional experience (SUARTE; SILVA; SEIBERT, 2021).

Graph 2 Time of experience as a teacher and teaching experience only in the Final Years of Elementary School (6th to 9th grade) for the Natural Sciences teachers.



Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

Darling-Hammond's (2017) studies on teacher education found that more experienced teachers achieve better results and are more effective with students, especially on tasks that require higher-order thinking and problem solving. This corroborates with the studies of Shulman (1987), who reports that for less experienced teachers, teaching practice is relatively underdeveloped because it depends on an integrative process, rooted in the day-to-day life of the classroom.

Regarding the education of the teachers who participated in this research, 100% said they had attended higher education. Of these, 53 teachers (76%) studied in public Higher Education institutions, and 17 (24%) in private institutions. These data show that public universities are the main training institutions for these professionals in the state.

Regarding the area of education, 64 teachers (91%) graduated in Nature Sciences and related areas (Biological Sciences (53), Chemistry (8), Physics (2), and Environmental Management (1)); and 6 teachers (9%) graduated in other areas: Pedagogy (1), Geography (2), and Mathematics (3). It is important to highlight the relevance of the teacher to work in the area for which he or she has been professionally prepared. Teaching Nature Sciences in the Final Years of Elementary School is complex and requires commitment, dedication, time for planning and study in order to understand Biology, Chemistry, Physics, and Geosciences in a connected way. Compiani (2005) points out that the first three areas are hypothetical-deductive, much explored with observation and experimentation strategies, and the Geoscience seeks to understand the physical-chemical processes of inorganic and organic matter, with broad and diverse spatial and temporal scales to describe, formulate and explain the history of the planet through

historical reasoning. Therefore, taking on curricular components in Natural Sciences without specific training compromises the quality of teaching.

With regard to professional qualification, 33 teachers (47%) did not continue their studies after finishing higher education. Only 6 teachers (9%) completed a Master's degree, and 1 (1%) had a Master's degree in progress (post-graduate *stricto sensu*). These teachers have been in education for 10 or more years, but with experiences that varied in relation to their time in elementary school. In addition, 21 teachers (30%) stated that they had concluded a *lato sensu* post-graduation course; and 9 (13%) had a *lato sensu* post-graduation course in progress. The experience of research through a *stricto sensu* post-graduation is a positive point in the teacher's qualification. Teachers who enter the Master's program, for example, especially in their area of expertise, tend to include in their practices similar tools in the teaching process, such as collecting data from students, regular use of formative assessments, and also start using questionnaires as a teaching tool (BOESDORFER; ASPREY, 2017). The studies by Ludke *et al.* (2012) found that teachers with Master's degrees, when they return to school, incorporate reflections and changes in their performance and begin to see the problems of the school and students in a different light. The appropriation of research leads them to reflect on their work, achieving better results in their practices.

Therefore, in-service professional training plays an important role in the improvement and quality of teaching, as it increases teachers' confidence to teach science. However, the number of teachers who continued their studies was small (30 teachers with *lato sensu* post-graduation; 7 teachers, *stricto sensu*), which may be associated with the low supply of courses in the municipalities where they live, especially in the regions far from the capital - Palmas. Another factor that may have a correlation is the Plan of Positions, Careers, and Remuneration (PCCR) for public Basic Education teachers, proposed by SEDUC, through Law No. 2.859, of April 30, 2014, in which the stimulus for qualification implies a low salary incentive. The Plan establishes two progressions: horizontal, which takes place every three years, according to performance evaluation and length of service; and vertical, which occurs by changing titles. However, there are conditions for achieving this qualification, such as a Master's degree with 40% of the credits in the area of education, whose consolidation only occurs when there are budget allocations. These appropriations prioritize the horizontal progression and, later, the vertical progression. The average salary difference between a beginning teacher with a higher education degree and a teacher with a Master's degree, presented in the PCCR, in 2015, does not exceed R\$ 650.00 (Tocantins Government, 2015). It should be noted

that the PCCR is implemented for teachers in the teaching career, a relatively small number in the state, since most teachers are on temporary contracts.

Thus, the group of teachers in the state network (70 teachers) who worked in 2019 in the Final Years of Primary Education, represented in this research, was composed mainly of women (66%), relatively young (33% of teachers up to 30 years old), trained in public institutions (76%), in the area of Natural Sciences (91%), with little experience at this level of education (50% with up to 5 years of experience) and with low investment in *stricto sensu* qualification (10%).

This group of teachers also participated in the evaluation regarding Environmental Health, the second stage of this research. The first question addressed whether the teachers had the theoretical knowledge to work with themes related to Environmental Health with a focus on scientific literacy. To this question, 66 teachers (94%) answered affirmatively, however, they highlighted restrictions such as the need for training in the area (73%), pedagogical support at school (7%), or difficulty in developing interdisciplinary work with teachers from other educational areas (14%). Only 4 (6%) recognized that they would not be able to work on these themes. In this question, the answers could be complemented with a justification. The report of three teachers is highlighted below. The teacher with a degree in Biology considered that "I am able to develop themes related to Environmental Health, but it is always good to improve". For another teacher, there is a distancing of Environmental Health in the curriculum, as he claimed that "there are no pedagogical resources and no monitoring by a professional in the area" (biologist). Another teacher stated: "I didn't have any training in this area" (mathematician).

The teachers were also asked about their participation in events that could provide training and scientific literacy to work on Environmental Health. In this question, only 21 teachers (30%) said they had participated in events or activities with this focus. It is noteworthy that the question involving scientific literacy was included in the questionnaire because it is provided for in the Science curriculum in the Common National Curriculum (CNC), which makes clear the importance of developing skills and competencies with this focus. In this way, the BNCC defines scientific literacy as the ability to understand and interpret the world and be able to transform it based on science arguments and processes (MEC, 2020). In addition, the term is related to the scientific knowledge produced throughout history and the appropriation of the main processes, practices and procedures of scientific research.

The Natural Sciences teachers were asked which pedagogical practices they considered best to work with Environmental Health. In this question, it was possible to

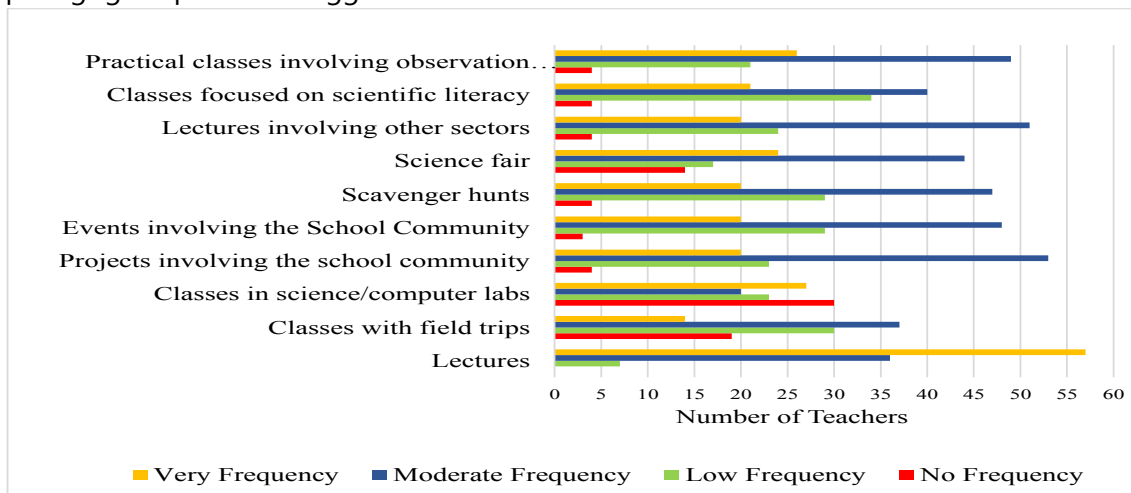
indicate whether the alternative was used very often, moderately often, not very often or not at all. Lectures were listed as the most frequently used (58% of the teachers). Those used moderately were projects involving the community (55%), lectures involving other sectors (50%), gymkhanas (49%), experimentation and observation (47%) and science fairs (46%). As for field classes, 30% of the teachers practice this infrequently, and 17% emphasized the absence of this practice (Graph 3).

The methodological strategies pointed out by teachers as important to work Environmental Health (Graphic 3) are in line with the difficulties they portrayed (Table 1), which were: lack of teaching materials (29%), followed by lack of laboratories (24%), lack of pedagogical support to conduct field classes (11%), insufficient financial resources (10%), lack of training in the area, time for research (9%), among others.

Some teachers (15; 21%) mentioned, in their justifications, the absence of practical methodologies, due to the lack of science/informatics laboratories, corroborating the information presented in Graph 3 and Table 1. In this perspective, understanding Environmental Health involving active methods in the area of Natural Sciences, such as laboratory class (23%) and field class (19%), for example, is imperative to achieve scientific literacy, which has been infrequent in the trend of the participants.

Scientific literacy promotes the development of skills to interpret scientific information, in connection with other areas (CHOI *et al.*, 2011; SASSERON; CARVALHO, 2008), including Environmental Health. Cachapuz *et al.* (2005) bring a bold proposal, that of connecting scientific literacy with the curriculum, articulating the social and personal aspects that allow awareness of the complex relationships between science and society.

Graph 3 Frequency of the methodological strategies used by the Natural Science teachers of the Final Years of Elementary School (6th to 9th grade) based on their pedagogical practices suggested to work Environmental Health content.



Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

It is noteworthy that, in addition to scientific literacy, the use of active methodologies can strengthen learning in the approach of Environmental Health content. Currently, active methodologies have been intensified in the educational debate, not because they are something new, but because they focus on the protagonism of students and are developed with the mediation of the teacher (MÓRAN, 2015). They are strategies that stimulate students to think, make efforts of personal reflection, have critical thinking and autonomy in their daily lives.

Table 1 Difficulties pointed out by teachers of Natural Sciences of the Final Years of Elementary School (6th to 9th grade) to develop themes in Environmental Health. Data collected from May to September 2019, for the state of Tocantins.

Components scored by teachers	Number of indications	% frequency
Lack of pedagogical materials	20	29
Lack of science lab, technology and internet	17	24
Lack of pedagogical support in field classes	8	11
Financial Resources	7	10
Lack of training in the area and time for research	6	9
Insufficient school space and/or environment	5	7
Lack of collaboration from other areas and/or other colleagues	3	4
Teaching methodologies and strategies	1	1
Lack of environmental educational legislation that ensures the actions	1	1
Much responsibilities in education	1	1
Lack of student interest	1	1
TOTAL	70	100%

Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

Of the strategies presented in Graph 3, all can be included in the list of active methods, even the lectures, provided that they are developed in short intervals to mediate the debate between teacher and student. However, if the lectures get out of this context, they will contribute little to the understanding of Environmental Health. Thus, they will continue to prioritize diversity, quantity and absorption of curricular content, hindering the formation of reflective, critical and creative thinking of the student (FERNANDES; MEGID-NETO, 2015). It is understood that the moments with expository lessons are inserted in the various teaching strategies. The field class itself, for example, indicated by 10 teachers (14%) as being used very often, also requires moments with

expository/theoretical lessons. Field classes are seen as potential for student motivation, as they produce a variety of cognitive, affective, social, and behavioral impacts, which bring significant contributions to learning and can be developed both in the school context and in non-formal institution settings, such as museums, parks, aquariums, and nature centers (KISIEL, 2013; MORAG; TAL, 2012). In addition, they favor the production of less fragmented knowledge, produce motivation, stimulus, provide research situations, allow concrete teaching, develop a posture of environmental preservation (SCOTT; BOYD, 2016) and can contribute to the themes related to Environmental Health.

In relation to science/informatics laboratories, although they are scored as a motivational strategy for students, they have been little used. In this study, only 18 teachers (26%) reported using these spaces as a practice used very often. Many teachers pointed out difficulties in developing teaching activities in science/informatics laboratories (Table 1). This report does not differ from those described in the literature, as studies conducted in different Brazilian states point out the following difficulties: inadequate physical structure of laboratories, lack of materials and maintenance, lack of training to enable teachers to work in these spaces, and lack of support from the school to organize the activities (BEREZUK; INADA, 2010; BORGES, 2002; SUARTE; SILVA; SEIBERT, 2021). However, it would be interesting if this scenario were different, because Science/IT labs exert fascination in the students' environment. However, it would be naive to affirm that only laboratory classes in teaching practice could be enough to understand phenomena that are related to Environmental Health. However, although they contribute, because they motivate and arouse the students' interest to understand the phenomena, the absence of a laboratory at school cannot be an impediment to practical classes in Natural Sciences, including Environmental Health. It is salutary to recognize the importance of proposing methodologies that use the natural environment of the school, or its surroundings, to stimulate students to experiment, construct variables, investigate (BEREZUK; INADA, 2010; SASSERON, 2015).

Another question investigated was about which elements were considered important for the development of Environmental Health in the Science curriculum. For the participants, the alternative pointed out was the domain of Environmental Health themes (57 teachers; 81%), the disciplinary planning (56 teachers; 80%) and the structural support from management (55 teachers; 78%) (Graph 4).

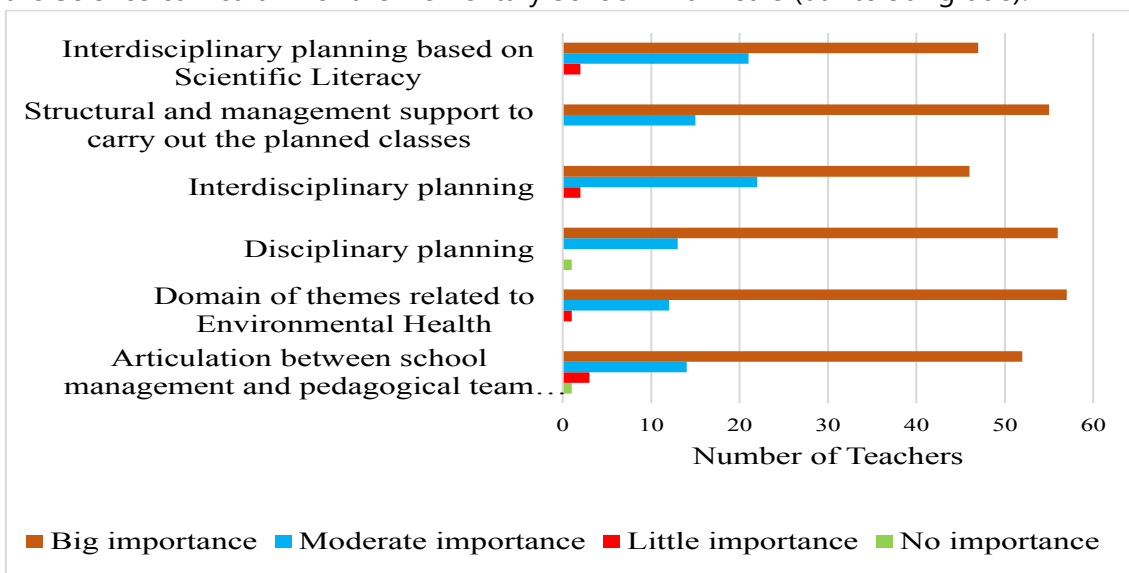
The knowledge domain was one of the themes related to Environmental Health indicated as being of greatest importance, according to the teachers who participated in this research. These data corroborate Carvalho; Gil-Pérez (2011), who state that the lack of knowledge of the subject to be taught, that is, of scientific knowledge, is configured

as the greatest ally for the absence of innovative activities and permanence of teaching, with mechanical transfer of content. For the teachers' didactic change to go beyond the simple "common sense", it is convenient to take ownership of the teaching methods and insert the contents in the context in which they will be implemented.

Another theme highlighted was disciplinary planning. Although interdisciplinarity was considered the watchword in the educational context at the end of the 20th century, it is still a term alien to the practices of many teachers. Fazenda (1998), after inserting the term in the Brazilian educational context, states that interdisciplinarity seeks to acquire its capacity to identify different types of knowledge when teaching, taking them as incomplete and always insufficient.

In Frigotto's (2008) ideals of interdisciplinarity, the inseparability between the multiple relations of social, cultural and political life in the mode of production and their interrelationships is assumed. The author argues that the most universal knowledge is that which has a higher level of abstraction, which, in its unity, engenders diversity, otherwise interdisciplinarity may be confused with the juxtaposition of disciplines and content. Working on Environmental Health with this approach, starting from a social problem, implies understanding that disciplinary knowledge in consonance promotes the path to totalitarian thinking.

Graph 4 Elements considered important for the development of Environmental Health in the Science curriculum for the Elementary School Final Years (6th to 9th grade).



Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

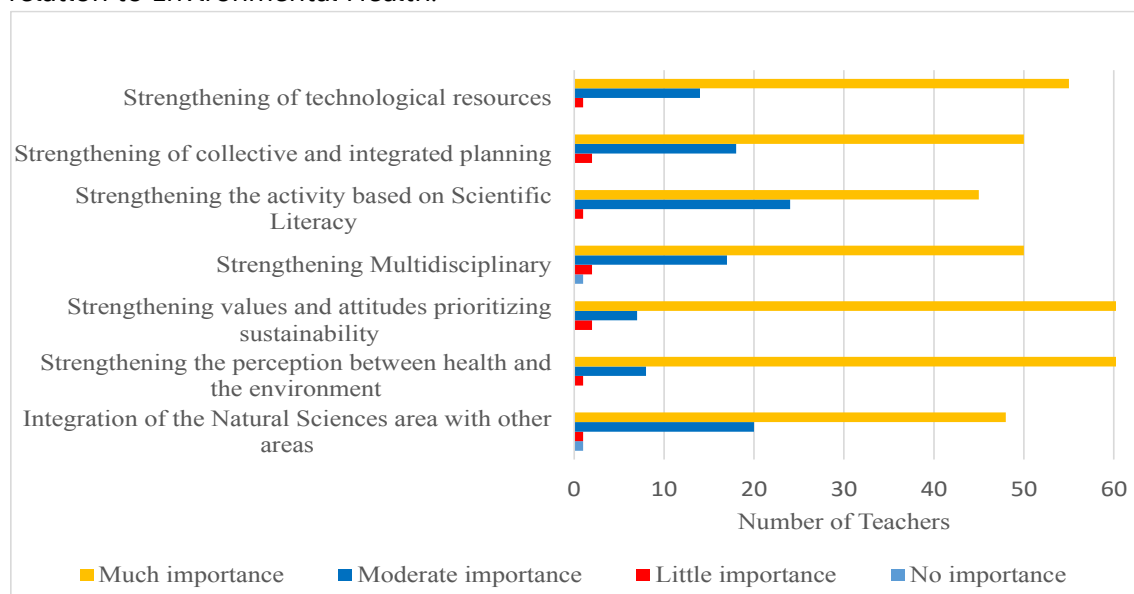
Graph 5 shows the elements considered important to improve the pedagogical practice in Environmental Health, as indicated by the teachers who participated in this

research. Seven conceptions were listed, and the three considered most important were: strengthening the perception between health and environment (61 teachers; 87%), strengthening values and attitudes prioritizing sustainability (61 teachers; 87%) and strengthening technological resources (55 teachers; 79%).

Cachapuz *et al.* (2005) assert that, many times, a view of science, identified as atheoretical, problematic, ahistorical, analytical, accumulative, individualistic/elitist, empirical/indutivistic and decontextualized from Science-Technology-Society-Environment (STSE) relations, can generate a distorted view. This contributes to the students' lack of interest in the themes related to Environmental Health, and, therefore, these themes should always be based on scientific elements.

The perception between health and environment, as well as values and attitudes prioritizing sustainability were the most frequently mentioned conceptions when thinking about Environmental Health problems. The discourse of sustainability in Environmental Health goes through the ability to ensure that the actions of the current generation do not promote so many negative impacts on human health and environmental quality for the future (SABOGAL, 2010). In the sustainable perspective, it is not convenient to look at the Science curriculum focusing on its traditional contents (physics, chemistry and physics), but to articulate the instances to understand sustainability in the social, cultural, environmental and economic scope.

Graph 5 Elementary School teachers for the improvement of pedagogical practices in relation to Environmental Health.



Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

In this bias, teachers listed 35 Environmental Health themes that they consider difficult to develop in schools (Table 2), related to Deforestation and Burning (22%); Preservation of Water Resources (13.8%), Epidemiologies and Arboviroses (11%), Environmental Education and Law and Sustainability (11%) and Environmental Impacts in Mineral Extraction (8.3%).

It is worth noting that the themes indicated by the teachers have a direct connection with the teaching of Natural Sciences and establish correlations with other areas such as Environmental Geography, Politics and Public Health. It was expected that the teachers would not present difficulties with these themes, especially those with degrees in Sciences/Biological Sciences. This result indicates a gap in the training of these professionals and the need for undergraduate courses to better prepare their students in Environmental Health. It is also pertinent to highlight that the four themes with the highest scores represent recurring problems in public health in the state.

Table 2 Environmental Health themes indicated by teachers of Natural Sciences as difficult to be worked in school, according to data collected in the period from May to September 2019.

Topics suggested by teachers	Nº profs.	% frequency
Deforestation and fires; preservation of the Cerrado; impacts on fauna and flora; burning of school waste	8	22%
Water resource preservation	5	14%
Epidemiology; arboviroses	4	11%
Environmental education; law and sustainability	4	11%
Environmental impacts of mineral extraction	3	8%
Technological impacts	2	6%
None	2	6%
Personal hygiene and preservation of the school environment	1	3%
Mental Health	1	3%
Healthy nutrition	1	3%
Use of biomass as renewable energy (less pollution)	1	3%
Environmental Health at Work	1	3%
Mass and volume	1	3%
Methodologies to motivate students	1	3%
TOTAL	35	100%

Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

It was also possible to verify that the themes pointed out by the participants demonstrated the need for actions that provide greater mastery and pedagogical

knowledge, integrating other knowledge. The goals of the 2030 Agenda, despite being pulverized in the seventeen SDGs, complement each other in an indivisible way, exercising correlations with skills and abilities of the BNCC (UNITED NATIONS, 2015).

Although they are visible in the documents and apparently easy to be developed, it is a complex discussion, but necessary in the process of continued education, especially for teachers of Natural Sciences in the final years of elementary school, since they are still shaped to look at the problems from a physical, chemical and biological perspective, anchored by the Cartesian model of seeing problems (MORIN, 2007).

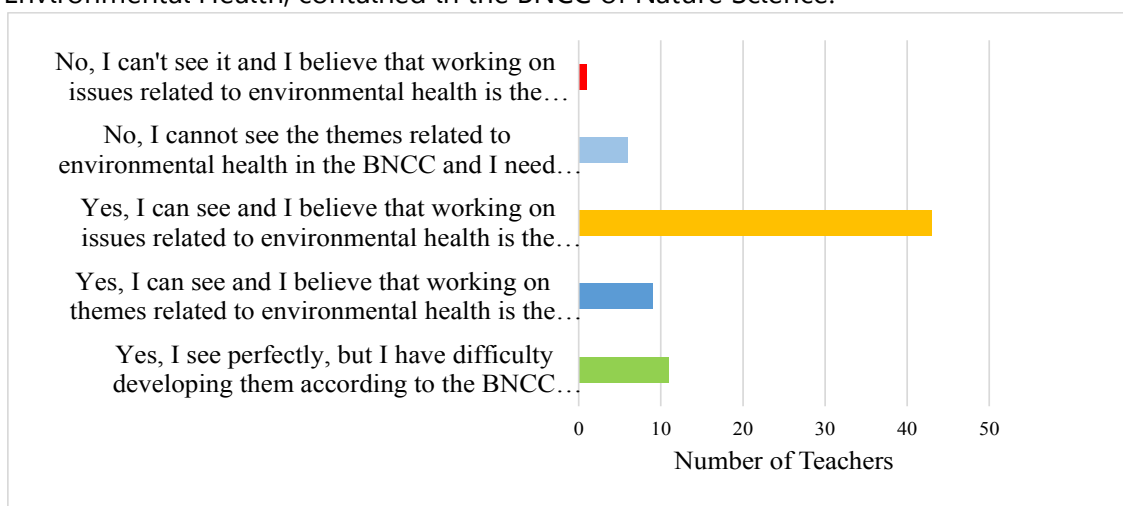
It is expected that the discussion for the discernment of what is advocated in legal documents, arising from conferences such as the Ottawa Charter (WHO, 1986), Rio 92, which dealt with the Report "Our Common Future" (Brundtland Report, published in 1987), and Agenda 2030, and the debates related to scientific literacy can shape critical and viable curriculum proposals, highlighting Environmental Health as a central element in this context. Environmental Health problems need to be thought of as part of the social macrosystem, interconnecting theory and practice, taking into account the growing insecurity and uncertainty of the risks produced by society as a response to a crisis of civilization (JACOBI, 2005).

The last question sought to assess how respondents perceive Environmental Health in the BNCC. Graph 6 shows that 64 teachers (91%) have this perception, and of these, 43 (61%) believe that Environmental Health should be worked on by teachers in all training areas.

The BNCC, for Kindergarten and Elementary School, a document approved in December 2017, subsidized the construction of the Tocantins Curriculum Document (DCT) and, thus, is being implemented to guide the development of curricula in the education networks. Although it is recent approval, the BNCC has received much criticism by curriculum scholars, especially by the National Association of Graduate Studies and Research in Education (ANPEd), alerting mainly to the interests of capital. For Lopes (2018), this document brings immediate link between education and economic development - the salvationist character, as if all problems were solved with more education, standardization of uniform learning, assumption that teachers do not know what they do in schools. Moreover, by establishing a single guideline from a base, inequalities in the "education system" are reinforced and room is opened for external assessments to continue dictating the curricula, with the prescription of minimum curriculum focused on skills and competencies (ALVES, 2018). These are discussions that make us reflect to think about possible ways to strengthen the teachers' knowledge, content and methodologies interrelated to the problems of Environmental Health, to the

specificities inherent to each territory. In Lopes and Macedo's (2021) conception, educational problems are not attributed to the absence of a base, but to the lack of differentiated investment in the teacher's career and curriculum production. The authors call attention to the investment in the multiplier effect of partnerships between universities and state and municipal education secretariats for curriculum training.

Graph 6 Nature Science teachers' view on the presence of themes related to Environmental Health, contained in the BNCC of Nature Science.



Source: The authors. Data collected from May to September (2019) for the state of Tocantins.

Regarding Environmental Health education, a range of research has pointed out the concealment of the theme in the BNCC or the manifestation only in the disciplines of Nature Sciences and Geography. This takes into account that the transformative perspective of Environmental Education (EE) does not commune with the neoliberal policies expanding in the country, the alienation of teachers and the exploitation of natural resources and, therefore, it is emphasized the need for the emancipatory and transformative character of EE in curricula from Basic Education to Higher Education (BEHREND; COUSIN; GALIAZZI, 2018; TONZONI-REIS *et al.*, 2013). The silencing of the critical socio-environmental approach may favor the positioning of an education focused on neoliberal and meritocratic ideals (SILVA; LOUREIRO, 2020). It is believed that these ideals are part of belligerent obscurantism, a movement that has provided environments of ideological, ethical, and political censorship of teachers, curricula, and teaching materials, opposing the dissemination of scientific knowledge and failing to prioritize the construction of democratic curricula and students' potentialities and enrichment of their needs (DUARTE, 2018).

It is worth reinforcing that, although the BNCC of Nature Sciences was approved in 2017, it is possible to trace a path to improve the mismatches pointed out in the criticisms of researchers and guide the education networks in the preparation of their curricula, bringing the discussions of Environmental Health to be incorporated during their constructions. However great the criticisms, it is worth reflecting that the curriculum detailing is always interpreted in different ways in schools (LOPES, 2018). If there are no intentions for a systematized training, centered in a critical curriculum, teachers will appropriate the document according to the conventional model that is presented and will repeat the same way they appropriated the NCPs. And, in this way, the discussions that have impacted Environmental Health will remain invisible.

The results of this research highlighted the need to rethink the curricular policies for teacher training, which involve Environmental Health education in the BNCC. It becomes a challenge, since, on the one hand, it is visible the fragility of the educational system and its structures, on the other hand, the framework of inexperienced teachers due to the absence of consolidated policies for the career, the lack of confrontation to break the cultural paradigm in the appropriation of information technologies and little consistency in continuing education policies. All these reflections promote impacts on the teachers' practice and show that continuing education is a fundamental pillar to improve the teaching and learning process.

Although many changes in neoliberal policies are observed, the teacher will always be the cornerstone in the process for the development of society and, therefore, initial and continuing education should be understood not as a cost/expense, but as a personal, professional, institutional, public, political, social and economic investment (GATTI, 2016). For the author, facing the great challenges of a changing society presupposes that teachers have a continued mode in their training, which is not light, simplistic and fragmented. Thus, it is understood that studying the BNCC in light of Critical-Historical Pedagogy (PHC) may be one of the ways to develop scientific literacy in the understanding of themes inherent to Environmental Health.

This presupposes inserting in this discussion the conception of the human being as a historical subject, which is constituted by social relations dimensioned through work. However, PHC will promote mediation so that education enhances the elevation of the student's consciousness as a fundamental part of social transformation. Thus, it assumes that historical-critical didactics needs to be developed integrated to its foundations and not thought of in a logical-formal way that compartmentalizes and segments the understanding of phenomena in didactic work (MARSÍGLIA; MARTINS; LAVOURA, 2019).

Final considerations

From the results of this research, it was possible to verify that, although the participants were 100% college-educated teachers, 91% of them graduated in Biological Sciences and related areas, they still find it difficult to work with themes related to Environmental Health. Most of them are young professionals, who showed a lack of confidence in working with these themes. When asked about the themes that are the most difficult to work with at school, the teachers pointed out themes related to "deforestation and fires", followed by "preservation of water resources" and "arboviroses". These themes are part of the sustainable development goals and are linked to the competencies of the BNCC of Nature Sciences, of the Elementary School Final Years from 6th to 9th grade. It can be seen that these themes reflect local and eminent problems in the state of Tocantins, which are increasingly evident due to the development model adopted by the state, which is mainly focused on agricultural and cattle raising activities.

Difficulties were also evidenced in the adherence of teachers to innovative activities, which is associated with a lack of knowledge of the subject to be taught. This hinders the appropriation of other methodologies, giving priority to those that promote the mechanical transmission of content. Thus, it can be inferred that there is a problem in the training of professionals, which is not providing consolidated knowledge of environmental issues in the state itself. These reflections need to be taken to the training institutions, in order to emphasize a more detailed approach to the specificities of the regional themes of Environmental Health in Tocantins.

The results also highlighted issues related to governmental management. The management has the responsibility to promote policies to strengthen Environmental Health in the training curricula and to stimulate the teaching career. The high percentage of inexperienced teachers (up to five years) represents the turnover of professionals, due to the predominance of contract teachers. Besides the turnover, with the lack of institutional stability, the continuing education policy is still limited, which denotes the low attractiveness of the career. Besides the training problems, there are also those of adequate physical structure, such as investment in science/informatics laboratories and in technology.

The research also analyzed the relationships of the teaching work involving Environmental Health and scientific literacy, since they have been the subject of discussions in curricula and teacher training. It was identified that, although 94% of the teachers have knowledge about theoretical references inherent to Environmental Health from the perspective of scientific literacy, 73% affirmed the need for continued

education. Although this research does not delve into the professional career, it is understood that it is essential for improving the quality of education. The need for training, with a bias in scientific literacy, became visible when analyzing the methodological strategies, in which the lecture classes were the most used (55% of teachers), and those that provide greater scope of scientific literacy, such as observation and experimentation, had little frequency.

When analyzing how respondents perceive Environmental Health in the BNCC, 90% emphasized this positive perception, however 16% pointed out difficulties in developing the themes from this curriculum guideline. Due to the pandemic that arose during the course of implementation of the document and the change in government management (2017-2018), which reduced the actions focused on this issue, it can be inferred that many teachers still have little knowledge about the BNCC.

Therefore, this study highlighted the difficulties encountered by teachers to work with themes of Environmental Health. Concerted actions by public administrators and higher education institutions are needed to improve the conditions for professionals to work on these issues, which goes beyond a well-structured curriculum for elementary school. The state needs to provide the entrance of effective professionals, to improve the attractiveness of the teaching career, to promote continued education with scientific literacy, and to adapt the physical structure of the schools, especially for the implementation of laboratories, relying on a pedagogical support structure. On the other hand, higher education institutions need to work on environmental and health issues, which are emerging and constant in the state, in the training process of future teachers, in order to prepare them for the challenges of the classroom.

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References

- ALVES, N. PNE, Base Nacional Comum Curricular (BNCC) e os cotidianos das escolas: relações possíveis? *In*: AGUIAR, M. A.; DOURADO, L. F. (org.). A BNCC na contramão do PNE 2014-2024: avaliação e perspectivas. Recife: ANPEd, 2018. p. 44-48.
- BARDIN, L. Análise de conteúdo. Lisboa: Edições 70, 2007.
- BEHREND, D. M.; COUSIN, C. da S.; GALIAZZI, M. do C. Base Nacional Comum Curricular: o que se mostra de referência à Educação Ambiental?. *Ambiente & Educação*, v. 23, n. 2, 2018.

- BEREZUK, P. A.; INADA, P. Avaliação dos laboratórios de ciências e biologia das escolas públicas e particulares de Maringá, Estado do Paraná. *Acta Scientiarum Human and Social Sciences*, v. 32, n. 2, p. 207-215, 2010.
- BOESDORFER, S.; ASPREY, L. Exploratory Study of the Teaching Practices of Novice Science Teachers Who Participated in Undergraduate Science Education Research. *Electronic Journal of Science Education*, v. 21, n. 3, p. 21-45, 2017.
- BRASIL. Ministério da Educação. Base Nacional Comum Curricular, 2020. Disponível em: <http://basenacionalcomum.mec.gov.br/> Acesso em 4 ago. 2020.
- BRASIL. Ministério da Educação. *Parâmetros Curriculares Nacionais*. MEC/SE 1998.
- BURNS, C.; DUNN, A. M.; SATTLER, B. Resources for environmental health problems. *Journal of Pediatric Health Care*, v. 16, n. 3, p. 138-142, 2002.
- CACHAPUZ, A.; GIL-PÉREZ, D.; PESSOA DE CARVALHO, A. M.; PRAIA, J. VILCHES, A. A necessária renovação do ensino de ciências. São Paulo: Cortez, 2005.
- CARVALHO, A. M. P.; GIL-PÉREZ, D. Formação de professores de ciências: tendências e inovações. São Paulo: Cortez, 2011.
- CHEN, C.; LI, Y.; LIU, J.; MENG, C.; HAN, J.; ZHANG, Y.; XU, D. Short-term.
- CHIACCHIO, R. F. A.; MEGID-NETO, J. Características e tendências das dissertações e teses brasileiras sobre práticas de ensino de ciências nos anos iniciais escolares (1972-2011). *Interacções*, v. 11, n. 39, p. 540-551, 2016.
- CHOI, K.; LEE, H.; SHIN, N.; KIM, S. W. Re-conceptualization of scientific literacy in South Korea for the 21st century. *Journal of Research in Science Teaching*, v. 48, n. 6, p. 670-697, 2011.
- COMPIANI, M. Geologia/Geociências no Ensino Fundamental e a formação de Professores. *Geologia USP., Publicação Especial*, v. 3, p. 13-30, 2005.
- DARLING-HAMMOND, L. Teacher education around the world: what can we learn from international practice? *European Journal of Teacher Education*, v. 40, n. 3, p. 291-309, 2017.
- DUARTE, N. O currículo em tempos de obscurantismo beligerante. *Rev. Espaço do Currículo*, João Pessoa, v. 11, n. 2, p. 139-145, maio/ago. 2018.
- FAZENDA, I. C. A. Didática e interdisciplinaridade. Campinas: Papirus, 1998.
- FERNANDES, W. R.; SOUSA, M. F. de. Estratégia para prevenção da Dengue, Zika e Chikungunya desenvolvidas na Região Norte do Brasil: o Programa Saúde na Escola em foco. *Revista Educação em Debate*, v. 42, n. 83, p. 0-2, 2020.
- FLICK, U. Introdução à metodologia de pesquisa: um guia para iniciantes. Porto Alegre: Penso, 2009.
- FRIGOTTO, G. Ideação Ideação. *Revista do Centro de Educação e Letras*, v. 10, n. 1, p. 41-62, 2008.
- GATTI, B. A. Formação de professores: condições e problemas atuais. *Revista Internacional de Formação de Professores (RIPF)*, v. 1, n. 2, p. 161-171, 2016.
- JACOBI, P. R. Educação Ambiental: o desafio da construção de um pensamento crítico, complexo e reflexivo. *Educação e Pesquisa*, São Paulo, v. 31, n. 2, p. 233-250, 2005.
- KISIEL, J. Introducing Future Teachers to Science Beyond the Classroom. *Journal of Science Teacher Education*, v. 24, n. 1, p. 67-91, 2013.
- LOPES, A. C. Apostando na produção textual do currículo. AGUIAR, M.A.da S.; DOURADO, L. F. (org.). *A BNCC na contramão do PNE 2014-2024*. Recife: ANPAE, 2018.
- LOPES A. C.; MACEDO, E. Apresentação de uma alternativa à políticas curriculares centralizadas. *Roteiro*, Joaçaba, v. 46, jan. 2021.

- LUDKE, M.; RODRIGUES, P. A. M.; PORTELLA, V. C. M. O mestrado como via de formação de professores da educação básica para a pesquisa. *Revista Brasileira de Pós-Graduação*, v. 9, n. 16, p. 59-83, 2012.
- MARSÍGLIA, A. C. G.; MARTINS, L. M.; LAVOURA, T. N. Rumo à outra Didática Histórico-Crítica: superando imediatismos, logicismos formais e outros reducionismos do método dialético. *Revista HISTEDBR On-line*, Campinas, v. 19, p. e 019003, 2019.
- MORAG, O.; TAL, T. Assessing Learning in the Outdoors with the Field Trip in Natural Environments (fine) Framework. *International Journal of Science Education*, v. 34, n. 5, p. 745-77, 2012.
- MORAN, J. Mudando a educação com metodologias ativas. *Convergências Midiáticas, Educação e Cidadania: aproximações jovens*, v. II, p. 15-33, 2015.
- MORIN, E. Introdução ao pensamento complexo. 3. ed. Porto Alegre: Sulinas, 2007.
- NASCIMENTO, F. de A.; COSTA, C. L. Uma discussão sobre propostas para uma alfabetização científica de qualidade. *Centro Científico Conhecer - ENCICLOPÉDIA BIOSFERA*, v. 5, n. 8, p. 1-7, 2009.
- ORDOÑEZ, G. Salud ambiental: conceptos y actividades. Informe Especial. *Rev Panam Salud Pública Peruana Salud pública*, v. 7, n. 3, p. 137-147, 2000.
- ONU. Transformando nosso mundo: a Agenda 2030 para o desenvolvimento sustentável. Disponível em: http://www.un.org/ga/search/view_doc.asp?Symbol=A/RES/70/1&Lang=E. Acesso em: 5 ago. 2020.
- SABOGAL, R. Global Environmental health: Sustainability. *Journal of Environmental Health*, v. 73, n. 3, p. 26-27, 2010.
- SASSERON, L. H. Alfabetização científica, ensino por investigação e argumentação: relações entre Ciências da Natureza e escola. *Ensaio Pesquisa em Educação em Ciências*, Belo Horizonte, v. 17, n. spe, p. 49-67, 2015.
- SASSERON, L. H.; CARVALHO, A. M. P. de. Alfabetização científica no ensino fundamental: estrutura e indicadores deste processo em sala de aula. 2008. 265 f. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2008.
- SCOTT, G. W.; BOYD, M. Getting more from getting out: increasing achievement in literacy and science through ecological fieldwork. *Education 3-13*, v. 44, n. 6, p. 661-670, 2016.
- SHULMAN, L. Pedagogical Content Knowledge in Social Studies. *Scandinavian Journal of Educational Research*, v. 31, n. 2, 1987.
- SILVA, E. F. da; FERREIRA, R. N. C.; SOUZA, E. de J. Aulas práticas de Ciências Natureais: o uso do laboratório e a formação docente. *Educação: Teoria e Prática*, v. 31, n. 64, p. 1-22, 15 jun. 2021.
- SILVA, S. N.; LOUREIRO, C. F.B. As vozes de professores-pesquisadores do campo da Educação Ambiental sobre a Base Nacional Comum Curricular (BNCC): Educação Infantil ao Ensino Fundamental. *Ciênc. educ.*, Bauru, v. 26, e20004, 2020.
- SUARTE, L. B. O.; SILVA, K. L. F.; SEIBERT, C. S. O PISA como instrumento de análise das Ciências no contexto da Saúde Ambiental, no âmbito internacional e nacional. *Revista Humanidades e Inovação*, v. 8, n. 39, p. 309-321, 2021.
- TOCANTINS. CEE/2019. Resolução nº 024, de 14 de março de 2019. Aprova o Documento Curricular da Educação Infantil e do Ensino Fundamental, para o Território do Tocantins, fundamentado na Resolução CNE/CP nº 02, de 22 de dezembro de 2017, que institui e orienta acerca da Base Nacional Comum Curricular (BNCC).

- Disponível em: <https://central3.to.gov.br/arquivo/528531/>. Acesso em: 27 maio 2021.
- TOCANTINS. Lei nº 2.859, de 8 de abril de 2014. Dispõe sobre o Plano de Cargos, Carreiras e Remuneração dos Profissionais da Educação Básica Pública, e adota outras providências. Diário da Oficial nº 4.120.
- TOCANTINS. Lei nº 2.977, de 8 de julho de 2015. Aprova o Plano Estadual de Educação do Tocantins – PEE/TO (2015-2025), e adota outras providências. Disponível em: <https://seduc.to.gov.br/plano-estadual-de-educacao---pee/>. Acesso em: 20 dez. 2020.
- TOCANTINS. Referencial Curricular do Ensino Fundamental das escolas públicas do Estado do Tocantins: Ensino Fundamental 1º ao 9º ano. 2. ed. Palmas: Secretaria de Estado da Educação e Cultura, 2009.
- TOCANTINS. Secretaria da Educação, Juventude e Esportes. Documento Curricular do Tocantins, Educação Infantil e Ensino Fundamental. Disponível em: <https://www.to.gov.br/seduc/documento-curricular-do-tocantins-educacao-infantil-e-ensino-fundamental/3pxz92xtgb1p>. Acesso em: 20 maio 2021.
- TOCANTINS. Sistema de Gerenciamento Escolar. 2019. Disponível em: <http://sge.seduc.to.gov.br/sgeseduc/sge/index.php?alterSession=2019>. Acesso em: 20 dez. 2020.
- TOZONI-REIS, M. F. C.; TALAMONI, J. L. B.; RUIZA, S. S.; NEVES, J. P.; TEIXEIRA, L. A.; CASSINI, L. F.; FESTOSO, M. B.; JANKE, N.; MAIA, J. S. da D.; SANTOS, H. M. da S.; CRUZ, L. I.; MUNHOZ, R. H. A inserção da Educação Ambiental na Educação Básica: que fontes de informação os professores utilizam? *Ciência e Educação*, v. 19, n. 2, p. 359-377, 2013.
- UNESCO. Learn for our planet a global review of how environmental issues are integrated in education. 2021. Education 2030. Disponível em: <https://unesdoc.unesco.org/ark:/48223/pf0000377362>. Acesso em: 15 ago. 2021.
- VIRGOLINO, A.; ANTUNES, F.; SANTOS, O. C. A.; MATOS, M. G.; BÁRBARA, C.; BICHO, M.; CANEIRAS, C.; SABINO, R.; NÚNCIO, M. S.; MATOS, O.; SANTOS, R. R.; COSTA, J.; ALARCÃO, V.; GASPAR, T.; FERREIRA, J.; CARNEIRO, A. V. Towards a Global Perspective of Environmental Health: Defining the Research Grounds of an Institute of Environmental Health. *Sustainability (Switzerland)*, v. 12, n. 21, p. 1-24, 2020.
- WEIHS, M.; MERTENS, F. Os desafios da geração do conhecimento em Saúde Ambiental: uma perspectiva ecossistêmica. *Ciência & Saúde Coletiva*, v. 18, n. 5, p. 1501-1510, 2013.
- WEXLER, B. Environmental Health. 2013. *Cengage Learning*, 2, 185.
- WHO. The Ottawa charter for health promotion. Ottawa: WHO, 1986. Disponível em: <http://www.who.int/healthpromotion/conferences/previous/ottawa/en/>. Acesso em: 3 mar. 2018.

RESUMO:

A Saúde Ambiental é uma área do conhecimento que transita por muitos componentes curriculares, principalmente nas Ciências da Natureza, campo de destaque para desenvolvê-la. Deve estar relacionada com preparo dos professores para trabalhar de forma crítica com viés para o letramento científico. Este estudo propôs avaliar os desafios do corpo docente da área de Ciências da Natureza para implementar a Saúde Ambiental no Ensino Fundamental Anos Finais, no estado do Tocantins. A partir de pesquisa quantitativa e qualitativa, identificou-se alto percentual de professores jovens, com maior prevalência a ministrar aulas expositivas e pouca apropriação do letramento científico. Apesar de os docentes indicarem pouca dificuldade para trabalhar com as temáticas da Saúde Ambiental, relataram a necessidade de formação continuada.

PALAVRAS-CHAVE: Letramento científico; Professor; Formação continuada.

RESUMEN:

La Salud Ambiental es un área de conocimiento que pasa por muchos componentes curriculares, especialmente en Ciencias Naturales, campo destacado para desarrollarla. Debe estar relacionado con la preparación de los docentes para trabajar críticamente con sesgo hacia la alfabetización científica. Este estudio se propuso evaluar los desafíos del personal docente del área de Ciencias Naturales para implementar la Salud Ambiental en los Últimos Años de la Enseñanza Fundamental, en el estado de Tocantins. Con base en la investigación cuantitativa y cualitativa, se identificó un alto porcentaje de profesores jóvenes, con mayor prevalencia de la docencia magistral y poca apropiación de la alfabetización científica. Aunque los profesores señalaron poca dificultad para trabajar con los temas de Salud Ambiental, relataron la necesidad de educación continua.

PALABRAS CLAVE: Alfabetización científica; Profesor; Educación continua.