



**Analysis of the national scientific production of the last five years
involving Environmental Education and Pesticides**

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ABSTRACT

This study aims to analyze the national scientific production of the last five years (2016 to 2020), which address EE actions and involve the theme of pesticides in chemistry teaching. The platforms SciELO, Capes Journals and BDTD were considered as sources of information, in which 30 productions were analyzed with the following criteria: author and year; public involved; theme approach; developed action; basic references and main results. In short, the analyzes made it possible to observe a variety of pedagogical activities, texts on reviews and materials for the agricultural sector. Limitations of critical approaches in educational practices are also evident. Therefore, it is necessary to expand studies, as well as to develop and disseminate actions that promote EE related to pesticides.

Keywords: Environmental Education. State of knowledge. Pesticides. Publications.

1. INTRODUCTION

It is notorious that, over the centuries, humanity has enjoyed the environment as a source of survival, as well as raw materials for its development. However, with the growing process of modernization of civilization, nature came to be mistakenly seen as an inexhaustible source of resources, which caused an uncontrolled exploration and several problems arising from this abusive use of natural resources.

When considering the context, it is observed that the Brazilian agricultural sector has been expanding at an accelerated pace and has contributed significantly to the growth of Brazilian agriculture. Among the various aspects of this sector, Agribusiness in Mato Grosso (MT) stands out in an intense and ascending way, with the potential use of high technology and the use of numerous inputs and, along with this growing development, the problem of pesticides.

Thus, this environmental context can be even worse when considering the alarming numbers regarding the release and the disorderly and abusive use of pesticides in Brazil in recent times (RIBEIRO, 2020; VIEIRA *et al.*, 2020). To resolve such problems, Environmental Education (EE) actions are intensified in contemporary times, which follow a philosophy and behavioral culture, which seeks the individual's commitment to the present and future of the environment and guides the educational process for the formation of citizenship.

Therefore, it was searched the literature for references on historical and contextual aspects, characteristics, and possibilities regarding EE, as well as the use of pesticides. This article is part of an investigation that makes up a master's thesis of the Graduate Program in Teaching (PPGEn), of the Federal Institute of Mato Grosso (IFMT/2022), from a problematizing and contextualized perspective for the development of concepts and positions related to EE, with emphasis on the use of pesticides.

During a socio-environmental emergency of the 21st century, caused by the relationships that constitute contemporary society, it has been provoked on environmentalists, educators and the civil community, a series of questions about the way of scientific-technological development of current production, being reported in history and linked to the environmental issue (PHILIPPI JR; PELICIONI, 2014).

In this sense, it is necessary to elucidate the founding reflection of the articulation and appropriation of knowledge based on the idea that EE and sustainability will be socially and culturally viable only if there are effective systems to change values and behaviors, facing a challenging scenario of conflicts and environmental risks (BARROS, 2018).

As stated in the National Curriculum Parameters for Secondary Education (BRASIL, 2002), EE is understood as individual or collective procedures that are constituted by social values, knowledge, skills, attitudes, and competences directed towards the conservation of the environment, of the common use by the people, indispensable to the quality of life and its sustainability. Philippi Jr. and Pelicioni (2014) write that EE refers to education applied to environmental issues.

Since EE makes it possible to develop a critical reflective perspective, in the sense of forming and preparing citizens in the face of a transforming social action of the system, to make the integral development of human beings viable. It should be emphasized that this process of socio-environmental and technological education implies knowing the situational reality, from which the educational objectives to be achieved should be established (RIBEIRO; PASSOS; SALGADO, 2018).

In view of this, through the EE developed and consolidated on political, educational, and scientific conceptual bases, new and positive ways of approaching and planning for the process of local, regional and national development with sustainability can be added (POZZEBON, *et al.* 2018). To this end, when considering the need and possibilities of producing knowledge and defining policies for EE, the construction of methodological proposals is directed as a way of bringing the knowledge produced closer to the historically neglected realities in the analysis of the human-nature relationship (BARROS, 2018).

The first law that established the National Environmental Policy (PNMA) was Federal Law nº 6.938/81, which, as one of its principles, provides for EE at all levels of education, including community education (BRASIL, 1981; PHILIPPI JR; PELICIONE, 2014). Provided for by the Federal Constitution of 1988, Art. 225 makes it clear that everyone has the right to an ecologically balanced environment, to be used as a common good by the population, and essential to life, and it is the duty of the public power to defend and preserve it for now, as well as for the future, dividing between the government and society the responsibility for its preservation and conservation (BRASIL, 2016).

According to the Law nº 9.394/96, of Guidelines and Bases of National Education (LDB), it is foreseen that in Basic Education and in Higher Education knowledge is assured regarding the natural and social environment in which one lives, with a view to education to perform the citizenship (BRASIL, 1996).

Another important legal apparatus is the Federal Law No. 9,795/99, which establishes the National Environmental Education Policy (PNEA), which generally comprises the EE as an essential and permanent component and everyone's right, in a present and articulated way in the different educational modalities. The PNEA presents guidelines for inserting EE in various contexts, whether in formal or non-formal education (BRASIL, 2002; SENADO, 2015; FILHO; FARIAS, 2020). In this context, the National Common Curricular Base (BNCC) predicts that educational systems should address cross-cutting and integrative contemporary themes that affect human life in different instances (BRASIL, 2018).

According to Art. 26, 7th paragraph of the Law of Guidelines and Bases of National Education, included by Law No. 12,608/2012, grants the creation of a disaster information and monitoring system, it is the duty of the Union, the States, the Federal District and the

Municipalities to adopt the necessary measures to reduce the risks of disasters with preventive and recovery actions related to protection and defense civil (BRASIL, 2012).

Recently, the State Environmental Education Policy (PEEA) of MT, Law No. 10,903, on June 7, 2019, predicts EE at school and outside of it; as well as establishing learning processes, with a view to conserving and improving the environment and quality of life, with a focus on society in general (MATO GROSSO, 2019).

According to the quoted law, social inclusion and socio-environmental responsibility are everyone's rights and duties. It is established to implement and strengthen preservation actions and, above all, the defense of the environment, promote the dissemination of sustainable practices and conscious consumption and, thus, contribute with a new ideology for current and new generations.

This state law gives responsibility to the State Department of Education (SEDUC-MT) by school actions that are supposed to be developed, and the State Department of Environment (SEMA-MT) is responsible for non-school EE. It also emphasizes that public policies are not made only with the responsibility of federal bodies, but also with the participation of communication bodies, enterprises, and society as a total.

Certainly, regulations, conventions, protocols, and programs apply in terms of the Environment over time. Among the existing ones, a selection of the main bases that are linked to the perspective of this research with a view to EE is highlighted here. In this thinking, although the evolution of the different documents that regulate EE in Brazil is remarkable, there is much to be systematized and implemented for its improvement regarding environmental concerns (SÁNCHEZ, 2013).

From this perspective, emphasis is placed on world agricultural production in the 20th century, characterized by a period of social division of labor, marked by mechanization and the intense use of agrochemicals, aimed at large-scale production. Together with the intensification of the use of pesticides posed by this way of 'doing' agriculture, social and environmental damages are combined (BRASIL, 2012).

Given these considerations, focusing on the study presented so far on EE and that, in this regard, there is a range of possibilities to direct the continuity of the research, priority was given, among several linked situations, to the use and handling of pesticides in the production of grains in Brazil and the issue with the environment. Therefore, the theme 'pesticides' is considered promising for the discussion of social aspects of Science and Technology (SOUSA; GORRI, 2019).

In that regard, 2nd Article of Federal Law No. 7,802, discusses pesticides as substances and products used as defoliantes, desiccants, growth stimulators and inhibitors, and agents of physical, chemical or biological processes, intended for use in the productive sectors, in the storage and processing of products agricultural, in pastures, in the protection of forests, other ecosystems and also urban, water and industrial environments, whose purpose is to change the composition of the flora or fauna, in order to preserve it from the harmful action of living beings considered harmful (BRAZIL, 1989).

As Philippi Jr. and Pelicioni (2014), the critical view and weighting of the facts, which stimulate scientific research, in order to understand and relate the causes and consequences, which concern environmental impacts, with emphasis on the approach to the indiscriminate use

of pesticides; they cannot imply interests of an economic, political or cultural nature, which stand out in the taking of adequate decisions to the costs related to health and the environment.

Thus, the modernization of agriculture in Brazil, from the perspective of increasing productivity in agribusiness, caused environmental damage, ranging from contamination of food and the environment, negative impacts on the health of farmers and consumers, contamination of natural resources to the intense and growing use of pesticides. In this context, the use of pesticides in Brazil has been the subject of intense debate in recent decades, so that the approach to the use of these inputs includes issues involved in food production and permeates the training of people with different knowledge and critical positions facing this reality (SOUSA; GORRI, 2019).

There is a need to put into effect laws that regulate the use of pesticides to establish criteria to minimize or eradicate these interferences. In addition, to enable their use in a balanced and environmentally sustainable way, to continue and maintain the conditions of natural resources of common good for the population (SOBRINHO; WALTRICH, 2017).

In addition, it is essential to train those who handle pesticides, as well as the prohibition of active ingredients that are proven to be harmful to the environment and health, in addition to strict supervision by the government, through the competent environmental agencies. It is a fact that the rupture of paradigms in agriculture and people's culture, despite being resistant, is necessary in the current scenario (VIEIRA *et al.*, 2016).

2 OBJECTIVE

The objective of this study was to analyze the national scientific production of the last five years, which address EE actions in chemistry teaching those involving the issue of pesticides. For that, it was necessary to collect data through publications in journals, identify and select the productions that address the theme in this given period, and describe a historical approach.

3 METHODOLOGY

This descriptive and exploratory study aims to systematize the scientific production on EE and pesticides in the last five years. A way to be followed to carry out the research is to map possibilities for investigation, according to its purposes, and that is accepted by the scientific community (MINAYO, 2015). The research carried out was based on the technical procedure classified as the State of Knowledge type, which consists of a mechanism that provides reading on a certain topic that is being researched by the academic community in an investigative process (MOROSINI; FERNANDES, 2014). This type of study collaborates to analyze characteristics of elaborated materials, that is, of the existing scientific production on a subject that, later, contribute to base new studies.

In view of the above, the research reveals an investigation delimited in the period from 2016 to 2020, the last five years, and deals with the contributions of EE and the use of pesticides, with a view to the sustainable development of Agribusiness. Data collection in search of information related to the theme of this research was systematized from April to July 2021. Platforms such as Scientific Electronic Library Online (SciELO), Capes Journals and Brazilian

Digital Library of Theses and Dissertations were consulted (BDTD); through articles, dissertations and theses.

The chosen time frame evidences an analysis of the updated environmental situation, regarding the conservation and control of the degradation of the environment, mainly in actions aimed at problems of anthropic origin and which, therefore, can serve as a basis for discussions of relevant environmental aspects in EE. Since different Brazilian regions and states face serious problems related to the preservation and use of natural resources (PHILIPPI JR; PELICIONE, 2014).

The consulted studies related to the research theme were identified using the keywords “Environmental Education”, “Agrochemicals” and “Teaching Chemistry”, to identify materials that met the study in question. Consequently, they were 30 productions were selected, mostly articles, other dissertations, and theses. In addition, the chosen studies prioritized Brazilian experiences, in addition to adopting the year of publication as a filter.

Soon after, for the selection of the material, according to the delimited theme, the following steps were followed, initially selective reading of the abstracts, choice of the material that contemplated the objectives of this research, download of the files, analysis of the texts (research stages), and the basic references and, finally, carrying out an interpretive reading of the material in its entirety. Next, a summary was made on the theme in question; in order to highlight its potentialities and paths to be followed.

It should be said that, as an exclusion criterion for the analyzed scientific productions, in addition to the time frame and the delimited platforms, scientific rigor was considered in studies specifically that were directed to CT (Chemistry Teaching), the environment, Brazilian legislation, as well as documents inherent to the curriculum of the basic education that deal with the pesticide theme as a possibility to promote EE. In this aspect, initially, after reading the summary of such productions, several were disregarded, and, even after uploading 43 materials, 13 others did not substantially match theoretical and practical subsidies for this research.

As for the aspects analyzed in the selected productions, they were: author and year; public involved; theme approach; developed action; basic references and main results. This was followed by categorization in a vertical way, confronting data, verifying its potential and the outcomes in the studies carried out, according to the elements listed in Chart 1. In this bias, in Bardin's view (2016), treating the material and coding it corresponds to a transformation of the text's raw data, through clippings and aggregations, which allow achieving a representation of content or its expression. Therefore, these criteria served to establish relationships and interpret trends in the studies.

4 RESULTS

From the analysis, the first observation observed was that the consulted platforms (Scielo, Capes Journals and BDTD) are repositories with a wide range of studies, viable for research regarding EE and Pesticides. Another important aspect to be highlighted is that the numerous studies show the veracity and relevance of the ideas presented, but that the subject addressed here still faces limitations, in terms of the breadth of this way of working, dissemination and access to related knowledge. to socio-environmental concepts.

Thus, a total of 23 articles, four Dissertations and three Theses were analyzed with the theme addressed, involving theoretical studies and research with teachers, students, farmers and health professionals, in the sense of helping studies and strengthening discussions on the approach to the issue of EE and pesticides, in different training spaces, presenting the potential to be used, including, as educational material, with a view to the integral formation of the citizen.

Thus, based on intense readings, the material was explored in order to analyze how EE appears in Brazilian legislation, in curriculum documents and in different formal teaching environments. After analyzing the materials, the tabulation stage was carried out, in which we sought to list the similarities and purposes of the sources, of the materials categorized in Table 1, constituting, in turn, the treatment of results (BARDIN, 2016).

Table 1– Tabulation of the analyzed criteria in the identified productions.

| Author/year | Public and place involved | Thematic addressed | Action Developed | Basic theoretical references |
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| Cross; Messias and Ribeiro (2020) (Article) | 3rd year high school students. State School of Campo Verde/MT. | Pesticides and their relationship with the environment; Human health and Chemistry concepts. | Analysis of Chemistry textbooks; online self-administered questionnaires. | Brazil (1976, 2017); Leite (2015); Santos (2015); Auler (2011); Fernandes (2015). |
| Vieira et al. (2020) (Article) | Review text. Descriptive narrative review, Pará/PA. | Analysis of Environmental Education as a promotion of healthy food, reflections of the food production process. | Description on how to develop EE based on the theme of food. | Buczenko (2018); Ploeg, (2008); Gomes (2017); Martinelli (2019). |
| Kölling; Andrade (2020) (Article) | Review text. Descriptive narrative review, São Caetano/SP. | Organic agriculture; Environmental externalities and Sustainability. | Daily practices focused on caring for people and agriculture. | Altieri (1989); Brasil (2020); Carneiro et al. (2015); Fonseca (2016). |
| Cunha; Soares (2020) (Article) | Review text. Descriptive narrative review, Rio de Janeiro/RJ. | Taxation on pesticides as a means of mitigating negative externalities and strengthening ecologically balanced agricultural practices. | Adoption of substances with less harmful effects; mitigate the use of pesticides; sustainable agricultural practices. | Brasil (1990, 1996, 1998, 2002, 2003, 2004, 2005, 2009); Cunha (2019); IBGE (2017). |
| Filho, Farias (2020) (Article) | Group of basic education teachers. Public school in Pernambuco/PE. | Perceptions of a group of basic education teachers about the text of the National Environmental Education Policy (PNEA). | Collective and reflective reading, continuing education, debate. | Azevedo; Costa; Santos (2017); Brasil (1965, 1967, 1981, 1988, 1993, 1997, 1998, 1999, 2012, 2016). |
| Lima; Pignatti; Pignatti (2020) (Article) | Review text. Descriptive narrative review, Northeast region of MT. | Analysis and discussions on pesticide residues in water and the dynamics of insertion of agriculture in the Marãiwatsédé indigenous land and region. | Determination of sampling sites was based on a hydrographic map and a satellite map; chemical analyzes in water. | Anvisa (2010); Hayes et al. (2011); Carneiro et al. (2015); Santos et al. (2011); Shelton et al. (2014). |
| Miranda; Zanetti (2020) (Article) | Review text. Descriptive narrative review, Brasília/DF. | Science Education through EE on the risks arising from scientific and technological advances, contributions to the formation of socio-environmental citizenship. | Training of teachers in the school space. | Beck (2009, 2011); Cook (2015); Pitanga (2016); Layrargues (2002). |

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| Nogueira; Swarcwald; Damacena (2020) (Article) | Review text Descriptive narrative review, Rio de Janeiro/RJ. | Scientific literature and the health of farmers associated with exposure to pesticides. | Observational cohort, case-control and cross-sectional studies. | Campos; Melo; Otero (2017); Greenpeace (2017); Lemarchand <i>et al.</i> (2018); Oliveira-Silva <i>et al.</i> (1989). |
| Silva; Loureiro (2020) (Article) | Research-teachers in the field of Environmental Education. Public and private educational institutions, Rio de Janeiro - RJ | BNCC conceptions on environmental education, the instrumentalization of the theme and the absence of critical approaches. | Semi-structured interview and ATD. | Aguiar (2018); Brasil (2016, 2017); Moraes; Saviani (2018); Veiga (2016); Venco; Carneiro, (2017, 2018). |
| Ribeiro (2020) (Thesis) | Students of Basic Education (EB), EF, EM, EM/EJA and Chemistry Tec modalities. Public state institutions, Porto Alegre/RS. | Environmental problems caused by pesticides; pedagogical sequence based on PS with EB students. | Problem Solving (PS); questionnaires, field diaries, audio recordings and written productions. | Pozo (1998); Ribeiro (2018); Tozoni-Reis (2008); Zabala, (1998). |
| Sousa; Gorri (2019) (Article) | Review text. Descriptive narrative review, Florianópolis/SC. | Pesticides in the Brazilian context; Education in Science and Chemistry. | Discussions on the use of pesticides in Brazil. | Auler (2002, 2007, 2011, 2015); Carneiro (2015); Calvao (2017). |
| Schollmeier (2019) (Article) | Elementary Education modality of Youth and Adult Education (EJA). Municipal school, Santa Maria/RS. | Environmental Education from the Pesticides theme, interdisciplinary work in EJA. | Interdisciplinary work; Workshops; semi-structured questionnaires. | Brasil (1999); Cavalcanti (2010); Braibante; Zoppe (2012); Dias (2004). |
| Busato et al. (2019) (Article) | Family farmers of high school and technical school students. Santo Agostinho Rural Family School; Quilombo/SC. | Application of pesticides in family farming; use of IPE; packaging discards; Health and the environment. | Questionnaire with open and closed questions. | Abrasco (2012); Embrapa (2005); Morri <i>et al.</i> (2015). |
| Ribeiro; Passos; Salgado (2019) (Article) | High School; Youth and Adult Education (EJA). Public school, Porto Alegre/RS. | Interdisciplinary work contextualized in EJA with the environmental theme of pesticides. | Problem Solving (PS); Interdisciplinary work. | Brasil (1999, 2002a, 2006); Pozo (1998); Lipman (1995); Loureiro; Torres (2014). |
| Corrêa (2019) (Article) | Farm workers and horticulturists. Towns of MT, Campo Novo dos Parecis; Campos de Julio and Sapezal. | Assessment of self-sufficiency in food production with the implications of the productive model. In agribusiness | Interviews. Transcription, pre-analysis, exploration of the material; data treatment, interpretation, and inferences. | Brasil (2017, 1996); Carneiro <i>et al.</i> (2015); IBGE, (2017); Oliveira (2016). |
| Boechel (2019) (Dissertation) | Review text Descriptive narrative review, Vacarias/RS. | Use of pesticides in agricultural production in Brazil at the national, state, and local context, socio-environmental risks from the perspective of Law. | Gathering the legal issues involving pesticides. | Brasil (1989, 1996, 2002, 2016, 2018); Leff (2001); Pereira (2008); Michael (2015); Silveira (2014). |
| Fonseca (2019) (Dissertation) | Science Teachers. Municipal education network, Dom Pedrito/RS. | The approach to the theme Pesticides based on CTS/PLACTS-Freire articulations about science teaching reflections in the | Questionnaire and semi-structured interview, Discursive Textual Analysis. | Auler, (2002, 2003, 2007b, 2016); Freire (1996, 2008, 2016a), Santos (2011). |

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| | | teacher training process. | | |
| Pozzebon et al. (2018) (Article) | High School Students. State Schools. Itaquí/SC. | Environmental Education and the impact of agriculture on the environment, considering regional and cultural characteristics. | Thematic panel, technical and educational lectures; questionnaires. | Effting (2007); Santos (2007); Tavares (2010); Freitas; Marin (2015). |
| Mello; Fonseca; Duso (2018) (Article) | Third grade high school students. School in the urban area, Dom Pedrito/RS. | Pesticides in Chemistry Teaching, Green Revolution; toxicity, biological control, and organic production. | Didactic sequence; Didactic game. Content analysis. | Cavalcanti (2010); Chassot (1999); Silva (2007); Silveira (1998). Fortune (2016). |
| Ribeiro; Passos; Salgado (2018) (Article) | 3rd year high school students. State public school. Porto Alegre/RS. | Environmental problems related to pesticides and scientific concepts on Chemistry Teaching. | Field sequence, audios; questionnaire, content analysis. | Anvisa (2016); Gó (2005) Pozo, (1998); Zabala, (1998). |
| Silva; Leão (2018) (Article) | 3rd year high school students. Rural School Sol Nascente, Confresa/MT. | Use of pesticides in agricultural production as a strategy to teach Chemistry. | Mock Jury. Studies of the chemical structures of the main pesticides. | Anastasiou; Alves (2004); Brasil (1989, 2002); Leão; Quartieri; Marchi, (2013); Leão (2014). |
| Barros (2018) (Article) | Review text. Descriptive narrative review, Brasília DF. | Brazilian political parties, proposals that defend the radical environmentalism and the notion of sustainability. | Mapping environmental themes incorporated by the 'party' programs. | Barros, (2015); Braga (2012,2014); Saiz (2015); Sainteny (1994). |
| Henemann (2018) (Dissertation) | Review text Descriptive narrative review, Curitiba/PR. | Environmental Education Analysis proposed in Basic Education based on official documents: PNEA; PNEE; Laws and curriculum documents. | EE official documents studies; Educational Development Program. | Brasil (, 1996, 1997, 2000, 2002, 2014, 2018); GIL, 2010); PARANÁ, (2013, 2015). |
| Silva (2018) (Thesis) | Farmer or irrigation system operator and business resellers/distributors. Jaguaribe/CE | Logistics and Reservation of pesticide packaging. | Allocation of empty packaging sub-stations. | Andrei (2005); Baird, (2011); Brasil (1993, 1998, 2010, 2010b); Cann, M. (2011); Embrapa (2016). |
| Sobrinho; Waltrich (2017) (Article) | Review text. Descriptive narrative review, São Luís/MA. | Pesticide legislation and the Sustainability model based on an ecological-social vision. | Study of Law projects, ecological-social vision of Leonardo Boff. Reflections in the academic environment. | Brasil (2015); Boff (2015); Cruz (2012); Morin (2016). |
| Souza; Marques (2017) (Article) | Teachers (Biologist, Agronomist, Veterinarian, Zootechnician) Technical Course in Agriculture institution in Mato Grosso | High use of pesticides in agricultural activities as a questioning process developed in a training activity with teachers and the consequences for the environment. | Formative activity in the Freirean educational perspective and the methodology of the three pedagogical moments; analytical treatment of data (ATD). | Abrasco (2010); Auler (2011); Delizoicov (2006); Freire (1997,1983, 2000,2005); Rigotto (2011). |
| Cassiano (2017) (Thesis) | Review text. Descriptive narrative review, Goiânia/GO. | International and Brazilian guidelines for EE and dependence and/or resistance relationships based on the mapping of convergences and divergences among them. | Practices and traditions inherent in the field of EE; environment, and development. | Brasil, (1981); Carvalho (2001); UNESCO (1948, 1950, 1969, 1977, 1985, 1987, 1989); Furtado (1976, 2003); Martins, |

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| | | | | (2011). |
| Ferreira; Viana Jr. (2016) (Article) | Health professionals, municipal schoolteachers, students and residents of the community, Quixeré/CE. | Implications for health, work and the environment arising from the introduction/expansion of agribusiness in the semi-arid region of Ceará. | Workshops; social cartography method, unstructured interview. | Rigotto (2011, 2013); Sampaio (2011). |
| Vieira et al. (2016) (Article) | Women farmers, Itajaí/SC. | Experience of the Culture Circle, agroecological knowledge, the harmful effects of the use of pesticides and the production of organic food. | Directed studies; pilot workshops. | Araújo(2009); Brasil (2015); Ehlers (1999); Guimarães; Mesquita (2010); Gliesman (2001). |
| Ribeiro (2016) (Dissertation) | Basic Education Teachers. and graduates of PIBID in Chemistry. University extension course, Porto Alegre/RS. | Theoretical and practical aspects of the methodology associated with the theme Pesticides in the training of Chemistry teachers. | EE university extension course, Problem Solving in Chemistry Teaching, questionnaires. | Anvisa (2014) Brasil, (1999, 2006, 2009, 2012); Carvalho (2006); Cassiano (2004); Mapa (2014). |

Source: Prepared according to data collected in the survey (2021).

The results that are presented (Table 1) show research in order to deal with the subject, with special emphasis on the damage caused to the environment, address specific concepts of Education in Chemistry and Science, teacher training and Brazilian environmental legislation.

In the first moment of the analyses, it is observed that, regarding the public involved, there is a partial focus on students and permeates the different modalities of Basic Education Teaching, in the following distribution: Escola Elementary Ribeiro (2019); Ferreira and Viana Jr. (2016); Elementary Education/EJA: Schollmeier (2019); Regular High School Cruz, Messias and Ribeiro (2020); Busato (2019); Pozzebon, et al. (2018); Mello, Fonseca and Duso (2018); Ribeiro, Passos e Salgado (2018); Silva e Leão (2018); High School/EJA: Ribeiro (2020); Ribeiro, Passos e Salgado (2019) and Technical High School: Ribeiro (2020); Busato (2019). Based on the analyses, it can be seen that there was a greater number of works in the Regular High School modality, in the Chemistry discipline; although these are not effectively expressive when compared to the total of materials analyzed in this research (Table 1), since theoretical studies prevail.

Regarding the topics addressed, trends are evident regarding the theoretical aspects related to Brazilian legislation. In this regard, regarding the EE foreseen in national laws and the duty of all citizens, contexts established in Public Policy, Federal, State and Municipal Laws, which deal with EE and the use of Agrochemicals in Brazilian agriculture, stand out; implications for the agricultural production sector are established, as well as their relationships with environmental and health impacts; actions based on ecological balance, in order to make the environment sustainable.

Furthermore, Brazil is emphasized as one of the countries that most use these products in the agricultural sector in recent years. To this end, we seek to assist in the dissemination and implementation of this socio-environmental theme, of such relevance, in view of the balance and maintenance of different ways of life (VIEIRA *et al.*, 2020; SOUSA; GORRI, 2019; BOECHEL, 2019).

Specificities regarding legislation on pesticides and sustainability are also elucidated; the studies are based on the ecological-social vision, through practices aimed at caring for the health

of human beings, the relationship between pesticides and agriculture, investigated in different contexts. There is also evidence of critical reflection on the production model, with the possibility of being culturally viable, strengthening sustainable agricultural practices and adopting substances with less harmful effects (BARROS, 2018; KÖLLING; ANDRADE, 2020).

Silva and Loureiro (2020) state that the different versions of the BNCC, the main guiding document for Basic Education, underestimate the EE theme integrated with socio-environmental approaches, which intensifies an omission in relation to what is discussed and produced by the field in Brazil.

It is notorious that, sometimes, teachers do not appropriate the guiding documents and consequently do not address EE issues in their pedagogical practice, and when they do, it is superficially and, often, the appropriation of the concepts involved is not effective. (FILHO; FARIAS, 2020). Therefore, it is opportune to fill these gaps, promote research linked to environmental practice and corroborate with the implementation of National Policies and the integral formation of individuals.

It is observed that in the review texts, the description, analysis, and theoretical discussions that support EE issues and the use of pesticides prevail; pervade the socio-environmental and scientific fields. In this respect, little is said about technological development, a point that implies considerable changes of an environmental nature. In addition, in the educational aspect, the actions performed were related to theoretical studies related to teacher training and interdisciplinary work carried out in the school environment, generally focused on EE.

It is noticed that the actions that integrate the concepts to be taught in Science and Chemistry in a way linked to the environmental theme are restricted. So, weaknesses are recognized in this issue of enabling concrete actions with a view to the applied teaching. According to the listed theoretical references, Brazilian legislation, the PNEA and the BNCC are a trend. In addition to the above, these documents are shown as a theoretical contribution for this research and other future investigations, regarding socio-scientific discussions related to environmental aspects.

In summary, this production points to reflective discussions regarding the understanding of the theme EE and Pesticides, environmental problems, preservation of the environment and incorporation of sustainable practices; the need for appropriation and systematization of the relationships involved from the legislation regarding the EE processes, and its insertion in Basic Education.

5 CONCLUSION AND CONSIDERATIONS

When carrying out the analysis of the national scientific production, in the time frame 2016 to 2020, which address EE actions in the teaching of chemistry, in particular, those involving the issue of pesticides, it was noted little appropriation and knowledge about laws and documents guiding this subject, both by professionals in the agricultural and educational sectors, as well as by society in general. Therefore, this point is remarkable when considering such relevance that it has in terms of socio-environmental impacts.

Through this research, 30 scientific productions were verified that deal with different aspects, among them EE, Legislation, pesticides, Environment, Human Health, Agricultural Practices, Sustainability, Science and Chemistry Teaching, and Teacher Training. Among them, 12 were review texts, which covered concepts regarding EE, pesticides, and Legislation; another 14 occurred in the educational field (students and teachers). However, without critical analysis or deepening of such pedagogical practices; the other four studies were focused on the agricultural sector, mainly related to cultivation and human health.

In view of the interpretation and analysis of articles, dissertations, and theses, it provided a comprehensive and contextualized view of the subject, allowing a coherent and consistent research structure with different perspectives. A vast potentially revealing theoretical contribution was observed as basic references for this and future studies. At this point, the trends were based on documents of Brazilian legislation, the PNEA and the BNCC.

On the other hand, gaps are evident through critical approaches to the subject, reinforcing the importance of teachers taking ownership of the concepts and laws that underlie EE and, therefore, enhancing their pedagogical practices to enable an articulation between theory and practice, scientific knowledge, and environmental problems.

Thus, the impressions identified in this study instigate the need to complement each other, and do not exhaust the scientific evidence on the subject. In addition, they provide evidence that the assessment regarding EE and exposure to pesticides is complex, as well as the diversity of associated damages. That is, the relevance of working, appropriating, and disseminating studies that refer to knowledge of approaches to EE and Pesticides is notorious.

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