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# SYSTEMATIC REVIEW ON THE ENVIRONMENTAL EDUCATION CURRICULUM IN TEACHER TRAINING BETWEEN 2015 – 2023

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## ABSTRACT

Considering the importance of environmental education in initial teacher training, this study presents the results of a research that investigated how the environmental education curriculum is integrated into teacher training, through a systematic review of scientific articles. Using Google Scholar, 3730 articles were initially identified using the keywords "environmental education" in initial teacher training curricula, published between 2015 and 2023. After applying inclusion and exclusion criteria, 41 articles were selected for detailed analysis. The abstracts were organized in a meta-research model in Excel and submitted to Content Analysis using the IRaMuTeq software, allowing the identification of thematic patterns and emerging trends. Textual analysis revealed the prevalence of keywords such as "environmental education", "teacher training" and "curriculum", indicating their centrality in the academic literature. The Descending Hierarchical Classification identified three classes related to the theoretical approach, teacher training context and curriculum development. The Similarity Analysis demonstrated significant connections between the keywords, highlighting the importance of the discussion about the training curriculum and the need to investigate how different courses approach the environmental theme. The results highlight that studies on the environmental education curriculum focus on disciplines such as Biological Sciences, Geography, Pedagogy and Chemistry, often not fully following the established legal guidelines. These findings underscore the urgency of effective integration of environmental education into teacher training curricula, in line with legislative requirements.

**Keywords:** Content Analysis, Systematic Review, IraMuTeq, Environmental Education.

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## INTRODUCTION

Environmental Education (EE) is a process of citizenship education that aims to make people aware of the importance of preserving the environment, as defended by Jacobi (2003). It is an interdisciplinary area that integrates knowledge from the natural, social, human, and artistic sciences. The training of teachers for EE is fundamental for the consolidation of environmental education in basic education. Teachers are responsible for planning and implementing educational activities that promote students' environmental awareness and awareness.

In Brazil, environmental education is an essential and permanent component of national education, as provided for in Law No. 9,795, of April 27, 1999, which institutes the National Policy for Environmental Education (PNEA). This Policy establishes that environmental education must be present in an articulated way at all levels and modalities of the educational process, in a formal and non-formal character. Although it is not explicitly an area of compulsory training in undergraduate courses, the law emphasizes its integration into educational programs.

However, the implementation of this training is still a challenge, as not all universities offer specific disciplines on EA. Teacher training for EE is an important investment in building a sustainable society. By developing environmental knowledge, skills and attitudes, teachers can contribute to the formation of conscious citizens committed to the preservation of the environment.

To respond to the research objective, the Systematic Review (SR) was used, which is a scientific method that aims to synthesize the available evidence on a given topic. It is a rigorous and systematic process of identification, evaluation and synthesis of relevant studies, with the objective of answering a specific research question (SILVA; DIAS, 2022). For the survey of scientific articles, the database of the search site "Google Scholar" was used, using the search words: "environmental education" in the "curricula" of "initial teacher training". The filter for a specific period was applied, between 2015 and 2023, highlighting the fact that the search was carried out in August 2023. The initial search resulted in a total of 3,730 scientific articles. After the rigorous application of the inclusion and exclusion criteria, which prioritized works that directly addressed the theme of "environmental education" in the curricula of initial teacher training, as well as those that carried out systematic reviews or curriculum analyses, and that were carried out in Brazil and published in Portuguese, a final collection of 41 relevant articles was reached. These articles were

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selected to compose the basis of the exploratory analysis presented in this study. This version retains the essential information, but presents a more fluid and clear structure.

For the analysis, the IraMuTeq[4] software (*Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires) was used*, which is used for the analysis of textual data, allowing the organization and identification of patterns in the texts collected from the selected articles.

Considering the above, this article aims to analyze how the environmental education curriculum is presented in the initial training of teachers in Brazil. As guiding questions, answer what are the main higher education courses that address EE? In addition to analyzing whether the approach of the environmental education curriculum in teacher training.

## MATERIAL AND METHODS

This article presents an analysis of qualitative data from a textual *corpus*, originating from abstracts of scientific articles from the search platform "Google Scholar". To this end, the frequency of the words present in the texts was quantified, the groups of words were compared to these frequencies, and complex and multivariate analyses were also performed with a diversity of quantitative variables extracted from the textual materials by means of appropriate *software*. The variables refer to the textual elements analyzed, such as the frequency of individual words and groups of words, as well as to the multivariate statistical analyses performed on these quantified textual data.

It is, therefore, a qualitative-quantitative research, based on the assumption that qualitative results are quantified (RODRIGUES; OLIVE TREE; SANTOS, 2021). It is a bibliographic research with descriptive analysis. (FONSECA, 2002).

In order to answer the research questions mentioned above, this research adopted, among other methods, the meta-research. This type of research refers to the process of conducting comprehensive and systematic research on existing studies in a given area of knowledge. Rather than focusing on a single study, meta-research involves collecting, selecting, and analyzing multiple relevant studies to identify patterns, trends, contradictions, and gaps in accumulated knowledge. (LIMA; SOUZA; SILVA, 2019).

[4] http://iramuteq.org/. R interface for multidimensional analysis of texts and questionnaires. Free software built with free software. Iramuteq is free software distributed under the terms of the GNU GPL (v2).

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Content analysis is a research method that analyzes qualitative data, such as text, images, videos, and audio. It is divided into four stages according to Bardin's (1977) Content Analysis method:

- *Pre-analysis*: In this step, the researcher does a floating reading of the data to get a general idea of the content. It also organizes the data and defines the objectives of the research.
- *Coding*: In this step, it transforms the data into units of analysis, which can be words, sentences, paragraphs, or even images.
- *Classification*: Here the researcher organizes the units of analysis into categories.
- *Interpretation*: The results of the research are analyzed and the content is inferred and interpreted.

To answer the proposed objectives, this research followed some steps, as described below:

1) Pre-analysis:

I. Search source: the database used was the search site "Google Scholar" which allows researchers to access several categories of scientific papers, including the scientific article that was used in this search.

II. Specific period: the selected works were those published between 2015 and 2023, considering the cut-off date being from the effectiveness of the 2030 Agenda of the United Nations (UN), which establishes the Sustainable Development Goals (SDGs). The survey was conducted in August 2023.

III. Search words: for the research to be carried out, the keywords "environmental education" were taken into account in the "curricula" of "initial teacher training". Which resulted in 3730 scientific articles.

IV. Inclusion criteria: Articles must directly address the topic of "environmental education" in initial teacher training curricula; scientific articles that have carried out systematic review or curriculum analysis; research in undergraduate courses; held in Brazil and in Portuguese;

V. Exclusion criteria: articles that do not directly focus on "environmental education" in initial teacher training curricula; articles without abstract; research in continuing education, or basic education; articles made in another country, or in another language.

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2) Material Exploration:

VI. Data extraction: after applying the criteria described, the search filtered a total of 41 articles. The articles were organized in an Excel table, to avoid duplication and facilitate the organization and extraction of information necessary for the research. Each article was organized into columns that covered the topics: Reference; Year of publication; Author(s); Graduate Program; Region; Title; Summary; Keywords; Thematic; "Approach, comments/criticisms/empirical t."; Descriptive/Analytical/Explanatory level of abstraction; Methodological Proc.; Theoretical frameworks.

VII. Analysis and synthesis: In order to analyze the research data, several approaches were used, including classical textual statistics, descending hierarchical classification, investigation of the specificity of groups of variables, similarity analysis, and word cloud visualization. All these techniques were applied using IraMuTeq on a *textual* corpus.

In this context, Camargo and Justo (2013) provide a comprehensive description of a *textual corpus* is a set of texts or a single text, in the case of this research, the *corpus* corresponds to 41 abstracts of scientific articles that were available on google scholar in August 2023.

For the preparation of the *textual corpus*, Camargo and Justo (2013) indicate using the text editor (txt). It is necessary that before each abstract, a command line is performed that the *software* will identify in the *corpus*, and in this search the command was: **** *RES_RESUMO *ANO_ANO *REG_Região. It is also noteworthy that some characters that the *software* does not identify were excluded, such as quotation marks, asterisks, hyphens and slashes. After the text preparation stage, the data were uploaded to the IraMuTeq software, where the procedures and techniques necessary to perform the content analysis were executed.

3) Treatment of results, inference and interpretation:

VIII. Interpretation of the results: For the presentation of the data, images and graphs are used, which were generated through the treatment of the results in the *IraMuTeq* software.

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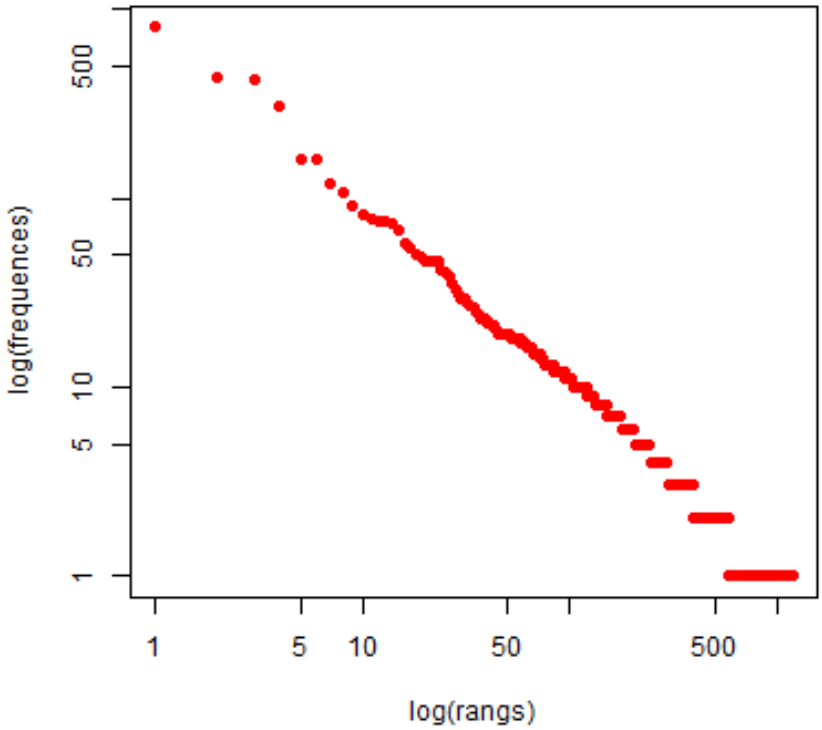
## RESULTS AND DISCUSSION

By importing the *textual corpus* into IRaMuTeq, it was possible to verify that the *software* performed the classical textual statistics, thus recognizing 41 texts, 207 text segments, 7316 occurrences, and 1573 forms (which are words), in addition to 899 hapax (words that appeared only once).

The first results processed in the *software* was the Zipf diagram (Figure 1), a graphical representation of the frequency distribution that characterizes the pattern of occurrence of words in the *corpus*. Zipf's Law, as discussed by Camargo; Justo (2013) describes the frequency of occurrence of words in a given text, explaining why this graphic representation is appropriate to illustrate the relationship between frequency and number of words. The frequency axis (y), on a logarithmic scale, reveals the number of times a word and its associated derived forms appear, while the axis of rangs (x) displays the corresponding order, also on a logarithmic scale.

**Figure 1** Corpus Zipf Diagram




Source: Generated by IraMuTeq, from the textual *corpus*. Org. The authors, 2023

Thus, it is observed that in Figure 1, a single word was mentioned with a frequency of more than 500 times, when consulting the data generated in the *software*, it was identified that it is the word "de" and also its forms (da, do, these, and their variations in the

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plural). Therefore, the active forms that appear most in Figure 1 are the textual forms "educação_ambiental" with 161 times, "formação_de_professores" 81 times, "teacher" 78 times and "environmental" 68 times. Textual forms such as: research, formação_inicial and curriculum, also appear with high frequency.

In this sense, the research was done with articles, whose main theme is Environmental Education in the teacher training curriculum, it is normal that these words appear repeatedly. As well as in Neto's (2021) research, which points to a strong trend of publications on the following topics: Teaching Work, Teacher Training and Public Policies and Curriculum on Environmental Education.

Continuing with the analyses, the *software* allows you to perform the Specificity Analysis, which has the function of identifying which words or expressions are specific to a given *textual corpus*. This is done by calculating the frequency of each word or expression in each of the documents in the *corpus* (VASCONCELOS, 2021). From this analysis, it is observed in Figure 2 that the terms: environmental education, teacher training and curriculum, appeared in all abstracts of articles analyzed, because it is the researched theme, and confirms the veracity of the articles filtered in the period from 2015 to 2023.

It is also observed that the word environmental education was widely used in works, especially in the years 2021 and 2022, according to the research by Nascimento et at. (2022) which shows the growth and evolution of research on environmental education, and the authors found a growth in scientific production on this topic, especially in the last decade. Considering that this period of greater publications was a period of the COVID-19 pandemic, this increase may have been due to the fact that research on the environmental education curriculum can be done without the need for field research. In this sense, Costa; Silva; Silva (2022) found that Environmental Education is fundamental for the sustainable transformation of society, in any scenario, it provides the necessary knowledge and skills for people to act to build a better future.

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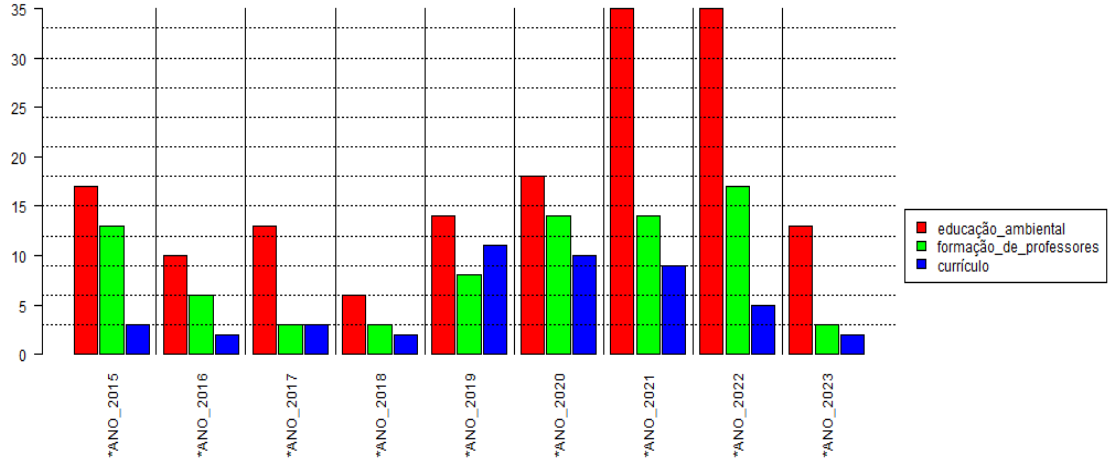
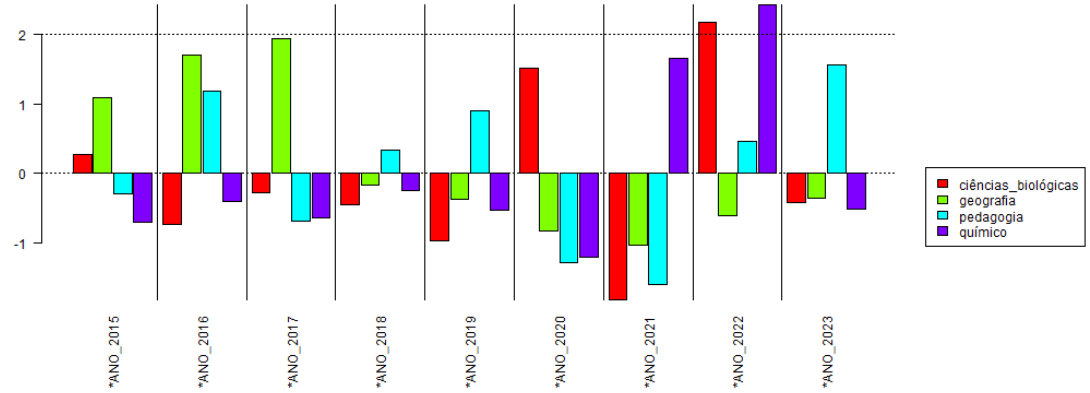
**Figure 2** Graph of the frequency of the terms between 2015 and 2023, generated from the specificity analysis




Source: Generated by IraMuTeq, from the textual *corpus*. Org. The authors, 2023

Thus, Figure 3 presents the teacher training courses that were surveyed between 2015 and 2023. It is noted that the research focuses on courses in biological sciences, geography, pedagogy and chemistry, contrary to what is established by Law No. 9,795, of April 27, 1999, which institutes the National Policy of Environmental Education (PNEA) and guides environmental education as an area of integrated training at all levels of education, including in teaching degree courses.

**Figure 3** Graph of attendance of undergraduate courses that address environmental education between 2015 and 2023, generated from the specificity analysis




Source: Generated by IRaMuTeq, from the textual *corpus*. Org. The authors, 2023

Another analysis carried out with IraMuTeq is the Descending Hierarchical Classification (DHC), where in order to obtain classes of elementary context units (ECU) with vocabulary similar to each other and different from the ECUs of the other classes, it is necessary to classify the text segments according to their respective vocabularies. This

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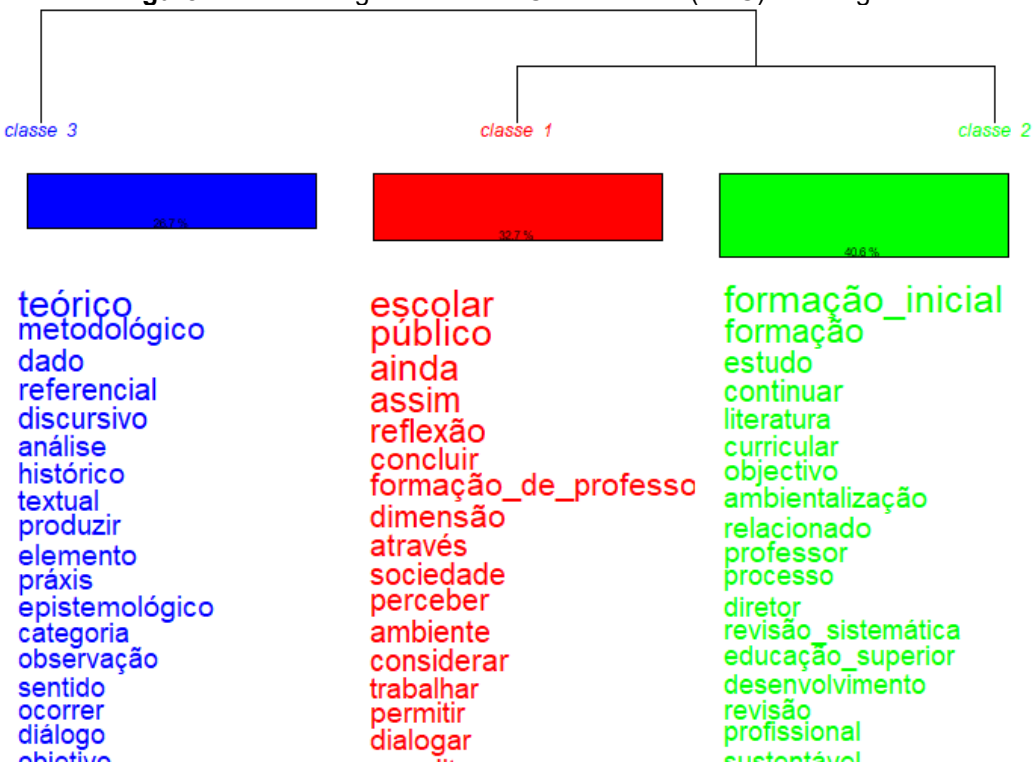
classification is made based on the frequency of reduced forms (words already stemmed) (CAMARGO; JUSTO, 2013).

Therefore, in this research, 206 text segments were analyzed, of which 105 were classified by the *software* for CHD analysis, thus returning 80.1% of the loaded segments. Of these, 3 classes were generated, which are illustrated in Figure 4. It is possible to see in the dendrogram that the classes were first divided into two groups, group one, which is class 3, and group 2, which was subdivided into classes 2 and 3.

**Figure 4** Descending Hierarchical Classification (DHC) dendrogram




Source: Generated by IRaMuTeq, from the textual *corpus*. Org. The authors, 2023

Still on Figure 4, it can be seen that class 3 (blue) represents 26.7% of the active forms, and presents words such as: theoretical; methodological, referential, analysis, historical. Thus, class 3 refers to the "theoretical approach", as it presents words that support aspects of the theoretical framework of the curriculum, as can be seen in the following excerpt extracted from the *textual* corpus:

> *RES_6 *ANO_2017 *REG_Nacional: In the analysis of the **theoretical frameworks** , a wide diversity of concepts was found, based on the assumptions established for the educação_ambiental, such as concern with environmental issues; university and curricular environmentalization, among others. (MIYAZAWA; CURI; FRENEDOZO, 2017)

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The second group, divided into class 1 (red) and 2 (green), represent 32.7% and 40.6% respectively. Class 1 presents words such as: school, public, formação_de_professores, society. Considering these terms, this class characterizes the "context of teacher education", as they point to reflections on teacher education, the context in which this training is inserted, ways of inserting this training. And class 2 presents words such as: formação_inicial, study, curricular, objective, process, guidelines, among others. Therefore, this class refers to "curriculum development".

It is important to report that the class with the highest frequency of occurrence is 2, corroborating with research and studies analyzed that it is the teacher training curriculum on the environmental theme. According to Pereira's work; Noviski; Saheb (2022), who researched environmental education in initial teacher training, conducting an analysis of the national curriculum guidelines.

The dendrogram of the Descending Hierarchical Classification (DHC) facilitates the visualization of the results because it divides the textual corpus into classes with similar vocabulary, allowing the identification of the main topics addressed. It presents the percentage of text segments classified in each class, showing which themes are most predominant. In this case, class 2 on curriculum development is the most frequent. It also groups the classes into dendrograms, showing the proximity between them. In the corpus analyzed, classes 1 and 2 appear in the same branch, indicating a greater relationship between them compared to class 3. It allows you to visualize the most relevant words in each class, highlighting the terms that characterize each theme. And it facilitates the interpretation of the results, as the dendrogram visually organizes the division of the corpus into classes with similar vocabulary, helping to understand the main subjects covered.

Continuing with the exploration of the *textual corpus*, it was possible to perform the Similarity Analysis, which according to Vasconcelos (2021) the analysis of word cooccurrence is a technique that uses graph theory to identify words that appear together frequently in a textual *corpus*. The result of this analysis provides information about the connection between the words, which can be used to identify the structure of the *corpus*, distinguishing the common parts and the specificities according to the illustrative (descriptive) variables identified in the analysis.

In order to generate the Similarity Analysis in a visually legible way, at the time of the analysis, the words "of" were excluded because they did not represent specific content, and it was also necessary to exclude the term "educação_ambiental" because it is the central

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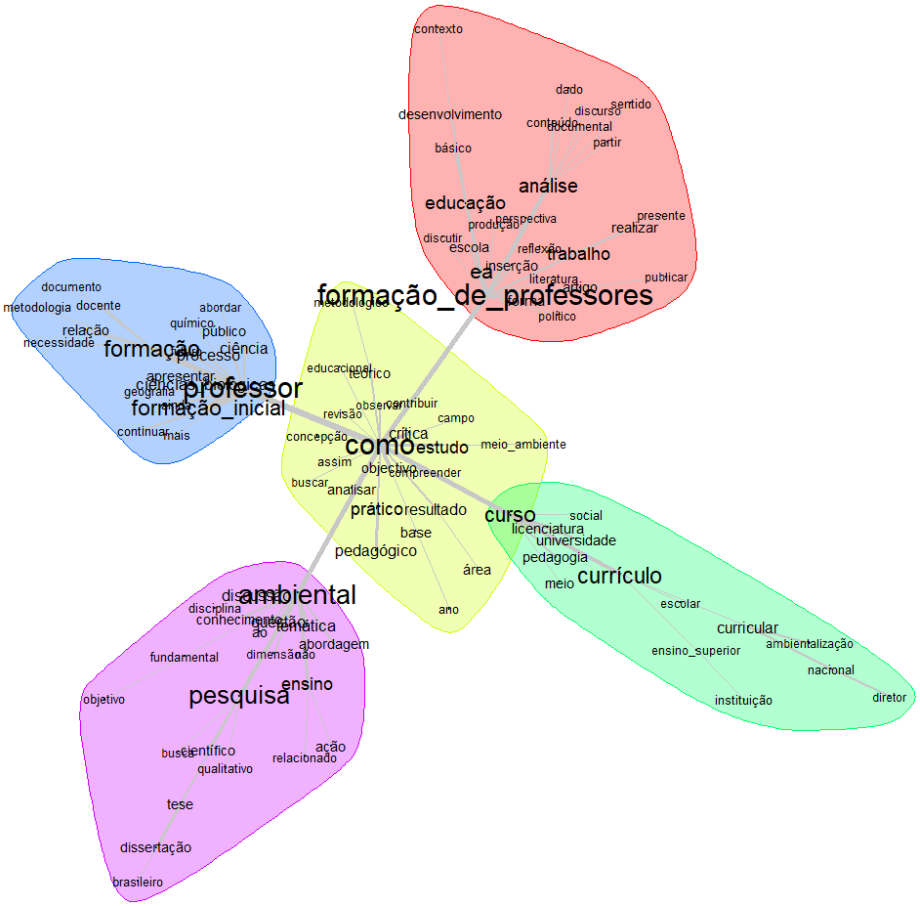
object of study, and with the exclusion of the theme, it facilitated the visualization of the connectives between the other words more frequently in the *corpus* textual. Only words with a frequency equal to or greater than thirteen were classified. The "communities" and "halo" options were marked to group the groups of words and to be highlighted with species of colored clouds, to facilitate the visualization of groups of words that connect repeatedly in the texts.

Therefore, the similarity tree highlights the forms with the greatest relevance and notability, especially the relationships between them. According to Vasconcelos (2021), this tree plays an important role in understanding the structure of the *textual corpus*, helping to interpret the context in which these forms are used.

**Figure 5** Analysis of the similarity of the *corpus*, and its connections




Source: Generated by IraMuTeq, from the textual *corpus*. Org. The authors, 2023

It is noted that when viewing the connections between the words, it is observed that in the *corpus* they are together, as in the green group, where one can read the words "curriculum", "ensino_superior", "course", "licentiate" ..., which bring an idea of the context in which they are inserted, whether about the curricular matrix of the courses. Another

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group that stands out is the one in red, as it involves words of analysis and discussion about teacher training, connecting words that are present in the text with the objective of discussing the training curriculum.

The group, in blue, represents which initial training courses address the environmental theme, as it is possible to identify the words: "ciências_biológicas", "geography", "chemistry", as well as words such as "approach" and "continue". This fact is confirmed in research by Oliveira *et al.* (2022), which researched undergraduate courses through interviews with pedagogical coordinators, and identified that only biological sciences and geography had the environmental theme in their curriculum. This goes against what is in Law No. 9,795, of April 27, 1999, which guides the insertion of Environmental Education in all undergraduate courses in an articulated way in its disciplines.

The similarity analysis (Figure 5) facilitates the visualization of the groups of words in the textual corpus in several ways:

1. Color-grouping: The similarity tree groups words into different colors, forming "clouds" that represent groups of words that connect repeatedly. This makes it visually evident which words are strongly related to each other.
2. Identification of key themes: The different colored groups in the similarity tree reveal the main themes addressed in the corpus. For example, the green group is related to the "curricular context of teacher training courses", the red to "teacher training" and the blue to "courses that address the environmental theme".
3. Connections between words: The lines that connect the words in the similarity tree demonstrate the strength of the relationship between them. The thicker the lines, the more often these words appear together in the corpus.
4. Highlighting keywords: The similarity tree emphasizes the most relevant and recurring words in the text, making it easier to identify key research concepts.

In this way, it allows a quick and visual understanding of the structure of the textual corpus, helping to interpret the context in which the keywords are used, as highlighted by Vasconcelos (2021). This tool is essential to map the connections between the main topics covered in the analyzed articles.

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## CONCLUSION

With the analysis of the *textual corpus* using the IraMuTeq software, it was possible to reach results about the research in Environmental Education in the teacher training curriculum. Highlighting the prevalence of keywords such as "environmental education," "teacher training," and "curriculum," indicating the centrality of these themes in the academic literature through the graphical representation of the Zipf Diagram highlighted the frequency of these certain words.

The Descending Hierarchical Classification (DHC) revealed three distinct classes, related to the theoretical approach, the context of teacher training and curriculum development. These classes reflect the diversity of topics and approaches within the field of Environmental Education in teacher education. Similarity Analysis demonstrated significant connections between keywords, helping to identify trends and areas of focus. These connections highlighted the importance of the discussion about the training curriculum and the need to investigate how different initial training courses approach the environmental theme.

The analysis carried out with the IraMuTeQ software revealed that research on the environmental education curriculum in initial teacher training in Brazil focuses mainly on Biological Sciences, Geography, Pedagogy and Chemistry courses. This finding contrasts with what is determined by Law No. 9,795, of 1999, which establishes that environmental education be integrated into all levels of education, which includes licentiate courses. Therefore, the results indicate that there is still a gap in the effective implementation of environmental education in several teacher training courses, despite the current legislation. This analysis points to the need to investigate more deeply the reasons for this concentration in certain courses, as well as to develop strategies to expand the insertion of the environmental theme in a transversal way in the curricular matrix of all teaching degree courses, as recommended by the national policy of environmental education.

This research is relevant to the field of environmental education, as it provides an overview of research trends and gaps in the field. From this overview, it is possible to develop new research that contributes to the improvement of teacher training for EE. It is recommended to investigate in depth the reasons behind the increase in research on Environmental Education during the COVID-19 pandemic, as well as the effectiveness of the curricular approaches adopted in different teacher training courses. In addition, it is

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important to explore the gaps identified in relation to the lack of insertion of Environmental Education in some undergraduate courses, considering the relevant legislation.

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## REFERENCES

1. BRASIL. Lei nº 9.795, de 27 de abril de 1999. Dispõe sobre a educação ambiental, institui a Política Nacional de Educação Ambiental e dá outras providências. Diário Oficial da União, Brasília, DF, 28 abr. 1999. Available at: https://www.planalto.gov.br/ccivil_03/leis/l9795.htm. Accessed on: Aug. 30, 2023.

2. Camargo, B. V., & Justo, A. M. (2013). Tutorial para uso do software de análise textual IRAMUTEQ. Laboratório de Psicologia Social da Comunicação e Cognição, Universidade Federal de Santa Catarina. Retrieved from: http://www.iramuteq.org/documentation/fichiers/tutoriel-en-portugais. Accessed on: Aug. 30, 2023.

3. Costa, D. C., Silva, J. G. d., & Silva, M. A. A. d. (2022). Educação ambiental durante a pandemia: Refletindo a partir da prática docente no ensino fundamental. Revista de Estudos em Educação e Diversidade - REED, 3(8), 1-19. Available at: https://doi.org/10.22481/reed.v3i8.11029. Accessed on: Aug. 31, 2023.

4. Nascimento, M. d. C. D. d., et al. (2022). Evolução da pesquisa em educação ambiental e desenvolvimento sustentável. REMEA - Revista Eletrônica do Mestrado em Educação Ambiental, 39(3), 78-99. Available at: https://doi.org/10.14295/remea.v39i3.14704. Accessed on: Aug. 31, 2023.

5. Fonseca, J. J. S. (2002). Metodologia da pesquisa científica. Fortaleza: UEC. Apostila.

6. Jacobi, P. (2003). Educação ambiental, cidadania e sustentabilidade. Cadernos de Pesquisa, 118, 189-206. Available at: http://www.scielo.br/pdf/cp/n118/16834.pdf. Accessed on: Oct. 25, 2024.

7. Lima, R. F., Souza, I. D. S., & Silva, A. J. N. (2019). Metapesquisa no campo da Educação Estatística com foco na educação de jovens e adultos. Revemat: Revista Eletrônica de Educação Matemática, 14, 1-17. Available at: https://doi.org/10.5007/1981-1322.2019.e62798. Accessed on: Aug. 30, 2023.

8. Miyazawa, G. C. M. C., Curi, E., & Fredenzo, R. d. C. (2017). A educação ambiental na formação inicial de professores: Um panorama das teses e dissertações brasileiras (2010-2016). Ensino, Saúde e Ambiente, 10(2). Available at: https://doi.org/10.22409/resa2017.v10i2.a21262. Accessed on: Aug. 31, 2023.

9. Neto, A. S. (2021). A formação de professores em educação ambiental: Uma análise do banco de teses e dissertações brasileiras em educação ambiental (BT&D/EA). Rev. Int. de Form. de Professores (RIFP), 6, e021014, 1-21. Available at: https://periodicoscientificos.itp.ifsp.edu.br/index.php/rifp/article/download/446/223/1537. Accessed on: Sept. 1, 2023.

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ISSN: 2358-2472

10. Pereira, C. M., Noviski, I. d. C., & Saheb, D. (2022). A educação ambiental na formação inicial de professores: Uma análise das diretrizes curriculares nacionais. Cadernos da Pedagogia, 16(35), 175-184. Available at: https://www.cadernosdapedagogia.ufscar.br/index.php/cp/article/view/1402. Accessed on: Sept. 1, 2023.

11. Oliveira, N. M. d., et al. (2022). A educação ambiental no ensino superior: O que dizem os acadêmicos e os coordenadores de curso. Revista Bio-grafía, Número Extraordinário, 1449-1457. Memorias XI Congreso Latinoamericano de Enseñanza de la Biología y la Educación Ambiental, 27 y 28 de octubre 2022. Modalidad virtual.

12. Rodrigues, T. D. d. F. F., Oliveira, G. S. d., & Santos, J. A. d. (2021). As pesquisas qualitativas e quantitativas na educação. Revista Prisma, 2(1), 154-174. Available at: https://revistaprisma.emnuvens.com.br/prisma/article/view/49. Accessed on: Aug. 30, 2023.

13. Silva, L. G., & Dias, L. F. (2022). Aprendizagem baseada em projetos no ensino de ciências da natureza com foco na colaboração: Uma revisão sistemática da literatura. Ensino de Ciências e Tecnologia em Revista – ENCITEC, 12(3), 86-102. Available at: https://doi.org/10.31512/encitec.v12i3.528. Accessed on: Aug. 30, 2023.

14. Vasconcelos, A. d. M. (2021, Sept. 27). IraMuTeq 7 Árvore de Similitude. YouTube. Available at: https://www.youtube.com/watch?v=KWnaOAFjnx8&list=PLoodt4UgFySPxzb7kK_kwN_6PtSYTeK1P&index=7&ab_channel=AlexandreMeiradeVasconcelos. Accessed on: Sept. 1, 2023.