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**EDUCAÇÃO & FORMAÇÃO**
Revista do Programa de Pós-Graduação em Educação
da Universidade Estadual do Ceará (UECE)

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# Research-Based Teaching and the traininig of Natural Science teachers: a bibliographic review

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**Abstract**
The objective of this study was to map publications on Inquiry-Based Teaching and teacher training in the Natural Sciences, focusing on national journals in Science Education. The research followed a Systematic Literature Review methodology, analyzing articles published between 2019 and 2023 in seven journals classified as Qualis A1 and A2. Six articles were selected after a rigorous inclusion and exclusion criteria process. The results highlight a balanced distribution between initial and continuing teacher training, with an emphasis on theoretical and practical approaches to Inquiry-Based Teaching. The analyzed research addresses the development of argumentative teaching practices, the integration of digital technologies, and the relevance of reflective processes regarding Inquiry-Based Teaching in initial teacher training. Among the most cited authors on the subject, Carvalho and Sasseron were used several times in all the analyzed articles. According to the results obtained, it is possible to indicate a lack of publications on teacher training using the Inquiry-Based Teaching approach.

**Keywords**
Inquiry-based approach; Teacher Education; Science teaching

## Ensino por Investigação e a formação de professores de Ciências da Natureza: uma revisão bibliográfica

**Resumo**
O objetivo deste estudo foi mapear publicações sobre o Ensino por Investigação e a formação docente nas Ciências da Natureza, com foco em periódicos nacionais de Ensino e Educação em Ciências. A pesquisa seguiu a metodologia de Revisão Sistemática de Literatura, analisando artigos publicados entre 2019 e 2023 em sete periódicos de Qualis A1 e A2. Seis artigos foram selecionados após um processo rigoroso de critérios de inclusão e exclusão. Os resultados destacam uma distribuição equilibrada entre formação inicial e continuada de docentes, com ênfase em abordagens teóricas e práticas do Ensino por Investigação. As pesquisas analisadas contemplam o desenvolvimento de práticas argumentativas docentes, a integração de tecnologias digitais e a relevância de processos reflexivos acerca do Ensino por Investigação na formação inicial. Dentre as autoras mais citadas sobre temática, Carvalho e Sasseron foram utilizadas diversas vezes em todos os artigos analisados. De acordo com resultados obtidos, é possível indicar carências de


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publicações acerca da formação docente com o uso da abordagem do Ensino por Investigação.

**Palavras-chave**
abordagem investigativa; formação docente; Ensino de Ciências.

**Enseñanza por Indagación y la formación de profesores de Ciencias Naturales: una revisión bibliográfica**

**Resumen**
El objetivo de este estudio fue mapear publicaciones sobre la Enseñanza por Indagación y la formación docente en Ciencias Naturales, con énfasis en revistas nacionales de Enseñanza y Educación en Ciencias. La investigación siguió la metodología de Revisión Sistemática de Literatura, analizando artículos publicados entre 2019 y 2023 en siete revistas de Qualis A1 y A2. Seis artículos fueron seleccionados tras un riguroso proceso de criterios de inclusión y exclusión. Los resultados destacan una distribución equilibrada entre la formación inicial y continua de docentes, con énfasis en enfoques tanto teóricos como prácticos de la Enseñanza por Indagación. Las investigaciones analizadas contemplan el desarrollo de prácticas argumentativas docentes, la integración de tecnologías digitales y la relevancia de los procesos reflexivos sobre la Enseñanza por Indagación en la formación inicial. Entre las autoras más citadas en la temática, Carvalho y Sasseron fueron referenciadas repetidamente en todos los artículos analizados. De acuerdo con los resultados obtenidos, es posible señalar una carencia de publicaciones sobre la formación docente a partir del enfoque de la Enseñanza por Indagación.

**Palabras clave**
abordaje investigativo; formación docente; Enseñanza de las Ciencias.

## 1 Introduction

Education faces the constant challenge of training critical individuals who are more autonomous and prepared to act in a world undergoing constant change. In this scenario, the role of teachers goes far beyond simply transmitting content, requiring them to promote the active construction of knowledge and the development of essential skills for life in society.

To this end, teacher training, both initial and continuing, acts as a strategic pillar, as it serves as the basis for pedagogical innovation and the quality of the educational process. At the same time, methodologies and approaches that place the student at the center of their own learning, such as Inquiry-Based Learning, are gaining prominence, as they can


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be effective in engaging students and deepening their understanding of the world around them.

Teacher training is a central field for the qualification of education. The teaching profession requires more than mastery of content; it requires pedagogical, ethical, and relational skills. This training should be understood as a continuous process of professional development, which values both experience and reflection on practice (Nóvoa, 1992). According to the author, the professional identity of teachers is built through interaction with the school and social context, and training should support this process.

In this sense, we can highlight that all educational practice is, in essence, political. Teacher training should support teachers to act as transformative intellectuals (Freire, 1996). Freire (1996) proposes a pedagogy of autonomy, in which the teacher, while teaching, also learns, and the student, while learning, also teaches, creating a dialogical cycle of mutual construction. Teacher training, therefore, should not only prepare teachers for the challenges of the classroom but also inspire them to guide students on their learning journeys.

Initial training, carried out in undergraduate courses, is the future educator's first formal contact with the theoretical and practical foundations of teaching. It is at this point that the foundations are laid for understanding the profession, teaching methodologies and approaches, and the relationship between theory and practice. The National Curriculum Guidelines for Initial Teacher Training (Brazil, 2019) emphasize that these courses should prepare teacher trainees to be critical and reflective, capable of responding to the demands of a constantly changing society.

However, the effectiveness of this training for the implementation of some approaches, such as Inquiry-Based Teaching, is still a point of discussion. Even in courses that address investigative teaching, many teachers still face difficulties in effectively implementing these concepts in the classroom (Silva, R.; Silva, F.; Suart, 2020). This gap between theory and practice reinforces the need for initial training that is not limited to theory but also offers practical and reflective experiences, consolidating the understanding and implementation of Inquiry-Based Teaching.

Continuing education, in turn, is essential for practicing teachers to update their knowledge, improve their teaching practices, and adapt to educational and technological


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innovations. It should be seen as a process of continuous development, which is part of the teacher's professional trajectory, integrated into their life and practice (Nóvoa, 1992).

In the context of Inquiry-Based Learning, continuing education also plays a very important role. Research such as that by Malheiro and Teixeira (2020) points out that courses focused on this teaching approach have the potential to transform teachers' practices and broaden their understanding of the approach in question. However, these studies also reveal obstacles, such as institutional resistance and a lack of support for the adoption of active methodologies (Silva; Moura, 2020). This reinforces the need for public policies and training programs that offer continuous support to educators so that they can effectively incorporate Inquiry-Based Teaching into their daily practices.

Unlike content-based teaching, which focuses on the passive transmission of information, Inquiry-Based Learning places the student at the center of the learning process. This approach encourages students to formulate questions, raise hypotheses, plan investigations, collect data, analyze information, and finally draw their own conclusions (Carvalho, 2018). Inquiry-based teaching is an important path for the development of autonomy and critical thinking, enabling students to solve problems and understand science as a dynamic and questioning process (Costa; Amaral, 2023).

Inquiry-based learning can be understood as a pedagogical approach inspired by scientific practice itself, in which knowledge is not presented as ready-made and finished, but constructed from problem situations. In this process, students are encouraged to observe phenomena, raise questions, formulate hypotheses, develop resolution strategies, test approaches, and reinterpret results (Zômpero; Laburú, 2011). Thus, rather than learning specific content, students experience fundamental stages of investigative practice, such as questioning, experimentation, and argumentation, developing essential cognitive and metacognitive skills (Carvalho, 2018).

In Inquiry-Based Learning, the role of the teacher changes. Instead of being the sole source of knowledge, they act as a mediator and facilitator, creating an environment conducive to exploration and discovery. Instead of providing ready-made answers, teachers guide students to seek solutions, stimulating discussion, argumentation, and the systematization of knowledge (Carvalho, 2018). When students engage, a task that could be seen as bureaucratic becomes a meaningful learning experience, both about the concepts and about the very nature of science (Sasseron, 2015).


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Although the benefits of Inquiry-Based Teaching are widely recognized, its implementation faces obstacles. The lack of time for planning, the perception that the methodology requires a lot of effort, and the absence of institutional support are some of the challenges (Azevedo; Marcelo; Machado, 2020). These obstacles reinforce the urgency of research that deepens the understanding of how teacher training has been discussed in the context of Inquiry-Based Teaching.

In this sense, the research is justified by the importance of understanding how Inquiry-Based Teaching has been incorporated into teacher training, especially in the area of Natural Sciences. Thus, the objective of this investigation is to map publications on Inquiry-Based Teaching and teacher training in the area of Natural Sciences.

## 2 Methodology

The research approach is qualitative (Bogdan; Biklen, 1994) and, in terms of technical procedures, it is configured as a Systematic Literature Review (SLR), based on Costa and Zoltowski (2014), and follows the steps defined by the researchers.

a) **Delimitation of the research question:** what is being researched and published on Inquiry-Based Teaching and teacher training in the field of Natural Sciences?
b) **Selection of data sources:** we restricted the search to publications in national journals in the field of Science Teaching and/or Education, with Qualis A1 and A2 ratings, according to the 2017-2020 quadrennial evaluation by the Coordination for the Improvement of Higher Education Personnel (Capes). The criteria for choosing the journals were based on their relevance to the research area. We also limited the selection to journals that accept works on Science Education in general, excluding journals with a specific focus on Chemistry, Physics, and Biology Education. In total, we selected seven journals in the area, four with Qualis A1 and three with Qualis A2, as detailed in Table 1. The choices are justified initially because they are journals of great relevance to science education and also because the first five mentioned were used in two previous studies on investigative activities in 2010 and 2015 by the authors Strieder and Watanabe (2018) and Maximo-Pereira and Cunha (2021), who researched the


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role of teachers in Inquiry-Based Science Education published between 2009 and 2019.

c) **Selection of keywords for the search:** in the initial stage, we searched the seven journals mentioned above using the descriptors “Inquiry-based teaching,” “inquiry activity,” and “inquiry teaching.” During the survey, we considered only articles published between 2019 and 2023. At this stage, 149 articles were identified (Table 1).

**Table 1 –** Number of articles identified in the initial stage by the journal

| Journal | Qualis | Number of articles |
|---|---|---|
| Ensaio: Pesquisa em Educação em Ciências (Impresso) | A1 | 13 |
| Ciência e Educação (Unesp. Impresso) | A1 | 27 |
| Investigações em Ensino de Ciências (*Online*) | A1 | 22 |
| Revista Brasileira de Pesquisa em Educação em Ciências | A1 | 33 |
| Alexandria | A2 | 5 |
| Revista de Ensino de Ciências e Matemática | A2 | 13 |
| Revista Brasileira de Ensino de Ciência e Tecnologia | A2 | 36 |

**Fonte:** Elaborated by the authors based on data obtained (2025).

d) **Search and storage of results:** the files of the articles found in the search were downloaded and stored in folders named after the journals in a Google Drive collection accessible to all researchers involved in this investigation. Additionally, we organized the data in a spreadsheet that lists each article by its title, journal, and respective storage folder.

e) **Selection of articles by abstract**, according to inclusion and exclusion criteria: this step consisted of reading the abstracts of the articles selected in the previous step. At this point, we identified the objective of the work, the keywords, and the approach adopted, with the aim of distinguishing the works that dealt with teacher training from those focused only on the implementation of investigative approaches. According to these criteria, we refined the selection to eight articles that addressed teacher training. Of these, two were subsequently disqualified,


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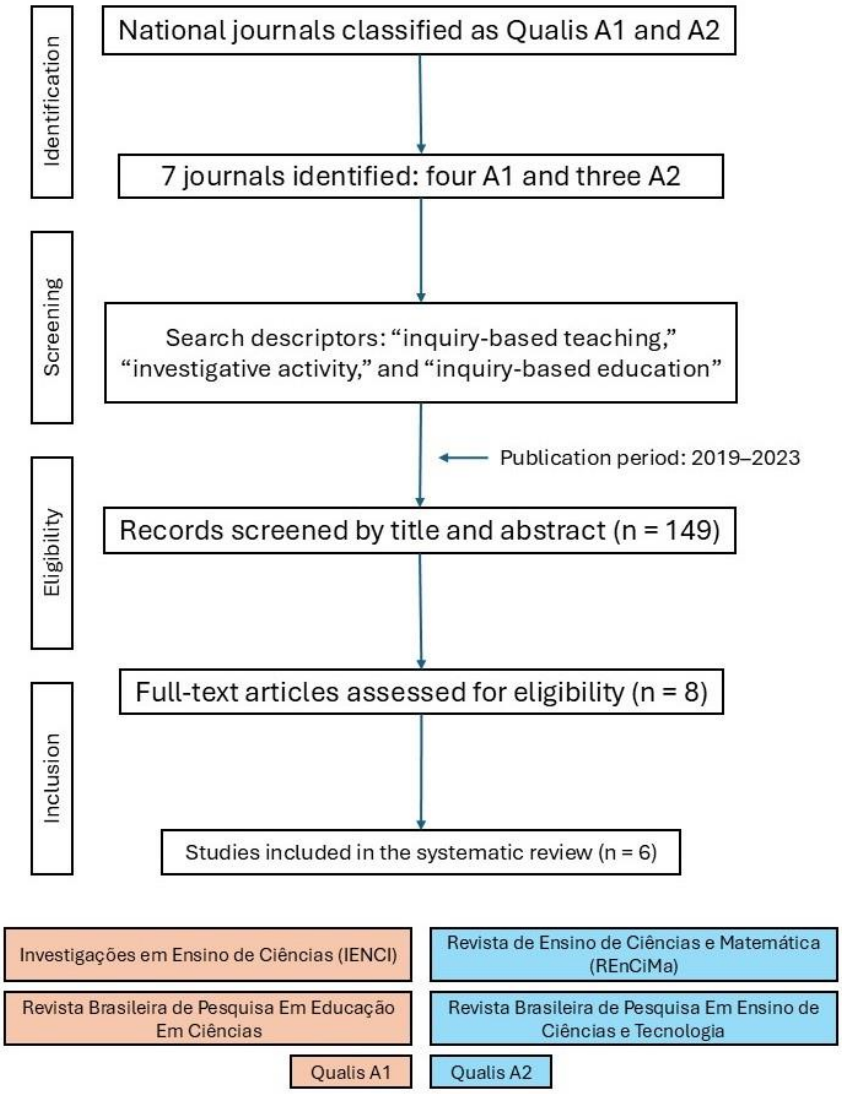
as one dealt with mathematics and the other did not have inquiry-based teaching as its central theme, but rather experimentation. Thus, we selected a final corpus of six articles for in-depth analysis. The details of the methodology can be seen in the flowchart below (Figure 1).

**Figure 1** – Flow chart of article selection for review, with eligibility and inclusion criteria




**Source:** Authors (2025).

f) **Extraction of data from selected articles:** data extraction from the six articles in the final *corpus* was performed after reading each one in its entirety. To organize the information obtained systematically, we created a spreadsheet with categories *a posteriori* (Bardin, 1977), which were: year, university, city/state,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author(s), type of teacher training (initial and/or continuing), objective, reference authors on Inquiry-Based Teaching, nature of training (theoretical and/or practical), description of the activity performed, approach to Inquiry-Based Teaching, methodology, research group, research subjects or objects, results and discussions, researchers' considerations, definition of Inquiry-Based Teaching, role of the teacher and student, and positive and negative points of the approach. In this paper, we will analyze only the types of teacher training, objectives, reference authors, and nature of training.

g) **Evaluation of articles:** the article evaluation process was guided by the initial question “Inquiry-based teaching and the training of natural science teachers: what has been researched on this topic?” Thus, of the eight papers that were pre-selected, two were ultimately removed, one because it was not in the field of Natural Sciences, but rather Mathematics, and the other because its focus was not on Inquiry-Based Teaching, but rather on experimentation.

*h)* **Data synthesis and interpretation:** for detailed analysis and interpretation of the data, we used content analysis, consisting of “[...] a set of communication analysis techniques that uses systematic and objective procedures to describe the content of messages” (Bardin, 1977, p. 42). We carried out the three phases indicated by Bardin (1977): pre-analysis, exploration of the material, and treatment of the results. After detailed readings of the six articles that comprise the *corpus* of this research, we conducted indexing and analysis, thereby enabling the creation of categories *a posteriori.*

## 3 Results and discussion

Of the 149 articles selected in the initial phase, only 49 dealt with the theme of Inquiry-Based Teaching, of which 41 focused on the implementation of investigative activities, and only eight were related to teacher training, which were therefore selected for detailed analysis. Of these eight papers, two were disqualified during the preliminary reading: one addressed mathematics training, which is not within the objective of this research, and the other did not have Inquiry-Based Teaching as its central axis of training. Thus, Table 2 shows the six articles selected for final analysis.


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**Table 2 –** Articles on teacher training in Natural Sciences and Inquiry-Based Learning

| Code | Reference | Origin |
|---|---|---|
| T1 | MALHEIRO, João Manoel da Silva; TEIXEIRA, Odete Pacubi Baierl. Processo comunicativo em um curso de formação de professores: uma análise baseada nos princípios argumentativos de Perelman e Olbrechts -Tyteca. *Investigações em Ensino de Ciências*, Porto Alegre, v. 25, n. 1, 2020. | UFPA/Unesp |
| T2 | SILVA, Raniele Aparecida da; SILVA, Francislainy Natália da; SUART, Rita de Cássia. Ações e reflexões vivenciadas por uma professora em formação inicial por meio de elaboração de planos e regência de aulas: contribuições do processo de reflexão orientada. *Revista Brasileira de Pesquisa em Educação em Ciências*, Rio de Janeiro, p. 1169-1196, 2020. | USP/UFLA |
| T3 | MOURA, Antonio Reynaldo Meneses; SOUZA, Caroline Batista Silva de; CUNHA, Aline Oliveira; SEDANO, Luciana. Limites e possibilidades encontrados por professores ao trabalharem com atividades investigativas nas aulas de Ciências: o que as pesquisas apontam?. *Revista Brasileira de Ensino de Ciência e Tecnologia*, Ponta Grossa, v. 13, n. 2, 2020. | Uesc |
| T4 | CLEOPHAS, Maria das Graças; CUNHA, Marcia Borin da. Contribuições da fotografia científica observatória (FoCO) para o Ensino por Investigação. *Revista Brasileira de Ensino de Ciência e Tecnologia*, Ponta Grossa, v. 13, n. 1, 2020. | Unila/Unioeste |
| T5 | AZEVEDO, Lília do Espírito Santo; MARCELINO, Valeria de Souza; MACHADO, Cassiana Barreto Hygino. Sequências de ensino investigativas: um desafio na formação inicial de professores de Ciências. *Revista de Ensino de Ciências e Matemática*, São Paulo, v. 11, n. 7, p. 360-378, 2020. | Uenf/IFF |
| T6 | MENDONÇA, Amsterdam de Jesus Souza Marques de; PEREIRA, Grazielle Rodrigues. O conceito de energia e suas manifestações: uma proposta de ensino investigativo para professores do Ensino Fundamental. *Revista de Ensino de Ciências e Matemática*, São Paulo, v. 11, n. 5, p. 165-184, 2020. | IFRJ/UFRJ |

**Source:** Elaborated by the authors based on data obtained (2025).
**Legend:** UFPA: Universidade Federal do Pará; Unesp: Universidade Estadual Paulista; USP: Universidade de São Paulo; UFLA: Universidade Federal de Lavras; Uesc: Universidade Estadual de Santa Cruz; Unila: Universidade Federal da Integração Latino-Americana; Unioeste: Universidade Estadual do Oeste do Paraná; Uenf: Universidade Estadual do Norte Fluminense; IFF: Instituto Federal Fluminense; IFRJ: Instituto Federal do Rio de Janeiro; e UFRJ: Universidade Federal do Rio de Janeiro.

Of the six publications analyzed in this study, five present partnerships between different institutions in different cities and, in some cases, even different states. This is an interesting finding, showing collaboration between the researchers involved. Another relevant finding is that four of the five regions of Brazil were represented, with only the Midwest missing. The Southeast region was most represented in the publications, notably Uenf/IFF, IFRJ/UFRJ (Rio de Janeiro), and USP/UFLA (São Paulo/Minas Gerais), accounting for three of the six articles. There was a partnership between UFPA (North) and Unesp (Southeast). Uesc represented the Northeast, and Unila/Unioeste (Paraná) the South. These findings corroborate Montani, Miranda, and Carvalho (2018), who also


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pointed out the predominance of the Southeast and the absence of the Midwest in publications on Inquiry-Based Learning.

### *3.1 Main authors cited on Inquiry-Based Learning*

We analyzed the six articles in this survey on Inquiry-Based Teaching and Teacher Training in Natural Sciences. The survey of citations allowed us to identify the most frequently referenced authors, which can be seen in Table 3.

**Table 3 –** Most cited authors and citation Frequency.

| Author(s) | Number of citations | Number of works that cited | Works in which they were cited |
|---|---|---|---|
| Carvalho (1998, 2004, 2008, 2009, 2011, 2013, 2014, 2017, 2018) | 69 | 6 | T1, T2, T3, T4, T5, T6 |
| Sasseron (2008, 2011, 2012, 2013, 2014, 2015, 2017) | 30 | 5 | T2, T3, T4, T5, T6 |
| Suart e Marcondes (2018) | 9 | 1 | T2 |
| Machado (2012, 2017) | 8 | 2 | T3 e T5 |
| Malheiro (2005, 2008, 2009, 2016) | 8 | 1 | T1 |
| Zômpero (2017) | 7 | 1 | T2 |
| Laburú (2011) | 6 | 1 | T2 |
| Almeida (2017) | 3 | 1 | T1 |
| Krasilchick (1987, 2009) | 2 | 1 | T3 |
| Munford e Lima (2007) | 2 | 1 | T3 |

**Source:** Elaborated by the authors based on data obtained (2025).

According to the table, Carvalho is the most cited author, with 69 references in six works, highlighting her central role in Inquiry-Based Teaching research. Sasseron follows with 30 citations, followed by Suart and Marcondes, with nine, Malheiro, also with nine, and Machado, with eight. Authors such as Zômpero (7), Laburú (6), Almeida (3), Krasilchick (2), and Munford and Lima (2) complete the set of authors cited in the works. The distribution of citations among these authors reflects the density and main directions of research in the area. The prominence of Carvalho and Sasseron, in particular, indicates the existence of fundamental theoretical and methodological pillars that guide most of the studies.

Carvalho is widely recognized as one of the main national references in Inquiry-Based Learning, with a remarkable track record in teacher training and the production of


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references for Science Education (Carvalho, 2013). The author advocates a pedagogical change based on questioning, problem solving, and valuing prior knowledge, aiming at intellectual autonomy and student protagonism in scientific learning (Carvalho, 2013). For Carvalho (2013), Inquiry-Based Teaching goes beyond the simple application of practical activities, as it requires teachers to stimulate critical thinking, the collective construction of knowledge, and the development of essential skills, such as argumentation, communication, and cooperative work (Carvalho *et al*., 1998).

In this context, the author emphasizes that this approach should be understood "[...] as a didactic attitude committed to overcoming the traditional transmission of content, allowing students to become effective participants and agents of their own learning" (Carvalho, 2013).

### *3.2* Classification of the works analyzed: objective of the articles analyzed

Among the many aspects analyzed, we established a categorization (Bardin, 1977) *a posteriori* with the classification: level of teacher training addressed and nature of the research. The first category differentiates between initial training, aimed at undergraduate students, and continuing education, aimed at practicing teachers.

The nature of the research distinguishes between theoretical research, which proposes conceptual discussions, literature reviews, or methodological proposals without implementation on teacher training in Inquiry-Based Teaching, and practical research, which contains the implementation, report, or analysis of a material intervention. The categorization of the studies can be seen in Table 4, as well as the objective of the studies.

**Table 4 –** Categories of articles according to research type, nature of teacher training, and objective

(continues)

| Code | Level of education | Nature of research | Objective |
|---|---|---|---|
| T1 | Continuing | Practical | "[...] analisar, com base nos princípios argumentativos de Perelman e Olbrechts-Tyteca (1996), os argumentos docentes elaborados a partir de uma Sequência de Ensino Investigativo durante o curso 'FormAÇÃO de Professores na Perspectiva do Ensino Investigativo', realizado na região Centro-Oeste paulista para 24 professores" (Malheiro; Teixeira, 2020, p. 306). |


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**Table 4 –** Categories of articles according to research type, nature of teacher training, and objective

(conclusion)

| Code | Level of education | Nature of research | Objective |
|---|---|---|---|
| T2 | Initial | Theoretical and practical | "[...] investigar como a participação de uma professora em formação inicial em Química, em um grupo de reflexão orientada, contribuiu para uma formação mais crítica e reflexiva sobre a sua prática docente" (Silva, R.; Silva, F.; Stuart, 2020, p. 1170). |
| T3 | Continuing | Theoretical | "[...] analisar o que foi publicado nos últimos seis anos em artigos de referência da área, abordando como o professor vem desenvolvendo as atividades investigativas em suas aulas a partir do que é discutido sobre o ENCI em cursos de formação continuada de professores" (Moura *et al.*, 2020, p. 204). |
| T4 | Initial | Practical | "[...] sugerir um Modelo Aplicacional de Ensino por Investigação (MAEI) que faça uso da Fotografia Científica Observatória (FoCO), tendo como aporte as Tecnologias Digitais Móveis (TDM), além de apoiar-se nos recursos da web 2.0" (Cleophas; Cunha, 2020, p. 350). |
| T5 | Initial | Theoretical and practical | "[...] auxiliar futuros docentes na elaboração de aulas nos moldes do Ensino por Investigação, além de contribuir para reflexão sobre suas respectivas práticas pedagógicas" (Azevedo; Marcelino; Machado, 2020, p. 360). |
| T6 | Continuing | Theoretical and practical | "[...] analisar os resultados da aplicação de uma sequência de ensino investigativo sobre o conceito de energia, de forma interdisciplinar, junto aos professores do ensino fundamental. [...] investigar as concepções de professores em um curso de formação continuada em Ciências Naturais, acerca do tema energia e suas manifestações" (Mendonça; Pereira, 2020, p. 167). |

**Source:** Elaborated by the authors based on data obtained (2025).

After categorizing the works, we observed a balanced distribution between the types of teacher training addressed in the articles, with three on initial training and three on continuing education. Regarding the nature of the research, one paper is strictly theoretical, two are practical, and three combine both approaches. This variety may indicate a concern with both the preparation of future teachers and the updating of current teachers.

When conducting an individual analysis of each article, we noticed different approaches and objectives. Article T1 (Malheiro; Teixeira, 2020) analyzed the arguments of 24 teachers during a training course on Inquiry-Based Teaching, using the


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argumentative principles of Perelman and Olbrechts-Tyteca as a basis. The work focused on the communicative process and the construction of arguments by practicing teachers, therefore, it was practical in nature. T4 (Cleophas; Cunha, 2020) was also practical in nature, proposing an Investigative Teaching Application Model (Maei), which uses Observational Scientific Photography (FoCO), with the support of mobile digital technologies and web 2.0 resources.

T3 (Moura *et al*., 2020) was the only purely theoretical study, as it consisted of a literature review to analyze what recent research points out about the limits and possibilities that teachers encounter when applying investigative activities based on what is discussed in continuing education courses.

T2 (Silva, R.; Silva, F.; Suart, 2020) combined theory and practice, as it analyzed how participation in a guided reflection group contributed to the critical training of a chemistry teacher in initial training. The study sought dialogue between the teacher candidate's performance in the process of developing lesson plans and teaching, and the theoretical basis of Inquiry-Based Teaching. T5 (Azevedo; Marcelino; Machado, 2020) was also theoretical and practical in nature, as it sought to assist future science teachers in developing lessons in the Inquiry-Based Teaching format, in addition to encouraging reflection on their own pedagogical practices. Another article that used both approaches was T6 (Mendonça; Pereira, 2020), which analyzed the results of applying a sequence of investigative teaching on the concept of energy with elementary school teachers, investigating the teachers' conceptions on the topic during a continuing education course in Natural Sciences.

Thus, although the *corpus* of the work is small, the content analysis of the six articles reveals a specific focus on what has been researched about Inquiry-Based Teaching. The practical works (T1, T4) indicate that training interventions have explored teaching skills for the subject, such as argumentation (Malheiro; Teixeira, 2020) and the integration of mobile digital technologies to propose models for applying Inquiry-Based Teaching (Cleophas; Cunha, 2020). On the other hand, T2, T5, and T6, which combine theory and practice, demonstrate the relevance of reflective processes that connect the theory of Inquiry-Based Teaching to classroom practice, both for teachers in initial training and for those already working. The theoretical review T3 systematizes the limits and


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possibilities faced by teachers, pointing to persistent challenges, such as a lack of time and institutional support.

The balanced presence of studies on initial and continuing training highlights the need for teacher training as "a continuous process of professional development," as advocated by Nóvoa (1992), reinforcing the idea that teacher learning does not end with graduation, and that updating and reflecting on practice are essential to incorporate new approaches, such as Inquiry-Based Teaching. Studies T2 and T5, which seek to contribute to the reflection on educational practices, expose the presence of Freire's (1996) perspective, which sees the teacher as a "transformative intellectual" and educational practice as a "dialogical cycle of mutual construction."

Costa and Amaral's (2023) conception of Inquiry-Based Teaching as a way to develop autonomy and critical thinking and their assertion that this approach can transform a task into "a meaningful learning experience" (Sasseron, 2015) corroborate the objectives of works T4, T5, and T6, which propose investigative teaching approaches to assist future teachers and investigate the conceptions of practicing teachers. Thiengo *et al*. (2022, p. 12) highlight that :

> [...] teacher training is a dynamic, unfinished process that is embedded in a historical context. It should be noted that, within the framework of capitalism and its instrumental rationale, the teacher training process tends to occur predominantly in a fragmented and instrumentalizing manner, with few opportunities for broader and more humanistic training. (Tradução nossa -Translation by us)

Considering the above excerpt from the aforementioned authors, it is worth reflecting on the fact that teacher training is a continuous process, since it is never finished. Thus, it is necessary to think about teacher training during all stages, from initial to continuing education. In this research, we emphasize that Inquiry-Based Teaching is an approach that needs to be worked on and discussed in teacher training so that teachers can implement it in their classroom practices, in the pursuit of more dynamic lessons, in which students play a more active role, and the teacher assists them in the construction of knowledge.


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## 4 Final Considerations

This research aimed to map publications on Inquiry-Based Teaching and teacher training in the field of Natural Sciences in seven relevant journals in the area. The search was conducted in the journals: *Ensaio: Pesquisa em Educação em Ciências*; *Ciência e Educação*; *Investigações em Ensino de Ciências*; *Revista Brasileira de Pesquisa em Educação em Ciências*; *Alexandria*; *Revista de Ensino de Ciências e Matemática*; and *Revista Brasileira de Ensino de Ciência e Tecnologia*; of the total of 149 articles published between 2019 and 2023 on Inquiry-Based Learning, only six dealt with the bias in teacher training in Natural Sciences. Although numerically scarce, analyses of these publications indicate that research in this area in recent years has addressed topics such as the development of teacher argumentation, the integration of digital technologies, and the promotion of reflective processes that seek to connect theory and practice. In addition, we emphasize that, in the present study, we conducted a survey on Inquiry-Based Teaching and teacher training in the area of Natural Sciences, but the approach in question is not restricted to this area of knowledge, and research should be encouraged and conducted on how Inquiry-Based Teaching appears in research on other curricular components and their related areas in teacher training.

Among the results obtained, we highlight as relevant the partnership between researchers/institutions in their publications, since, among the six articles analyzed, five were in collaboration with different institutions, reinforcing the partnership and the need for dialogue in scientific productions. Another finding was the prominence of the authors Carvalho and Sasseron, who were the two most cited in the works analyzed.

Regarding the level of training addressed in the articles analyzed, it occurred equally, with half being initial training and half continuing education. When analyzing the nature of the research, the results pointed to one theoretical work, two practical works, and three with two natures.

The results obtained already indicate a discrepancy in publications between research focused on Inquiry-Based Teaching, with most of the research focusing on areas other than teacher training. These findings reinforce the need to investigate how and whether the topic of Inquiry-Based Teaching is addressed in the training of teachers in this area.


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Finally, we emphasize that the article contributes to the theme of Inquiry-Based Teaching in relation to teacher training in the field of Natural Sciences, but this theme is not exhausted. In this sense, we highlight the need for further research to contribute to and increase research on the topic in question, given that, according to the results obtained, there is a lack of research on Inquiry-Based Teaching in the training of Natural Science teachers.

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## DATA AVAILABILITY

The entire dataset supporting the results of this study has been published in the article itself.

**Chief Editor:** Lia Machado Fiuza Fialho

***Ad hoc reviewers*:** Mercedes Causse Cathcart and António António

**Translated by**: Luciane de Lima Paim

**How to cite this article (ABNT):**
KOCK, Tarso Augusto Petry; SALVI, Leonardo Monari; DREHMER-MARQUES, Keiciane Canabarro. Ensino por Investigação e a formação de professores de Ciências da Natureza: uma revisão bibliográfica. *Educação & Formação*, Fortaleza, v. 10, e16238, 2025. Available at: https://revistas.uece.br/index.php/redufor/article/view/e16238

Received on August 16, 2025.

Accepted on October 31, 2025.

Published on December 15, 2025.


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