

# Bibliographic review of ENPEC meeting Minutes on the teaching of science in the first years of elementary school: continuing education for teachers

## ABSTRACT

This article represents the expansion of an initial paper sent to the XIII ENPEC/2021 that aims to investigate how the continuing education for teachers (CET) working with young children on Natural Sciences (NS) has been historically carried out and presented in the editions of the National Meeting of Research in Science Education (ENPEC - 1997 to 2021). This is an exploratory research, of the bibliographic study type and was constituted from data from 14 complete papers, which were selected and analyzed in the light of Discursive Textual Analysis (DTA). In the categorization process, eight categories of analysis emerged: 1) training needs; 2) teaching concepts; 3) conceptions about training; 4) characteristics of the subjects; 5) training methodologies; 6) formative process and how the subjects felt; 7) direct results of training; and 8) post-formation (legacy), organized into three periods: pre-formative, formative and post-formative, interspersed with transitional units. After analyzing the works year by year, less than 1% of the papers published in this event and only 10% of the selected ones met the objectives of this research. The units of meaning representing the pre-formative period showed the deficiency in the initial training of educators in training, the importance of knowing the skills to work NS, planning, conducting and evaluating the teaching process, in addition to the importance of continuing the reflection process and teacher training. The two most pronounced characteristics among the educators in training were the need to deepen their conceptual knowledge in NS and the attempt to change their teaching methods after the group reflections. In the formative period, the teachers went through moments of reflection and reformulation of their practices, formation of concepts and changes in their vocabularies about NS. The direct results of the training showed that the educators in training were able to reflect on the action, face their problems, and change their attitude towards the teaching of NS, in addition to being motivated to create new strategies to achieve their goals in the classroom. In general, the researchers/trainers observed some methodological changes, safety to teach NS and the overcoming of some difficulties in the initial training of teachers, as well as a greater involvement of students during classes and the creation of collective spaces for discussion in Schools, which, until then, did not exist in these places. It is hoped that this work will contribute to researchers in the teaching area of NS in order to qualify their continuing education actions aimed at teachers in the early years, as well as to elucidate some gaps to be explored in research on the subject.

**KEYWORDS:** Professional training. Continuous training of educators. Elementary school. Nature sciences.

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## INTRODUCTION

The theme of teacher training has long been an object of investigation in the field of education. According to Davis et al. (2011), the so-called second democratization of public education led to a dissonance between the expansion of the offer of places and the ability of schools to serve students with the expected quality. Thus, the working conditions of teachers in schools worsened as school systems were no longer able to face the challenges presented. The authors point out that the Ministry of Education recognizes, through a report, at the end of the 1990s, that the initial and continuous training made available to Brazilian teachers did not contribute for an effective and qualified learning by students.

The motives behind the movement in search for professional teacher qualification through continuing education in Brazil are, precisely, the failures in the initial training to face contemporary demands resulting from an accelerated production of scientific knowledge. Those failures harmed the teaching that reaches students and, still, the difficulty of carrying out an initial training that meets the professional requirements for the qualified exercise of the teaching profession (SILVA; BASTOS, 2012). In this context, in which initial training and the education offered to children are questioned, the continuing education of teachers, linked to the teaching profession, begins to be a target of interest (DAVIS et al., 2011, GONÇALVES; COMPIANI; JÚNIOR, 2019). How has continuing education for teachers (CET) contributed to the professional development of teachers and to the quality of educational processes in the country?

Training is a process of human and, therefore, professional development (ALVARADO-PRADA; FREITAS; FREITAS, 2010; NÓVOA, 2017, 2019). Teachers develop, mainly, in the context of the work carried out in the school institution, as it is where they create and recreate relationships based on complex structures that support them. Thus, it is expected that CET will allow the transformation of relationships that support the professional development of teachers in the school institution (ALVARADO-PRADA; FREITAS; FREITAS, 2010).

In relation to research in Science education, the focus of this work, the theme of teacher training is also one of the most present in the last 20 years (BASTOS, 2017). In this context, it deserves more detailed attention from researchers, according to the author, to investigate the approaches and strategies used in the programs of initial and continuing education in order to understand how the subjects (graduates and teachers in service) interact with them, entering, thus, to the working mechanisms of these formative processes.

The research niche in which this work is inserted comprises an active CET in the Initial Years of Elementary School in relation to the teaching of Natural Sciences (NS). To understand how these formations have historically been taking place, the productions in the Minutes of the National Meeting of Science Research and Teaching (ENPEC) were investigated. The text of this study was deepened and expanded from a complete work submitted to the XIII ENPEC, which was recently accepted. The data were reanalyzed and have substantial differences and additions, mainly in the results and discussion section.

## METHODS

This research is exploratory, of the bibliographic study type (GIL, 2019). For Gil (2019) this type of research has flexible elaboration and its main objective is to develop, clarify and modify concepts and ideas in order to raise more precise questions or hypotheses for testing in future research.

First, a survey was carried out about the complete papers published in the Minutes of ENPEC from 1997 (I edition) to 2021 (XIII edition), which presented details on continuing education carried out with in-service teachers on the practice of NS in the classroom. For the search on editions I, II, III, IV, VI and XIII of the event, the summaries with the names of the published papers were evaluated and those that presented continuing education of teachers of the initial years in the area of NS as a theme were separated.

In edition III, only oral presentations were considered, as there were only summaries of panel presentations on the website; and in edition VI, the search was carried out through the search channel by selecting the oral presentations and panels by titles and abstracts. In editions V, VIII and XII, the option chosen was **Training of science teachers** on the icon **Make List by Area/Theme** and we picked those developed in the initial years in the Science theme.

In editions IX, X and XI, the search was carried out using the available keywords that are listed on the event's website, in the search area for each year of the event: **initial grades; initial years; early years of elementary school; elementary school – early years; initial years of schooling; and, teaching science in the initial grades.** This survey does not include the papers published on issue VII, as they were unavailable on the website of the event.

Thus, in this first search, a total of 146 papers were found, of which the title, abstract and methodology were analyzed, in order to verify and separate those that contained data on continuing education with teachers of the initial years related to the NS. In this selection, papers on training with teachers from other stages of education (kindergarten, high school, etc.), other areas of education (exact sciences, etc.), initial training of pedagogues and papers that presented only the conceptions of a group of teachers. From this selection, a total of 14 papers were obtained, which were read in full.

For data analysis, the methodology of Discursive Textual Analysis (DTA) was used (MORAES E GALIAZZI, 2016). DTA is structured in three stages: unitarization, categorization and production of metatexts. It is also noteworthy that, in the elaboration of the text, the units that had elements to respond to the research problem and that met the objectives outlined were selected.

In the unitarization stage, 418 units of meaning were chosen, based on the full reading of the 14 selected papers and, then, we identified some textual fragments that could help answer the research problem (Table 1). During the second stage, categorization, all units of meaning were read, which were organized by similar elements and meanings. Finally, 356 units were separated in order to help answer the research problem.

Table 1 – Amount of papers published at ENPEC (1997 to 2021)

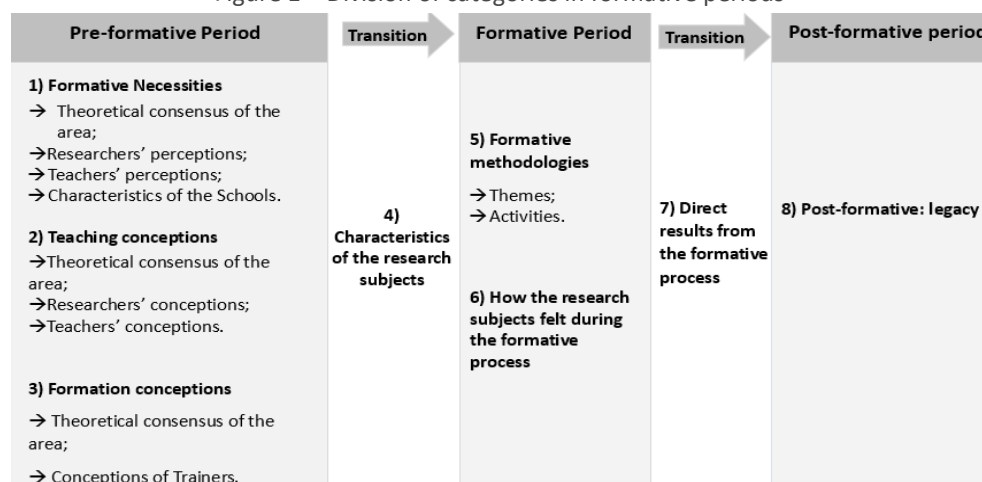
Year	1997	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019	2021	TOTAL
ENPEC	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
Total papers	178	163	233	451	738	669	799	1235	1526	1768	1335	1249	797	10.491
Papers found	-	2	1	7	9	16	-	11	17	16	37	24	6	146
Selected papers	-	2	-	1	4	-	-	2	2	2	-	1	-	14

Source: The authors (2002)

In the production of the metatexts, not all the separate units were used, as there were many elements repeated among them. Thus, the units chosen to compose the metatext were the most demonstrative and exemplary. From the analysis of the 356 units, the following categories emerged: 1) Formative needs; 2) Teaching conceptions; 3) Conceptions about formative courses; 4) Characteristics of research subjects; 5) Formative methodologies; 6) How the subjects felt during the formative process; 7) Direct formative course results; and, 8) Post-formative: legacy.

These eight analytical categories, represented by numbers, were organized, according to the meaning shown, into three formative periods (pre-formative, formative and post-formative), as shown in Figure 1. The other units of meaning were discarded because they were related to the collection of data from the research carried out, that is, the tools used in order to know the previous conceptions of the research subjects, among other objectives of each work.

Figure 1 – Division of categories in formative periods



Source: The authors (2022)

The pre-formative period is characterized by encompassing units that deal with organizations and actions prior to the training carried out by the researchers

and portrayed in the works. Afterwards, the transition between the pre-formative and formative period is presented, including the units of meaning, containing the characteristics of the subjects participating in the training mentioned in the papers.

The formative period comprises the units that presented the training methodologies and how the subjects felt during the activities proposed by the researchers. From this period to the next there is a transition in which the units demonstrate the direct results of the CET described by the researchers. The post-formative period brings together units of meaning that highlight the legacy of these trainings in the Schools and in the professional life of the participating teachers.

It is also noteworthy that the tables detail the quantities of meaning units within each subcategory. Each subcategory was organized in order to present the number of units on the theoretical consensus of the area (Theory), perception of researchers (Trainer), perceptions of teachers (Teacher) and Characteristics of Schools, if any, on the topic discussed in the category.

## **RESULTS AND DISCUSSION**

The institutions responsible for the continuing formative courses portrayed here were created and developed by university researchers. The universities involved were: Federal University of Rio de Janeiro (UFRJ) through two courses; University of São Paulo (USP) with four courses; São Paulo State University “Júlio de Mesquita Filho” (UNESP) with three courses; Federal University of Bahia (UFBA) and the Pontifical Catholic University of Rio Grande do Sul (PUCRS), each one with one formative course offered. Three articles did not present the institutions that carried out the training.

All training was carried out with teachers in service from City and State schools in Brazil, working in the initial years of Elementary School. As for the degree of the research subjects, it was not detailed in all articles; however, those who brought this information offered training courses to teachers trained in pedagogy and/or teaching.

### **1. FORMATIVE NEEDS**

The “Formative Needs” category emerged from the explanation in 70 units of why teachers needed to participate in the training proposed by the researchers, and the justifications for this need ended up being configured as subcategories, as shown in Table 2.

Table 2 – Formative Needs of teachers in training

Subcategories	Theory	Trainer	Teacher	Schools
Deficiency from undergraduate studies	5	8	2	4
Lack of content knowledge	5	7	3	3
Rare permanent training	5	2	0	2
Lack of reasoning upon actions	4	1	0	1
Discrepancy between 'ideal' education and the actual one	1	3	0	3
Lack of space/resources	0	0	0	3
Fragmented Curriculum	0	0	0	3
Little class time	0	0	0	2
Schools equipped with laboratory; continuing training	0	0	0	2
Books that contradict scientific studies	0	0	0	1
<b>Total: 70</b>	<b>20</b>	<b>21</b>	<b>5</b>	<b>24</b>

Source: The authors (2022).

Among the subcategories, the most frequent units dealt with deficiencies in undergraduate studies and the teachers' lack of mastery of the content. As the following units demonstrate:

[...] it takes place preferably in pedagogy courses, in which, in general, the curriculum presents a single subject dedicated to the teaching of physical and natural sciences. [...] (1\_2015\_U6).

In the initial years of Elementary School, Science Teaching is the responsibility of so-called multipurpose teachers who are often tasked with teaching content that was not part of their university academic training, such as Science. [...]. This lack generates insecurity (2\_2011\_U5).

The curricular gaps in initial training can reflect on the teacher's pedagogical practice, for they may turn them insecure when teaching NS, less creative and daring in their planning, in addition to reinforcing their dependence on the textbook. Such notes are corroborated by the studies cited in unit 2\_2013\_U20:

Raboni (2002), Maldaner (1997) and Bonando (1994) indicate in their research that the lack of specific content limits the teacher's action, since activities that involve the possibility of greater student participation, with questioning, observation and survey of hypotheses, generate insecurity. Thus, if the teacher does not master the content, he will not take the risk, preferring a safe harbor, which is often the reproduction of the textbook content.

Studies by Pimenta et al. (2017) denote a fragility present in the initial training of multipurpose teachers in the state of São Paulo. When analyzing 144 curriculum matrices of Pedagogy Courses offered by public and private institutions in the state, the researchers highlighted the inadequacy of current courses characterized as superficial, generalizing, without a focus on teacher training that is often fragmented and dispersed.

For Libâneo (2012), Pedagogy Courses in Brazil reflect a tradition of training teachers more to care than to teach. The response to the criticisms, however, has had repercussions on Higher Education Institutions in increasing the workload of internships, without the necessary expansion for the practical learning of teaching under institutional supervision (MARAFELLI; RODRIGUES; BRANDÃO, 2017).

Some units elucidated the insecurity in teaching NS, resulting from gaps in undergraduate formation, as a theme in the speech of training researchers and teachers in training. According to these units, insecurity can lead to:

Activities poorly prepared or based on rigid scripts, often disconnected from a broader context of Science Teaching do not achieve such goals, since students are unable to establish a relationship between the experiment and the concepts. [...] (2\_2013\_U8).

[...] In the interviews, all of them declared that they did not feel fully prepared to teach Science [...] due precisely to this lack. [...] (2\_2013\_U19).

According to Davis et al. (2011), the specialized bibliography in the area of teacher training indicates a recurring idea that CET is necessary due to the limitations in undergraduate studies. Thus, it would have as its main role to assist in filling these gaps, since they have a strong impact on the teacher's practice. This model is known as the "deficit model" (DAVIS et al., 2011).

Possibilities are lost, however, when CET is reduced to a mere "repair" of undergraduate studies, as CET has its own dynamics, which are imbricated in the plural realities and trajectories of each teacher, school and community:

[...] The construction of teacher training involves the entire trajectory of professionals, their conceptions of life, society, school, education, their interests, needs, abilities and also their fears, difficulties and limitations. This construction of training is continuous and is not restricted to an institution, the classroom, or a particular course, as teachers can be trained through their own professional practice, based on the analysis of their own reality and confrontations with the universality of other realities that also have everyday facts, political situations, experiences, conceptions, theories and other formative situations (ALVARADO-PRADA; FREITAS; FREITAS, 2010, p. 370).

For Nóvoa (2017), CET should not be treated as a solution to all the educational problems experienced by teachers, but it is necessary to understand the motivations of educators, their profiles and their tendency to teach. When systematized and officially offered, CET needs to be developed through more lasting projects, in which trainers define, together with schools and teachers, the organization and structuring of activities, encouraging the analysis and consideration of various theoretical and practical aspects of teaching (JACOBUCCI, 2006; DAVIS et al., 2011).

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Some units were analyzed and showed the fundamental role of the School as a supporter and promoter of the professional development of teachers in service:

The deficiencies during undergraduate studies, added to the lack of pedagogical teaching resources and adequate conditions of the school's organizational structure to promote education, have been aspects that interfere in teaching-learning, so teaching, in most cases, boils down to the transmission of facts, theories and scientific phenomena passed from the teacher to the student, in an expository way (3\_2005\_U3).

As a result of the lack of content in their training, the teacher ends up resorting to textbooks and texts taken from the internet. In general, this reduces teaching to the exposition of concepts, a situation that, as already mentioned, provides the student with the role of mere spectator and receiver of ready and finished content. As a result, Science Teaching, which could instill curiosity and imagination, ends up becoming boring (2\_2011\_U6).

The units that made up the Formative Needs category clarified the importance of the triad: TRAINING - TEACHER - SCHOOL. Starting from the assumption that initial training is a finite period and briefly circumscribed in the school reality, CET appears in its perennial and continuous aspect drenched in everyday school experiences and dependent on a greater appreciation of education professionals, career and working hours with time allotted to it.

## 2. TEACHING CONCEPTIONS

The conceptions about teaching were highlighted in 53 units of meaning (Table 3), the majority being expressed by the opinion of the trainers supported by citations by scholars in the area.



Table 3 – Teaching Conceptions

Subcategories	Theory	Trainer	Teacher
Competence for teaching	11	7	3
Knowledge Building	3	2	0
Distance between what would like to do and what actually does	2	5	2
Lack of content knowledge (insecurity)	2	3	1
Profession learned during practice	2	1	1
Interdisciplinary practice at school	0	3	0
Depend on the undergraduate study articulated with other factors	1	1	0
Importance of several kinds of competence for teaching	0	1	1
What does not improve the practice of teachers	1	0	0
<b>Total: 53</b>	<b>22</b>	<b>23</b>	<b>8</b>

Source: The authors (2022).

The kinds of competence for teaching were mentioned in 21 units, most of which were based on authors who are scholars in the area. Among these units, it is evident the presentation of some characteristics considered necessary for the teaching by the researchers, such as:

[...] organizing learning situations, working in teams, creating learning environments; seek its continuous development, among others (1\_2015\_U10).

According to Walker & Goulart (2003), it is important for the teacher to be aware that his knowledge is limited and that his role is much more to lead the student to reflect on the information obtained, than simply to incorporate it. The framework is the knowledge of the reality in which they are inserted (4\_2005\_U18).

These kinds of competence do not have the role of citing rules or making teachers more overloaded and insecure, but they can serve to show the importance of the role they have when planning, conducting and evaluating the teaching process. This is evident in the following units mentioned by the trainers:

Not knowing is natural. Seeking to learn is an important step. From the moment that the teacher learns to share his doubts with his students and creates in his classroom an environment favorable to curiosity and new discoveries, he encourages a relaxed atmosphere of investigation (3\_2005\_U15).

The teacher's openness to dialogue with students is fundamental for a good relationship, which may generate a real partnership interaction between

student-student and teacher that can make learning a pleasant activity, so the student understands that the teacher is a figure that will help him in their knowledge, a real partner, with whom they can express their doubts and propose explanations about the facts and phenomena (3\_2005\_U15).

The issue of the teacher “having the obligation to know everything” was widely discussed in some formative courses presented in the analyzed works, since the teaching of NS is experienced as a drama by many versatile teachers.

The teachers [...] at certain times, also experienced this situation of cognitive anguish. At some points in our meetings, there were unanswered questions. [...] This movement of letting the doubt show, so that later, with some tranquility, to be willing to study, possibly strengthened the participants' understanding that being a teacher does not mean knowing everything, but being open to knowledge of the world, open to the new possibilities under permanent construction (1\_2013\_U20).

The role of the University, through the training offered, is fundamental so that, through activities, courses and events, teachers have contact with new knowledge on the educational field in order to try to overcome their anxieties and their problems in addition to dealing properly with the profession (DAVIS et al., 2011). It was also observed that during the CET, educators in training had the opportunity to understand their role as mediators in teaching and that reflecting on their actions makes it possible to develop their potentialities and overcome their own fears and prejudices. Some trainers realized at the end of the CET that:

[...] if the students' action depends on the teacher's, the evaluation of the students' results must also be integrated into the teacher's evaluation of his work. Student assessment should serve as an instrument that allows the teacher to check what is not going well in order to improve it. [...] (2\_1999\_U45).

In order to become a teacher, one needs to go through a process. It is necessary to reason on one's own personal areas and the teaching profession and without the presence, support and collaboration of other teachers, it is impossible to learn the teaching profession (NÓVOA, 2019). This support and collaboration were present in the formative education described in the works analyzed here.

### 3. CONCEPTIONS ABOUT TRAINING

The analyzed conceptions about CET were built from pedagogical reflections theoretically anchored in authors such as Ana Maria Pessoa de Carvalho, Clermont Gauthier, Donald Schön, Maurice Tardif, among others. Carvalho was cited in 11 of the 14 analyzed papers and she was the author/co-author in three of them.

Altogether, 78 units of meaning brought the conceptions of theorists and researchers/trainers on CET (Table 4). The conceptions about training expressed by the research subjects were sorted and used in the categories Formative Period and Post-Formative Period in this article.

Table 4 – Conceptions on formation represented in the meaning units

Subcategories	Theories	Trainer
Importance of continuing formation and pedagogical reasoning	18	37
The teacher as a researcher in the classroom (reasoning during practice)	5	11
Deficiencies at teaching degree courses	3	4
Total: 78	26	52

Source: The authors (2022).

Concerning the importance of CET, Jacobucci (2006) identified in his studies, based on several authors, the existence of concepts of teacher training already well established in Brazil, from which three training models were proposed, namely: classical, practical-reflective model and emancipatory-political model. Thus, among the 14 works analyzed, four formations presented characteristics of the classic model (29%); eight from the practical-reflective (57%) and two from the emancipatory-political (14%) according to the classification by Jacobucci (2006).

The classic training model is characterized by specific short-term activities and courses (lectures, workshops, seminars), in which teachers and students do not participate in the preparation and selection of topics. In this model, there is a clear separation between theory and practice, so that there are “updating” tools for teachers to apply the contents in the classroom later (JACOBUCCI, 2006). Among the researched works, those that took the themes to be developed in training ready to school were identified as belonging to this model, whose training time seems too short to promote theoretical and practical changes with the teachers, and also those that seemed to suppress theory in relation to practice.

The present work is inserted in the context of the project Science Today in School - Support Material for Elementary School [...]. The research involved two stages: accompanied application in the classroom of the volumes of the Science Today in School notebooks. It is preceded by a guidance on how to use them for students and teachers; and training courses for elementary school teachers [...]. (1\_1999\_U28). Authors' emphasis

The project “The Animals go to School: an Educative Project”, elaborated [...] in the form of a course on the initial and continuing training of teachers of kindergarten, elementary and high school, regarding the recycling of knowledge about the so-called “villains” of nature (spiders, scorpions, snakes and bats). (4\_2005\_U10) Authors' emphasis

The testimonies indicated that the workshops represented moments of learning in terms of didactic possibilities and also in terms of reviewing and updating some concepts. However, in the next step of the work, in the transposition to their classrooms, some difficulties were noticed in the implementation: most of the teachers were not able to carry out, even partially, the incorporation of such knowledge in their teaching practice. [...] (2\_2011\_U19) Authors' emphasis

The main objective of the research was to understand how elementary school teachers work with astronomy content in their Science classes. The specific objectives were: 1) Diagnose what knowledge elementary school teachers have on astronomy topics; 2) Build a space for dialogue between teachers and researchers in which they could develop teaching strategies for some astronomy content present in the early years and 3) Create a digital repository of materials so that teachers could carry out some research on astronomy topics present in the early years initials. (1\_2013\_U4)

The trend observed in Jacobucci's research (2006) showed that, since the 1960s, continuing teacher education has shifted from the classical model to the practical-reflective model and, from this model, to the emancipatory-political one. This characteristic, however, was not evidenced in the ENPEC editions.

The two selected ENPEC papers from the 1990s were classified as classic and the other as practical-reflective. In the first decade of 2000, one paper belonged to the classical model, three of them belonged to the practical-reflective and another one to the emancipatory-political model. In the last decade, two formations of the classic model were found, four practical-reflective ones and a single one was of the emancipatory-political kind. In general, most units of meaning showed that the PCFs had practical-reflective and short- or medium-term characteristics of the model.

The practical-reflective and emancipatory-political models, despite being epistemologically distinct, consider reflective activity as essential to the permanent training process of teachers. Examples of the influence of these two models can be found in the fragments below:

[...] several situations were carried out [...] offering the opportunity for them to solve the experimental problems and later to apply them in the classroom with their students [...], to examine the work of their students and students of their colleagues through a reflection on their own actions in the classroom. They could also watch their own recorded classes and make theoretical discussions based on real problems of teaching in the classroom (1\_2003\_U7).

[...] the reflective practice as an ingredient that provides teachers with a self-assessment of beliefs and daily pedagogical practices, changes in posture perceived in their stories, in their interactions with the various fields of knowledge, in problematization situations promoted in the educational act and, ultimately, by the social and historical conditions that they experience in the exercise of the profession (1\_2011\_U12).

Therefore, according to the characteristics and actions carried out, more than half (57%) of the CET analyzed here were classified as practical-reflective. Such formations considered the theme and promoted reflections and group discussions. However, this training model does not theoretically deepen the study of teaching methodologies, political and social issues and the teacher is rarely led to carry out this in-depth study on his own (JACOBUCCI, 2006). The author also states that normally, in order to understand a practical action, it is necessary to build a bridge with the theory that underlies it, because, from this, a possibility of uniting them can be opened (theory-practice), even if it is to explain real situations (JACOBUCCI, 2006).

For these reasons, it is important for CET to focus on expanding their professional and cultural experiences, in addition to helping them build and find

solutions to their own teaching difficulties (NÓVOA, 2019). It becomes necessary to provide support to educators in training to be agents capable of transforming the school and social reality “with critical autonomous actions facing their own pedagogical practice, the school curriculum, and all the events that occur in the world in which they participate as citizens” (JACOBUCCI, 2006, p. 271).

#### 4. TRANSITION CATEGORY: CHARACTERISTICS OF RESEARCH SUBJECTS

In general, the training courses analyzed were carried out with teachers of the first years of elementary school in city and state public schools in Brazil. The initial training of these subjects was not detailed in all the articles, however, those articles that did mention it cited the teachers had teaching degrees in pedagogy and/or a teaching course. During the training process, the researcher-trainers listed the characteristics presented by the research subjects. Table 5 lists the ten common characteristics observed in educators in training.

Table 5 – Characteristics of teachers in continuing formative courses mentioned by trainers

Characteristics	Units
Necessity to deepen their conceptual knowledge	5
Try to change their pedagogical practices after reflecting upon them	5
Cannot easily change their practices	4
Teachers with access to several courses and materials	3
Do not systemically work with science	3
Present bias and disbelief on students’ capacities	2
Do not feel safe with investigative methodologies	1
Use practices to overcome traditional class problems	1
Need materials that are ready and easy to manipulate	1
Teachers without access to formative and reflexive moments at school	1
<b>Total</b>	<b>26</b>

Source: The authors (2022)

Among the ten characteristics, seven refer to the drama in teaching NS experienced by the research subjects. In this sense, insecurity and anxiety may be linked to gaps during the teaching degree and, because of this, many need specific training to deepen their conceptual knowledge in the area of NS.

For Pizarro, Barros and Lopes-Junior (2016) the reduced space for discussions and deepening on Science in initial education in the Pedagogy Course ends up generating professionals who believe that teaching Science is limited to teaching some concepts. It is therefore necessary that trainers working in undergraduate

courses ask themselves how to rearrange the curriculum in order to help overcome needs and insecurity in the area (LIMA; MAUÉS, 2006; PIZARRO; BARROS; LOPES-JUNIOR, 2016).

As a consequence of these basic needs, some teachers were not able to easily change their routines and practices even during continuing training. For Davis et al. (2011), the fragility during the teaching degree course brings a double concern, the quality of students' education and the professional development of teachers. This demonstrates the need to discuss in depth how CET contribute to the professional development of educators in training and education in the country (GONÇALVES; COMPIANI; JÚNIOR, 2019; DAVIS et al., 2011). This was evidenced by some educators in training, who, in addition to feeling insecure, also showed misconceptions about NS.

However, the results showed that even this group of teachers, considered interested, has great difficulty in introducing modifying elements in their teaching practice (1\_1999\_U3).

It was noticed that most teachers yearn for changes, but when implementing them, they cannot easily change their routines, privileging traditional and well-established sequences (2\_2011\_U3).

Such findings may result from the short training time and the need for some solid theoretical training in order to consolidate a more substantial transformation of practice. Perhaps such results could be different if these teachers participated in CET closer to the emancipatory-political model. This model points out that only when teachers have a broad understanding of the world, can they critically observe their own real behaviors and connect them with educational theories and specific realities, and thus achieve political emancipation to, finally, change society (JACOBUCCI, 2006).

Another aspect observed in four different formations was the teachers' attempt to incorporate the knowledge learned during the formation in their classes in order to deepen their knowledge in NS and then complement and develop their practices in class with their students.

We can now see the attempt at complementation (in their classes) [...]. Now, after the course activity, she can use the term "sun incidence" with meaning and correctly [...] (1\_2019\_U12). Authors' emphasis

This fact has been widely perceived in the activities I do with teachers. When proposing and discussing any of the practical activities of the teaching unit, it is clear that teachers try to incorporate the concepts involved in the activity, not only to understand the phenomena, but to integrate them into the curriculum and develop them with their students (2\_2005\_U30).

Such attempts corroborate the studies by Alvaro-Prada, Freitas and Freitas (2010) where they showed that teachers generally consider relevant training courses that dialogue and meet their and students' needs through the exchange of experiences and interactions, as well as actions that help in reflection in action, in its pedagogical practice and attitude towards all sectors of life. In general, it was noted the effort of some teachers to fulfill their needs through practical and theoretical activities, individual and group reflections, the use of new teaching

strategies in their classes during training and in the construction of a climate of trust and support among the participating group.

In addition, few units of meaning showed that some teachers already had access to different courses and materials before starting the training proposed here analyzed. Such characteristics were observed in two of the 14 formations.

[...] teachers have access to various courses and materials. Among these teachers, 70% had already participated in regular courses linked to the Pole and other training institutions. [...] (1\_1999\_U32).

[...] she is involved in training activities [...] (1\_2015\_U18).

A reduced number of professionals with access to or participation in in-service training was noticed. CET is extremely important to get to know each other professionally and to reflect on the profession and practice developed in class, which is why there is a concern with such teachers who have such low permanent qualifications. For Nóvoa (2017), understanding how to become a teacher requires a thorough and systematic work of three central aspects.

The first aspect corresponds to self-development in relation to cultural and scientific life, through contact with science, literature and art on an ongoing basis to turn the dialogue with students a formative resource. The second aspect corresponds to the construction of professional ethics and the commitment that the teacher must make with the education of all children, giving special attention to those who need it most in order to learn as much as the others. Finally, the third aspect is related to “the understanding that a teacher has to prepare to act in an environment of uncertainty and unpredictability”, where decisions are taken in the face of unexpected situations (NÓVOA, 2017, p. 1.122).

That is why it is so important to develop training that helps in the personal and professional strengthening of teachers. In this way, they can be motivated to reflect and criticize their practice, expand and improve their knowledge in order to meet the daily demands of the classroom.

## 5. TRAINING THEMES AND ACTIVITIES

When analyzing the topics worked on in the CET, six of them worked only with Physics and five only with Science/Biology, one addressed the areas of Physics, Geography and Sciences throughout the training, one worked with Geosciences, and one training explored themes of Physics and Sciences/Biology, totaling the 14 formations examined.

In general, the analyzed CET started the activities with group discussions to verify the previous conceptions of the research subjects and, later, they were followed by practical activities in some formations. The theoretical and practical activities carried out were mentioned in 24 units, of which 58% reported the practices and 42% the theoretical part.

[...] the dialogue between teachers in continuing education can allow more people to integrate themselves into each other's doubts and to be able to do reflection exercises on their knowledge, learning with each other to teach the contents and themes of astronomy in classes of Sciences (1\_2013\_U17).

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This outing (of the field) motivated us to discuss the complexity of environmental, historical, social, political and economic aspects, which can be addressed in the various school subjects (1\_2011\_U24).

[...] The teachers got involved with the construction of materials and the deepening of concepts, spontaneously manifesting their potential applicability (2\_2011\_U2).

[...] meetings promoted, to a large extent, transformations in the practices and knowledge of the participating teachers. In this process, there is interaction between theory and practice. From this interaction, new possibilities, new challenges and new questions arise [...] from the practice itself (1\_2013\_U21).

During the time of CET, teachers had the opportunity to study some specific topics of CS, through workshops and practical activities, in order to improve their planning and develop their classes with less insecurities. Nóvoa (2017) uses the analogy of medical training to transpose the importance of CET centered on theory, practice, reflection and teacher improvement, explaining that it is not possible to train doctors without the presence of other doctors and without the experience of health institutions.

Thus, it is not possible to train teachers without the presence of other teachers and without the presence of school institutions (NÓVOA, 2017). Thus, through the CET, we seek the genuine contact that the teacher has with the profession he has chosen and the moment of strengthening his knowledge through socialization and group reflection.

## 6. FORMATIVE PROCESS AND HOW THE SUBJECTS FELT

During the training processes presented in the papers, the trainers observed how the teachers behaved, what were their opinions and reflections, which were pointed out in 39 units of meaning where similar units were categorized (Table 6).



Table 6 – How the subjects felt during the formative courses

How the subjects felt during the formative courses	Unit
Reasoning and reformulation of teaching practice after discussion	15
Reasoning and understanding of what really needs to be changed	8
Formation of new concepts, change of vocabulary	8
Deficiency in Science contentes	3
Anguish feeling in trying to solve problems proposed during the formative course	2
Should be open to new knowledge in NS	1
Positive report on group work (reasoning, talk, etc.)	1
Feels bothered by being observed in class	1
Total	39

Source: The authors (2022).

The units that contain the testimonies showed that the teachers in training liked the training and were able to improve their knowledge of NS. In the reports, the participants were able to rethink and reflect on/in their actions during the activities, both individually and in groups, and to see what they needed to change in their practices and vocabularies.

[...] contributed a lot. I think that everything is valid [...] seeking to add new knowledge and experiments on a daily basis. (Teacher 4) [...] The presentation of the subject was very relaxed and very serious too. These are subjects studied in school in a methodical and tiring way and here we did it with pleasure and that is what is lacking in classroom practice: letting people think. (Teacher 5) (2\_2011\_U16).

[...] It certainly influenced, I wish there was more of this type of course for us. It refreshes our memory with some things we have already learned, [...] and you have a better way of putting this more concretely for the children, you know (...)"'. (teacher E) (1\_2005\_U30).

It was possible [...] to analyze the changes in the teachers' vocabulary, the construction of relationships woven with the school practice and with the syllabus, within a more integrated vision [...] the participation of teachers directing their own training, deciding on the contents covered according to their needs, strengthened the group that began to make changes in form and content in the Study of the Environment. (1\_2011\_U22).

It was chosen to show above a statement of each training classified in the classic, practical-reflective and emancipatory-political model (JACOBUCCI, 2006), in the sequence, to indicate how each group of teachers felt during the different types of training. At times the perceptions were similar and at others different.

It was noticed that, even in thematic workshops (classic model), in which the teacher did not participate in the planning of training activities and the course was organized to offer content instruments, teachers were open to reflection. In this

case, the reflections were about what they taught “wrong” and how they can improve in the next classes through research. Teachers in training also requested courses with longer hours in order to deepen and detail the subjects, in addition to updating their knowledge in NS.

During the pedagogical workshops (practical-reflective model), the educators in training had the opportunity to reflect on the problems of their own pedagogical practice through themes and contents developed. These meetings also served to reflect on different points of the teaching-learning processes on NS and to show an awakening in the concern to improve and the curiosity to seek new resources to work NS differently with students.

Finally, in collaborative projects (emancipatory-political model), it was possible to observe the development of educators as a whole. Unfortunately, the papers did not report how the educators felt during the trainings, only the trainers' observations made during and after the trainings were shown. Educators were involved throughout the training process, directing their own training and deciding the content they needed to address.

Changes in teachers' vocabulary were mentioned in the construction of more solid relationships with school practice and pedagogical content within a more integrated perspective. Each training was directed at a school and this whole process strengthened the group of educators where they began to make changes in the form of teaching and content and, also, working more on interdisciplinarity.

## 7. TRANSITION CATEGORY: DIRECT TRAINING RESULTS

In general, most units reported, from the trainers' point of view, that the teachers were able to reflect on their practices and adapt their pedagogical actions according to the training offered. In addition, some other points were raised, according to the trainers' view (Table 7).

Table 7 – Results from the formative courses

Results	Units
Reasoning on the action and change of attitude in the classroom	35
Importance of the course to supply your doubts on science	7
Even though they were interested in the training, teachers had difficulties in introducing modifying elements in their teaching practice	5
The training encouraged teachers to rely not only on books and to start using more teaching practices	3
The integration of the teachers of the same school took place	1
<b>Total</b>	<b>51</b>

Source: The authors (2022).

The subcategories described above demonstrate that most of the teachers participating in the training were able to reflect upon their practice and face their

problems through new strategies, in addition to the adequacy of scientific language, the change of attitude towards the student and the search for improvement in teaching. This can be seen in the following observations from the trainers:

During the course of the project, the partnership relationship was strengthened, facilitating discussions and reflections on changes in pedagogical and mediation practices. In this way, the partner teacher gradually adapted her attitudes towards the classroom, assuming a posture in which she invited the classroom to study together topics of interest and which, apparently, would be of lesser scientific domain on her part (3\_2005\_U14).

[...] it is possible to say that [...] they built a new knowledge about teaching, learning and the relationship between them, which is not restricted, on the contrary, goes beyond the teaching and learning of Science (2\_1999\_U49).

The importance of the CET is shown in the units when they seem capable of meeting the teachers' concerns about NS, in addition to arousing the interest of the teacher in new qualifications in order to improve and perfect their practices with the advancement of knowledge. Thus, training was very important in the development of the teaching process of educators, because when they were able to qualify and improve their pedagogical practices, it was possible to observe a greater interest and participation of their students in class.

## 8. POST-FORMATIVE PERIOD: LEGACY

When analyzing the units of meaning on the post-formative period, we could notice a positive legacy left by CET in the Schools (and in the professional life of the teachers) participating in these moments of group reflection (Table 8).

Table 8 – Legacy of the formative courses

Legacy of the formative courses	Units
Started teaching practice classes (methodological changes)	6
Acquired knowledge (more safety for teaching)	4
The formative courses prompted room for discussion in the School	2
They overcame the difficulties felt since graduation	1
They noticed a greater student involvement in classes	1
<b>Total</b>	<b>14</b>

Source: The authors (2022).

Most educators felt more confident in teaching NS and began to use new methodologies. Teachers and researchers demonstrated the importance of these moments in the following units:

“[...] I myself acquired more knowledge and was able to pass it on to them. Some of those concepts were even quite wrong in my head, well forgotten,

you know. So it refreshed my memory and I could pass it on more safely to them, [...]" (teacher E) (1\_2005\_U33).

When comparing all the teachers investigated, we observed that there was a contribution of the workshop to their practices. Some improvements were more evident as the change in their posture and evidences were less visible when, for instance, we realized that there was only an 'internal' reflection but the teacher did not show any differences in his teaching. However, he showed in his speech that he acted differently before [...] (1\_2005\_U36).

Although trainers and teachers belong to heterogeneous groups, the formative moments provided opportunities for teachers to reflect upon their own practices and behavior in the classroom, which could help them to understand various theoretical and practical aspects necessary for teaching NS in the first years of elementary school. Nóvoa (2019) states that it is in continuing education that the cycle of professional development is completed and, also, teachers can find a way out of dilemmas through the exchange of professional experiences.

In this sense, it is shown how fruitful formative courses are to promote the professional development of educators so that they may perceive the impact of teaching NS for their students and on the school community through the development of scientific knowledge. Finally, the CET analyzed here has left a very positive legacy in the lives of many educators and schools.

## FINAL CONSIDERATIONS

After a comprehensive review of the papers published during all editions of ENPEC, it was noticed a little production within the researched topic. Of the more than 10,000 papers published over the 12 editions of the event, only 14 met the criteria of this research, that is, they presented continuing education for teachers of the first years of elementary school on Natural Sciences in a practical way. From the 356 selected study units, eight analytical categories emerged, which were organized into three formative periods (pre-formative, formative and post-formative).

In the pre-formative period, the researchers reported cases of some knowledge gaps coming from the undergraduate course, the lack of reflection on the action, and the lack of mastery of NS contents. In addition, there are scarce permanent training, a situation corroborated by theorists in the area.

During the training period, the educators in training went through moments of reflection and reformulation of their practices, through the elaboration of concepts and changes in their vocabularies, which were based on thematic and pedagogical workshops on basic contents of physics, biology and geosciences.

Throughout the FCP processes, the educators in training showed more motivation, trying to rethink their actions during the activities, individual and in groups, as the actions were built through reflections and collective conversations. There were reports that some chose to reformulate their pedagogical practices concomitantly with the training in order to obtain the opinion of the trainers in order to qualify their practices. They also reported reflection in action, in order to be able to face their problems, change some necessary attitudes towards the

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teaching of NS, in addition to being motivated to create strategies to achieve their goals in the classroom.

Among the researched papers, we did not find the tendency signaled by Jacobucci (2006) that the formations, gradually over the years, acquired characteristics of the emancipatory-political model or even of the critical-reflective model and, thus, encompassed discussions of a political-social nature, establishing less punctual and less unilateral partnerships from the Universities, as advocated by theorists in the training area. In the units, it was observed that, even more current formations, still have characteristics of the classic model. In general, however, the units of meaning showed most of the CETs with characteristics of the practical-reflective model, based on the Action-Reflection-Action studies proposed by Donald Schön (1992), of short or medium duration.

As a legacy of the FCP (post-formative period) some changes were observed, such as the methodological ones, directly linked to the educators in training and their classes, greater security when teaching NS and the overcoming of some difficulties of initial training, resulting in greater student involvement during lessons. The formations also provided collective spaces for discussion in schools where they, actually, did not previously exist.

In general, the CETs for teaching NS in the first years of elementary school reported in the ENPEC minutes highlighted the importance of the University-School vertical partnership and the indispensable role of theory that supports practices. The drama experienced by those teachers in relation to the teaching of NS was also explained, as most do not feel prepared for such an undertaking, demonstrating insecurities, mainly because they believe they do not have knowledge about the area. Few studies were found concerned with carrying out a continuous follow-up with the teachers after the completion of the training in order to identify, in fact, substantial changes in practices regarding the teaching of NS.

Thus, it is expected that this work will contribute to researchers in the area of Science Teaching who aim to qualify their training actions aimed at teachers of the first years of elementary school, in addition to elucidating some gaps to be explored in research on the subject.

# Revisão bibliográfica das atas do ENPEC sobre o ensino de ciências nos anos iniciais: formação continuada de professores em serviço

## RESUMO

Este artigo representa a expansão de um trabalho inicial enviado ao XIII ENPEC/2021 que objetiva investigar como as formações continuadas de professores (FCP) dos anos iniciais sobre Ciências Naturais (CN) vêm sendo, historicamente, realizadas e apresentadas nas edições do Encontro Nacional de Pesquisa em Educação em Ciências (ENPEC - 1997 a 2021). Trata-se de uma pesquisa exploratória, do tipo estudo bibliográfico e foi constituída a partir de dados de 14 trabalhos completos selecionados e analisados à luz da Análise Textual Discursiva (ATD). No processo de categorização, emergiram oito categorias de análise: 1) necessidades formativas; 2) concepções de ensino; 3) concepções sobre formação; 4) características dos sujeitos; 5) metodologias das formações; 6) processo formativo e como os sujeitos se sentiram; 7) resultados diretos das formações; e 8) pós-formações (legado), organizadas em três períodos: pré-formativo, formativo e pós-formativo, intercalados com unidades de transição. Após a análise dos trabalhos ano a ano, menos de 1% do total publicado neste evento e apenas 10% da totalidade selecionada atenderam aos objetivos desta pesquisa. As unidades de significado representativas do período pré-formativo mostraram a deficiência na formação inicial dos educadores em formação, a importância de conhecer as competências para trabalhar CN, planejar, conduzir e avaliar o processo de ensino, além da importância da continuidade do processo de reflexão e formação docente. As duas características mais acentuadas entre os educadores em formação foram as necessidades em aprofundar seus conhecimentos conceituais em CN e a tentativa de mudar seus métodos de ensino após as reflexões em grupo. No período formativo, os professores passaram por momentos reflexivos e de reformulação das suas práticas, formação de conceitos e mudanças em seus vocabulários sobre CN. Os resultados diretos das formações mostraram que os educadores em formação conseguiram refletir na ação, enfrentaram seus problemas, mudaram a postura frente ao ensino de CN, além de se apresentarem motivados na criação de novas estratégias para alcançar seus objetivos em sala de aula. De maneira geral, os pesquisadores/formadores observaram mudanças metodológicas, segurança para ensinar CN e a superação de algumas dificuldades da formação inicial dos professores, assim como um maior envolvimento dos alunos durante as aulas e a criação de espaços coletivos para discussão nas Escolas, que até então não existiam nesses locais. Espera-se que este trabalho contribua com pesquisadores da área de ensino de CN visando qualificar suas ações de formação continuada voltadas para professores dos anos iniciais, bem como elucidar algumas lacunas a explorar nas pesquisas sobre a temática.

**PALAVRAS-CHAVE:** Formação profissional. Formação contínua de educadores. Anos iniciais. Ciências da natureza.

## NOTES

This text has been translated by Rodrigo Jappe, contact: +55 (55) 9 8115-2530, <http://lattes.cnpq.br/1729569883703972>.

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