

ARTICLE

TEACHING PRACTICE OF CHEMISTRY TEACHER EDUCATORS: WHAT RESEARCH REVEALS?¹

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ABSTRACT: Teaching at the university level implies knowledge that contributes to this exercise, as well as specific and pedagogical knowledge about one's field of study and the subjects to be taught. This text analyzes research on the teaching practices of teacher educators in Chemistry teacher education programs. In this research, a bibliographic study was conducted of articles published in the journals *Revista Docência do Ensino Superior*, *Cadernos de Educação*, *Química Nova*, *ReSBEnQ*, and *REDEQUIM*, available on the CAPES Journal Portal, Redalyc, and SciELO, from 2018 to 2023. The data were analyzed using Textual Discourse Analysis (TDA), which resulted in two categories, one a priori and the other emergent: i) Teaching decision: the starting point of teaching practice; ii) Focusing on challenges: a trend in educational research. The analysis of the articles identified that discussions about teacher educators permeate the obstacles faced at the university and the implications for the organization and implementation of teaching action. Regarding the choice of subjects to cover, teachers establish their own criteria, which sometimes differ from the course's pedagogical project. In conclusion, the research shows a tendency to address on the difficulties faced by teacher educators and a lack of articles discussing their teaching practices, particularly the intentions behind the methods and strategies used in the classroom.

Keywords: teacher educators, teaching practice, chemistry degree, higher education.

PRÁTICA DOCENTE DE FORMADORES DE PROFESSORES DE QUÍMICA: O QUE REVELAM AS PESQUISAS?

RESUMO: A docência universitária implica conhecimentos que contribuam para esse exercício, além de saberes específicos e pedagógicos sobre a sua área de estudo e as disciplinas a serem ministradas. Esse

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texto analisa o que vem sendo pesquisado sobre a prática docente de formadores de professores em cursos de licenciatura em Química. Nesta pesquisa, foi realizado um levantamento bibliográfico, no período de 2018 a 2023, de artigos publicados nos periódicos Revista Docência do Ensino Superior, Cadernos de Educação, Química Nova, ReSBEnQ e REDEQUIM, disponíveis no Portal de Periódicos da CAPES, na Redalyc e no SciELO. A análise dos dados foi à luz da Análise Textual Discursiva (ATD), na qual se obtiveram duas categorias, uma *a priori* e outra emergente, respectivamente: i) Decisão docente: o ponto de partida para a prática docente; ii) Em foco os desafios: uma tendência nas pesquisas educacionais. Entre os resultados, os artigos analisados permitiram identificar que as discussões sobre os formadores de professores permeiam os obstáculos enfrentados na universidade e as implicações para a organização e a implementação da ação docente. Quanto à escolha dos assuntos a serem abordados, identificou-se que o docente estabelece critérios próprios que, por vezes, divergem da ementa do Projeto Pedagógico do Curso. Em suma, essa pesquisa indica uma tendência de abordar as dificuldades enfrentadas pelos formadores e evidencia, além disso, a ausência de artigos que discutam a prática docente desse professor, em aspectos como as intencionalidades das metodologias e estratégias utilizadas em sala de aula.

Palavras-chave: formadores de professores, prática docente, licenciatura em Química, ensino superior.

PRÁCTICA DOCENTE DE LOS FORMADORES DE PROFESORES DE QUÍMICA: ¿QUÉ REVELAN LAS INVESTIGACIONES?

RESUMEN: La docencia universitaria implica conocimientos que contribuyen al ejercicio de la enseñanza, saberes específicos y pedagógicos relacionados con el área de formación y las asignaturas impartidas. Este estudio analiza las investigaciones acerca de la práctica docente de los formadores de profesores en cursos de Licenciatura en Química. Para ello, se realizó un levantamiento bibliográfico de artículos publicados entre 2018 y 2023 en las revistas Revista Docência do Ensino Superior, Cadernos de Educação, Química Nova, ReSBEnQ y REDEQUIM, disponibles en el Portal de Periódicos da CAPES, Redalyc y SciELO. El análisis de los datos se desarrolló a partir del Análisis Textual Discursivo (ATD), del cual surgieron dos categorías: i) Decisión docente: el punto de partida de la práctica docente; ii) Los desafíos en foco: una tendencia en las investigaciones educativas. Los resultados evidencian que las discusiones sobre los formadores de profesores se concentran en los obstáculos enfrentados en la universidad y en sus implicaciones para la organización e implementación de la acción docente. Asimismo, se identificó que los docentes establecen criterios propios para seleccionar los contenidos abordados, los cuales, en ocasiones, divergen de la planificación prevista en el Proyecto Pedagógico del Curso. En síntesis, esta investigación señala una tendencia a enfatizar las dificultades enfrentadas por los formadores y evidencia la ausencia de estudios que profundicen en las intencionalidades pedagógicas de las metodologías y estrategias utilizadas en el aula.

Palabras clave: formadores de profesores, práctica docente, licenciatura en química, educación superior.

INTRODUCTION

Teaching as a profession requires knowledge of the science, technique, and art of teaching (Marcelo Garcia, 1999). Consequently, university teaching entails knowledge that informs practice, specifically, both subject-matter expertise and pedagogical knowledge regarding the field of study and the

courses to be taught. Thus, the professional identity of the university professor, particularly within the context of teacher education programs, is shaped by contradictions that manifest at every stage, from initial training to the stances adopted regarding the specific nature of the program.

It is important to understand how the identity of a university professor is constructed, particularly within teacher education programs. This requires considering the contradictions inherent in their training since we cannot assume that an educator is fully prepared to teach simply upon completing a master's or doctoral degree. The practice of teaching is a process of constant change, shaped by evolving identities, experiences, and contexts (Guimarães; Massena; Siqueira, 2021).

In this study, we understand that a faculty member may also be a teacher educator. This role includes those who help preservice teachers and already qualified professionals learn to teach (Mizukami, 2005). It may therefore include faculty members in teacher education programs as well as schoolteachers who contribute to students' preparation. For this study, however, teacher educator refers specifically to faculty members working in teacher education programs (*licenciaturas*).

Their understanding of their program and the professionals they aim to train does not always align with the conceptions and objectives they share with their peers. These distinctions can be observed in the intentionality behind teacher educators' practices, as such practices may exhibit both differences and similarities in the classroom. However, the selection of specific methodologies and strategies may vary regarding intent, that is, what is being prioritized: pedagogical knowledge, scientific knowledge, or a process of mediation between both forms of knowledge (Garcia; Cunha, 2020).

In Chemistry teacher education programs, these differences can be understood through the power struggles and teaching *habitus* that permeate the training process. According to Silva and Mesquita (2022), two visions of teaching and research coexist among teacher educators: one is aligned with the reproduction of the *chemical habitus* and another that opposes it. The *chemical habitus* emphasizes research activities at the expense of teaching practice and is reinforced by a university and social context that legitimizes and elevates this profile. Thus, the differing intentions behind teaching practices are directly linked to these structured dispositions, highlighting how symbolic struggles influence the shaping of the curriculum and teacher education.

In this context marked by tensions between differing conceptions of teaching and teacher education, there is an emerging need for research that deepens the understanding of the practices of teacher educators. Studies point to the necessity of analyzing how these professionals carry out their work in interaction with their peers, and fostering reflective processes that enable them to reframe their practices. This entails incorporating innovative practices that challenge traditional approaches, create space for new ways of learning, and prompt to reconsider their teaching methods (Cunha & Alves, 2019).

A gap is evident in the academic literature regarding institutional curricula and the training of teacher educators. This may result in a disconnection between subject-specific and pedagogical knowledge in teacher education degrees, while also influencing academic culture and the formulation of public policies aimed at university professors (Silva & Ferreira, 2021). Thus, this article analyzes literature

published in databases and scientific journals concerning the teaching practices of teacher educators in Chemistry teacher education programs.

THE UNIVERSITY CONTEXT AS A FACTOR IN THE IDENTITY CONSTRUCTION OF TEACHER EDUCATORS

The university is characterized by the integration of teaching, research, and extension, different from colleges and other private or public institutions. Maintaining this status depends on the work performed by hired professionals who play different roles. However, there is a clear bias favoring one of these roles: research. This is evident when considering that university performance evaluation criteria are linked to increasing faculty scientific output rather than to their contribution to, or concern for, the quality of student education (Zabalza, 2004).

According to Ferenc and Mizukami (2008), the demand for research output is significant in two aspects: first, research reflects a professional's social position due to the “academic status”, as it is viewed as an indicator of productivity, something that is highly valued. The second point concerns research's importance to the very survival of the public university. In this context, the dissemination of knowledge becomes a bargaining asset in partnerships with private institutions that help sustain the public university (Ferenc & Mizukami, 2008).

Thus, the formation of a professional identity in higher education takes place within a system that assigns different value to academic practices, in which scientific research tends to serve as the primary source of prestige in universities. This arrangement contributes to the marginalization of teaching, diminishing the formative role associated with being the “professor” and reinforcing the peripheral status of teaching, as highlighted by Ferenc and Mizukami (2008). Although the role of the faculty member calls for the integration of teaching, research, and extension (Cunha, 2019), this integration is strained by an academic culture historically shaped by power relations that establish a hierarchy among these dimensions.

In this context, the Chemistry teacher education program is a space where such tensions materialize in a particular way, given that teacher training competes for centrality with other demands of the academic field. The lack of a more precise definition of the educator's role, particularly regarding the articulation between teaching and productivity (Quadros & Mortimer, 2018), intensifies the indeterminacy of its formative function.

Thus, teaching practices come to be guided by individual conceptions of the profession, shaped by interests and forms of recognition legitimized within the academic field. Working in these courses does not necessarily ensure the development of a sense of belonging to the realm of teacher education, nor the recognition of this responsibility as a structuring element of practice within the Chemistry teacher education programs.

Pathways for the teaching practice of teacher educators

Initial teacher education can serve as a space for reflection and participation, fostering the development of practices that engage with diverse contexts. In this process, teacher educators also redefine their roles, as they are shaped by changes in their experiences, identities, and institutional conditions.

However, in Chemistry teacher education programs, this dynamic is complicated by the diversity of faculty backgrounds and their involvement in different academic fields. As Silva and Mesquita (2022) note, the field of Chemistry is shaped by competition among its members for capital. In degree programs, this is reflected in the presence of faculty affiliated with both the field of education and the disciplinary field of Chemistry. These groups draw on different *habitus*, which shape their understandings of the program and of teacher preparation.

Chemistry educators often focus on the processes of teaching, learning, and the development of school-based knowledge (Schnetzler; Antunes-Souza, 2018). In contrast, faculty members with backgrounds in chemistry prioritize scientific research, considering it the primary form of academic capital (Silva; Mesquita, 2022). This asymmetry, historically influenced by a positivist legacy, contributes to unequal recognition between the two groups and directly impacts curricular decisions. However, researchers in chemistry education have been working to challenge this imbalance by creating spaces and resources dedicated to teacher education (Schnetzler; Antunes-Souza, 2018).

These tensions are also reflected in the curricular organization. The separation between subject-specific courses and those focused on teaching, often taught by different faculty members, hinders the development of an integrated training program and the establishment of a consensus regarding the profile of the preservice teacher (Maldaner, 2006). In this context, fragmentation appears not merely as an issue of curricular organization, but also as an expression of a hierarchy of knowledge that tends to subordinate teacher education to the logic of the scientific field.

Within the context of initial teacher education, Francisco Imbernón (2011) highlights that teacher educators must analyze both the practices of other teachers and their own, fostering systematic opportunities for reflection. Organizing and carrying out practices through dialogue with others allows for re-examining actions from new perspectives, raising questions about what needs to be addressed in the classroom and which strategies are best suited to achieving the proposed objectives.

As Melo and Campos (2019) point out, isolated actions contribute little to promoting changes in practices. Collective work creates opportunities to challenge conservative beliefs and assumptions that have become solidified throughout the course of a professional career. Interaction with others also makes it possible to reconstruct one's knowledge, professional identity, and teaching practices.

Ferenc and Mizukami (2008) warn that knowledge sharing is uncommon among faculty in higher education. The traditional understanding of autonomy is based on their expertise in specific disciplines and their control over classroom activities. Teacher educators remain focused on their own disciplines and fail to consider the connections between different areas of content. Consequently, they do not plan collaborative activities that integrate the knowledge they consider important for preparing preservice teachers (Araújo & Silva, 2021).

As shown before, individual practices are common in the university setting, and the movement to change this reality is proceeding gradually, with various objectives aimed at enhancing initial teacher training. Thus, a challenge to be overcome is professional isolation to foster the exchange and sharing of practices that contribute to understanding and valuing the Course Pedagogical Project (PPC), the graduate profile, curricular integration, and the development of new curricular paradigms (Masetto, 2020). An example of overcoming this isolation, one that can guide collaborative efforts, is the work of Authors B (2013), who developed an activity for a course within the Chemistry teacher education program. This initiative involved a collaboration between an educator specializing in Science Education and another in Chemistry, aiming to support the hours reserved for “Practice as a Curricular Component.”

In Chemistry teacher education programs, faculty members who teach Chemistry courses must be aware of the realities of schools and the working conditions faced by schoolteachers (Schnetzler; Antunes-Souza, 2019). Consequently, practice must be structured with an eye toward the impact of training teachers who not only understand scientific concepts but are also capable of transforming them into school-based knowledge. In this regard, educators and teachers must consistently exercise critical judgment when reviewing content and reflecting on their professional development, avoiding the mere reproduction of practices or uncritical adherence to external knowledge (Imbernón, 2011).

Encouraging the reformulation of practices points toward autonomy and active engagement in both individual and collective learning. Activities involving the class group, with teacher participation in professional development settings, can serve as a viable alternative (Masetto; Gaeta, 2019). Further possibilities emerge and evolve as efforts are made to transform teaching practices. Through these inquiries and new proposals, innovative practices arise as options to be implemented in university classrooms (Wagner; Cunha, 2019).

Innovative practices in higher education are linked to the context in which they emerge, specifically, when the need for change is recognized by the educator (Imbernón, 2011; Cunha, 2019; Wagner & Cunha, 2019). Innovation imposed by those in senior positions disregards the teacher's role, autonomy, and capacity to reflect on their work environment.

From this perspective, Wagner and Cunha (2019) point out that innovations are not neutral and embody intentions that depend on the goals the educator seeks to achieve. Thus, they are constructed based on curricula or university classes. A sense of inquiry regarding a problem and the active role of students are characteristics of innovative practices. Consequently, these practices are not directly linked to abandoning the use of the chalkboard or to the nature of assessments, but rather to how power structures and the true purpose of the classes are perceived (Wagner & Cunha, 2019).

Lived practice and the theoretical ideas developed from and about those experiences inform one another. This relationship contributes to the legitimacy and intentionality of educator's pedagogical practice, through which they communicate rules, values, and codes of social behavior (Cunha & Alves, 2019). Therefore, the choice of specific practices warrants investigation, as it serves as a model for future teachers (André et al., 2010; Oliveira & Mortimer, 2020).

METHODOLOGY

This study involved a literature review, which consists of searching for works published by other researchers across various data sources (Rodrigues, 2007). The databases included CAPES, *Rede de Revistas Científicas da América Latina y el Caribe, España y Portugal* (Redalyc), and the Scientific Electronic Library Online (SciELO). These databases were selected because they provided access to recent academic productions and apply rigorous criteria for including journals, which contributes to the reliability of the articles retrieved.

To broaden the search and identify studies focusing on educators, a survey was conducted across other journals such as: *Revista Docência do Ensino Superior*; *Cadernos de Educação*; *Química Nova*; *Revista da Sociedade Brasileira de Química* (ReSBEnQ); and *Revista Debates em Ensino de Química* (REDEQUIM).

This research represents a subset of a broader study. To identify gaps and map existing literature, the search for articles was delimited to the 2018–2023 period, enabling access to recent publications and an understanding of the evolution of research on teacher educators. The search used descriptors found in titles, keywords, and abstracts, such as *formadores de professores* (teacher educators), *professores formadores* (educators for teachers), *prática docente* (teaching practice), *docente universitário* (university faculty), *Ensino Superior* (higher education), and *prática pedagógica* (pedagogical practice). The search strings used were: “*formadores de professores* OR *professores formadores* OR *docentes universitários* AND *prática docente* OR *prática pedagógica* AND *licenciatura em Química*.” Initially, a total of 396 articles containing these descriptors were found.

Articles were selected for analysis if: i) their participants were Chemistry teacher educators; and ii) the studies were partially or fully empirical. These criteria were set because this article focuses on research involving and analyzing educators who work specifically in Chemistry teacher education programs.

Thus, seventeen (17) articles remained and were read in full. The analysis was conducted using Discursive Textual Analysis (DTA), which enabled an understanding of the phenomena and discourses under study (Moraes & Galiazzi, 2016). The analysis cycle comprises three main stages: i) deconstruction of the texts; ii) establishment of relationships; and iii) capturing the emerging new (Moraes & Galiazzi, 2016). Each of these stages is described below.

i) Text dismantling is the stage in which text fragments meaningful to the researcher are separated, generating units of meaning. Each unit is assigned an identification code. Since the research corpus consists of previously published articles, we chose to retain author identification within the cited units.

ii) Establishing relationships is the categorization process that takes place based on units of meaning grouped by their similarities. These categories may be emergent or *a priori*.

iii) Capturing what emerges involves producing metatexts that communicate new understandings by bringing description, and interpretation together and deepening the understanding of the phenomena under investigation (Moraes; Galiazzi, 2016).

Based on the analysis, two categories were established: one *a priori* and one emergent. The *a priori* category discusses aspects that university faculty consider important for organizing their practice and for the relationships established with the course's pedagogical project. Category 2 discusses the challenges of different educational contexts and what these contexts reveal in articles regarding professional practice in Chemistry teacher education programs and the expectation of assuming administrative roles within the university.

RESULTS AND DISCUSSION

The research aimed to identify the practices of faculty members teaching in Chemistry teacher education programs. Studies addressing the context of Federal Institutes offering this level of education were also included, given that the program aims to train teachers and that faculty members contribute to this training. Table 1 shows the articles meeting the inclusion criteria.

Table 1: Articles found in databases and journals.

Title	Authors	Year
Environmental themes in teacher training within undergraduate degree programs at the Federal University of Rondônia: a case study at the Porto Velho campus	Clarides Henrich de Barba Rosa Maria Feiteiro Cavaleri	2018
Conceptions of Chemistry Teacher Education: Challenges and Possibilities	Lairton Tres José Claudio Del Pino	2018
Analysis of Chemistry teacher educators' conceptions regarding the inclusion of students with disabilities in higher education	José Gonçalves Teixeira Júnior Nayara Costa Souza	2019
Practice as a curricular component: horizons of understanding among Chemistry teacher educators	Vivian dos Santos Calixto Neide Maria Michellan Kiouranis Rui Marques Vieira	2019
Co-teaching praxis as an interdisciplinary experience in Natural Sciences education	Dalana Campos Muscardi Vivian Estevam Cornelio	2020
Challenges of university teaching: the perspective of teacher educators	Thamiris Christine Mendes Berger Ana Lucia Pereira Cristina Costa	2020
Perceptions of teacher educators and their relationships with knowledge in the Chemistry teacher education program at the Federal Institute of Goiás	Ronan Santana dos Santos Marinez Meneghello Passos Sergio de Mello Arruda	2020
Transformation pathways of action mediated by educational resources: the perspective of a higher education Organic Chemistry professor	Leandro Oliveira Eduardo Fleury Mortimer	2020
Collaborative construction of practices as a curricular component by Chemistry teacher educators: an analysis based on the theory of communicative action	Beatriz dos Santos Araújo João Ricardo Neves da Silva	2021
Continuing training for teacher educators in the area of natural sciences: what elements to consider?	Franciele Siqueira Radetzke Roque Ismael da Costa Güllich	2021

The role of teaching knowledge in the pedagogical training of Chemistry degree programs: what do teacher educators think?	Alane da Silva Marinho Wanderson Diogo Andrade da Silva Neidimar Lopes Matias de Paula	2021
Views of teacher educators on the training and teaching practice of chemistry teachers	Gabrielle Gomes Ferreira Thiago Antunes-Souza	2021
Higher Education Chemistry Professors' Perceptions of the Use of Molecular Models in Their Professional Paths	Leandro Antonio Oliveira Eduardo Fleury Mortimer	2022
Analysis of university professors' views on the role of experimental activities in a chemistry teacher training course	Marcela Duarte Caetano Silva Cristina Binsfeld José Gonçalves Teixeira Júnior	2023
Challenges and Possibilities Faced by Teacher Educators at a Federal Institute	Rosenilde Nogueira Paniago	2023
Educational resources and multimodality in meaning-making in higher education stereochemistry classes	Leandro Oliveira	2023
Symbolic Relationships among Teacher Educators in Chemistry Degree Programs at the Federal Institutes of Santa Catarina	Priscila Juliana da Silva Orliney Maciel Guimarães	2023

Source: Research data, 2024.

The categories presented below compose the analysis of the articles in Table 1. The discussion of the results is presented based on these categories, one *a priori* and one emergent, respectively: i) Teacher decision-making: the starting point for teaching practice; ii) In focus: challenges, a trend in educational research.

Teacher decision-making: the starting point for teaching practice

The degree program aims to prepare teachers for work in basic education, a stage regarded as initial teacher training. The connections established during this period and their impact on the future teacher's development depend on a range of factors influencing the construction of their professional identity, such as the curriculum, interactions with faculty, and participation in extension, teaching, or research programs. Teacher training is not defined by any one of these factors but by their combination, which plays a significant role in shaping the professional being developed. The purpose of this initial teacher training is evident in one of the analyzed articles, as highlighted in the following statement.

Analyses of the statements show the value placed on initial teacher education as a stage for internalizing theories and integrating practice, a time when future teachers adopt professional reference points and master specific, pedagogical, and curricular knowledge. (Ferreira & Antunes-Souza, 2021, p. 16).

The statement highlights the centrality attributed to initial training as a space for appropriating knowledge fundamental to teaching, including specific, pedagogical and curricular knowledge. According to the research, the teachers' responses reinforce the need for this stage so students can build references about being a teacher and guide their future practices. However, assigning it such a central role risks placing excessive responsibility on initial teacher education, as though it alone could

fully prepare someone for teaching, while overlooking both the limits of this process and the concrete conditions in which it takes place.

Therefore, the development of teaching practice is not limited to initial training but constitutes a continuous process marked by revisions, tensions, and the reinterpretation of meaning throughout one's professional journey. Although initial training plays a foundational role, its effectiveness depends on the conditions under which it takes place and its integration with actual practice and continuing education. Otherwise, it risks being reduced to a set of reference points that are rarely applied in the actual exercise of the profession.

According to Manfredo and Gonçalves (2020), teachers' professional knowledge begins to develop even before initial training. This knowledge is shaped by their experiences as students, during the pre-professional phase, and throughout their teaching careers. Thus, it is understood that the knowledge required for the profession comes from multiple sources and is built continuously. This ongoing development helps distinguish and characterize teaching in comparison to other professions.

Tardif (2014) categorizes teacher knowledge into four dimensions: knowledge from professional training, disciplinary knowledge, curricular knowledge, and experiential knowledge. Although they are different, these forms of knowledge are integrated during the act of teaching, shaping pedagogical practice. This practice is not limited to classroom performance but also encompasses processes such as planning, strategy selection, and interaction with students. In this context, Muscardi and Cornelio (2020) discuss lesson planning and the challenges and possibilities of collaboratively developing instruction, as the following excerpt shows:

There was always a concern to introduce topics from macroscopic aspects, culminating in microscopic and symbolic aspects, which are more abstract to our students. We considered the various topics and their interrelationships when preparing the lessons, and based on this, selected the best methodologies and teaching resources. We consistently incorporated the reality of rural life into the lessons, each of which was individually planned. (Muscardi, Cornelio, 2020, p. 13).

The excerpt highlights an intentional pedagogical approach based on the progression of chemical knowledge, as proposed by Johnstone (2006). This approach aims to support the students in gradually developing their ability to think abstractly. Additionally, integrating real-world contexts into lesson planning reflects a commitment to contextualizing instruction by linking scientific content to the students' experiences, which can enhance the meaningfulness of the concepts addressed.

For future studies, it is worth considering that, while progression between levels and contextualization are relevant, a linear logic of knowledge may persist, in which the abstract occupies a final, superior position. This tends to reinforce learning difficulties in the absence of continuous mediation between levels. Although incorporating local realities can be powerful, care is needed to avoid using them merely as illustrative examples without critically examining the social, cultural, and productive relationships that shape them.

The statement highlights the articulation between curricular and experiential knowledge, as the teacher draws upon knowledge regarding institutionally defined objectives, methodologies, and syllabi

while simultaneously forging new connections based on their experience and the university context (Tardif, 2014). As can also be seen below:

The content presented by the teacher concerns the study of plants in their natural habitat, enabling students to understand the importance of environmental preservation: “it is crucial to keep the forest standing and to show how biodiversity is essential for the development of the Amazon region” (P13). Thus, the choice of the biodiversity theme, as described by the teacher in his account, highlights the need to preserve the natural environment (Barba & Cavalari, 2018, p. 301).

The teachers' choice of specific content is linked to their position within a particular context. Thus, beyond the course syllabus, they select themes based on their intentions regarding what they consider relevant to address and critically examine at the time. This process establishes a dialogue between lived practice and the theoretical concepts that arise from, and reflect upon, those experiences. This interaction legitimizes the intentionality of their teaching practice, as it also involves the socialization of rules, values, and codes of social behavior (Cunha; Alves, 2019).

This teacher shows a commitment to developing their approach based on a social issue from their own experience as a student, aiming to achieve specific objectives through the knowledge addressed. However, the lack of detail on how this content is implemented limits the understanding of how the proposal is put into practice, which may indicate a gap between intent and action. Furthermore, the scarcity of research analyzing the work of practicing chemistry teacher educators hinders a deeper exploration of these issues, leaving the concrete mediations that structure teaching practice in this context largely unexamined.

Oliveira's (2023) study helps address this gap by observing classes taught by two Chemistry faculty members and analyzing both their use of educational resources to teach stereochemistry and the ways they conducted their lessons. Some points identified by the researcher include:

Rosa established a proxemic relationship, involving a shared observation, through her speech and her manipulation of the model, aiming to show the undergraduates how to handle the object to discover the direction of the rotation. Furthermore, she used specific intonation and prosody, raising her pitch and vocal intensity while using pauses between words and clauses. She also used gestures during her presentation. (Oliveira, 2023, p. 11)

Rosa and Aline taught the subject of stereochemistry, addressing various chemical, physical, and biological concepts while highlighting the structures, properties, and reactivity of certain organic molecules. Through lectures that included moments of interactivity, their primary teaching strategies involved explaining concepts, teaching rules, providing examples, solving exercises, and discussing the application of theory within the context of pharmaceutical production. (Oliveira, 2023, p. 9)

The study of organic chemistry generally requires students to use a certain level of abstraction to understand the topics. As the research indicates, both teachers use models to facilitate this understanding. However, while this approach aims to address students' visualization challenges, its adoption does not guarantee the overcoming of conceptual limitations, particularly if it is not integrated with strategies that foster inquiry and the transition between different levels of representation. Manfredo

and Gonçalves (2020) emphasize that, beyond updating strategies, it is crucial to value teachers' knowledge and reaffirm their central role in educational processes, recognizing that their experiences enhance their teaching practices. Thus, the use of such resources can be seen as a significant starting point, yet one that remains insufficient unless accompanied by more robust mediation intentionally focused on learning.

The second excerpt indicates that, despite some interactive moments, instruction is organized around lectures, explanations of concepts and rules, and exercises. This set of strategies tends to prioritize the reproduction of procedures and memorization over in-depth understanding. While the inclusion of examples related to pharmaceutical production expands the repertoire and connects the content to relevant contexts, it appears only sporadically, without necessarily guiding the construction of knowledge.

The use of instructional resources alone does not guarantee effective learning, but it provides a foundational step for addressing a problem identified by the teachers: students' difficulty with visualization. In this context, and considering adult learning, it becomes essential to make a clearer commitment to professional training by defining the desired graduate profile and aligning teaching practices with the guidelines of the course's pedagogical project. In their research, Calixto, Kiouranis, and Vieira (2019) make connections regarding teaching practice within the context of implementing “practice as a curricular component,” as shown below:

When describing the principles guiding the teaching strategies adopted in curricular components with a Curricular Component of Practice (PCC) workload, the development of activities focused on microteaching predominates. However, other approaches are also mentioned, such as those that emphasize the relationship between theory and practice, engagement with the reality of the school environment, and the analysis and evaluation of teaching materials. A common thread is the understanding that teaching practice is a broader dimension than only interacting with students in the classroom. In this context, one of the principles advocated in both regulatory documents and theoretical discussions is incorporated: the increasing complexity of the practical dimension of teaching (Calixto, Kiouranis, & Vieira, 2019, p. 196).

In this context, it is evident that professors direct the hours allocated to Practice as a Curricular Component (PCC) toward activities in which students prepare lessons and discuss aspects of the school environment. This approach is significant because it brings future teachers closer to real-world professional situations while they are still in their training phase. Masetto (2020) argues that assessment processes should contribute to learning rather than assign grades. These practices reflect an attempt to integrate assessment with teacher training. By engaging students in lesson planning and reflection on the school environment, professors foster the mobilization of knowledge essential to the teaching profession.

The potential of these activities depends on how they are conducted. If they are limited to lesson planning within contexts that lack critical inquiry, they tend to be restricted to technical exercises. On the other hand, when accompanied by reflection and critical inquiry, they can foster a more critical understanding of teaching. Thus, it can be considered that the teachers participating in the study seek to contribute to the development of the teacher identity.

This contrasts with the study by Tres and Del Pino (2019), in which few changes occurred despite the revision of the course's pedagogical project, as the following excerpt shows:

When examining how the program's faculty engaged with the new proposal, it becomes evident that, initially, "faculty participation was rather low-key, and the restructuring was partial, involving the introduction of Chemistry Education courses but few changes to the 'core' subjects" (Response from P2 to Interview Question 7). This highlights the absence of a fundamental change in the teaching-learning approach within the program, partly because many technical courses are shared between the two tracks, the Chemistry teacher education program and the bachelor's degree program in Chemistry (Tres & Del Pino, 2019).

The excerpt highlights that the curricular reform was limited in scope, involving minimal faculty participation and changes focused primarily on the inclusion of Chemistry degree courses. By leaving the "core" subjects virtually unchanged, the curriculum preserves a structure that prioritizes technical knowledge over teacher training. As Silva and Mesquita (2022) suggest, this arrangement can be understood as an expression of struggles for capital among different groups, particularly those associated with teacher education and with the disciplinary field of Chemistry.

The justification that these courses are shared between the Chemistry teacher education program and the bachelor's degree program in Chemistry helps explain this arrangement, but it also highlights a deeper issue. Organizing the curriculum in this way reinforces the idea that teacher training plays a complementary rather than a foundational role. Consequently, it reinforces the notion that mastery of chemical knowledge alone is sufficient, or even more important, for the training of Chemistry teachers, limiting the development of a more integrated and critical educational approach.

Finally, this category highlighted which aspects of the teacher educators' practice stand out most in the articles. Although only one study directly observed the classes, the others allow for the identification of factors guiding these practices. Key aspects include the university context, the choice of themes to address the topic, the use of instructional resources, and initiatives aimed at the training of future teachers. More than just isolated elements, these aspects reveal intentionality in the teacher educators' pedagogical decisions.

Focus on challenges: a trend in educational research

The analyzed articles show that discussions on teacher educators encompass the challenges faced both within universities and in Federal Institutes (IFs). Consequently, it is necessary to broaden the perspective beyond the university context, also considering the specificities of teaching within the IFs. Studies analyzed in this context include those by Santos, Passos, and Arruda (2019), Paniago (2023), and Silva and Guimarães (2023).

According to Silva and Mesquita (2024), faculty members at these institutions may work across a vertical continuum of educational levels, teaching everything from high school to postgraduate courses, depending on the institution's offerings. In this context, such vertical integration enables educators to work across different levels of education, with the relationships formed during this process

arising from their presence in the space between these levels. This dynamic requires educators to recognize emerging relationships and to enhance the quality of interactions within shared learning spaces (Silva & Mesquita, 2024).

However, across different educational levels, educators must adapt to diverse social contexts and instructional approaches suited to varied audiences. Consequently, the situation within Federal Institutes offering Chemistry teacher education programs presents challenges different from those found in the university setting. While universities place a high value on research, this emphasis is more limited in Federal Institutes, particularly those offering verticalized education. Research by Paniago (2023) highlights the difficulties faced by Chemistry teacher educators who must work across these different educational levels, as shown below:

PQ also describes the complexity of working across multiple fronts, including various courses within both technical and graduate programs [...]. PQ goes on to explain that his work is quite diverse, spanning the teacher training program, a course focused on pedagogical preparation, as well as “specific chemistry and experimental chemistry courses, and, at the graduate level, the field of natural products chemistry” (PQ, 2020). For him, working on multiple fronts is a challenge, particularly regarding research, which is highly demanding. (Paniago, 2023, p. 13.)

The multiple responsibilities assigned to faculty members at Federal Institutes can lead to severe physical and mental exhaustion. This points to a structural tension between institutional demands and the conditions needed to provide a robust teacher education program. This setup hinders the integration of the knowledge mobilized during training, pointing to the risk of a fragmented educational experience in which subject-specific and pedagogical knowledge fail to be effectively integrated.

According to Alves and Mesquita (2020), this issue is exacerbated by the teacher's tendency to orient their practice toward a more technical approach, influenced by both their field of expertise and the operational logic of the Federal Institutes (IFs). Thus, specialized subject-matter knowledge is prioritized over pedagogical knowledge. This type of logic reinforces the disconnect between teaching content and teaching how to teach, weakening teacher training.

Although a diversity of roles can broaden experiences, it also limits pedagogical depth. Work overload and the prioritization of specific demands reduce the scope for reflection, compromising the training of pre-service teachers. It is evident that classroom teaching and the teacher's total workload cannot be decoupled, given the direct influence each exerts on the other.

Faculty members may also take on responsibilities beyond classroom teaching, including administrative positions. Silva and Guimarães (2023) emphasize:

[...] this workload, particularly in roles involving additional responsibilities, reduces the classroom teaching hours of faculty members, serving as a form of symbolic capital, especially given that it does not represent a significant financial gain. These positions involve course and departmental coordination roles and are accessible to tenured faculty members after they have joined the institution. (Silva; Guimarães, 2023, p. 11).

Some professors decide to take on roles that carry a special designation or allowance, such as administrative positions, even when the financial return is not favorable. The authors characterize this

decision as a form of symbolic capital, given that these roles garner social recognition and offer non-financial rewards. However, this symbolic capital can also function as a mechanism for regulating and reproducing institutional dynamics. Driven by a quest for recognition and the preservation of the field (Silva & Mesquita, 2022), teachers may find themselves drawn into administrative logics that, at times, distance them from the core of teaching practice and reflection on instruction.

These roles give faculty members opportunities to improve the program's organization and participate in discussions about teacher education, potentially benefiting their colleagues as well. However, they can also increase workloads and divert attention from teacher education, intensifying the tension between administration, teaching, and professional development.

In this context of multiple demands, obstacles to teaching practice emerge, particularly regarding collaborative planning, as evidenced in the section of one of the analyzed articles:

The entire course was developed collaboratively. **This process of construction is, naturally, more challenging than working in isolation, and this is also reflected in the actual preparation of the classes.** Content, methods, resources, and other strategies are systematically discussed and debated beforehand, a process that requires more preparation time and a well-developed perspective regarding the importance, relevance, and understanding of the essentials. (Muscardi, Cornelio, 2020, p. 12) (emphasis added)

The excerpt highlights that the collective development of the course, while fostering dialogue and reflection on teaching elements, also intensifies the demands of the teaching role, particularly due to the increased planning time and the constant negotiations required to reach consensus. These challenges can be understood in light of Cunha (2019), considering that the culture of higher education remains characterized by a valuing of individual performance, which hinders the consolidation of collaborative practices.

On the other hand, the experience described in the article runs counter to this logic by demonstrating an openness to dialogue and a willingness to work together. Although more demanding, this collective approach fosters the development of more coherent proposals, indicating that collaboration can enhance teaching practice, even in the face of challenges.

Thus, spaces for continuing education, as advocated by Radetzke and Güllich (2021) in their study, emerge as an alternative for fostering dialogue and reflection regarding both individual and collaborative practices. This perspective is further reinforced by Marinho, Silva, and Paula (2021, p. 10), who state that continuing education should enable epistemological and attitudinal changes in teachers to enhance the quality of their work.

Thus, the need for continuous professional development becomes evident. This involves many situations throughout one's professional journey, requiring constant reflection and the reconstruction of practices. Such a collaborative process requires a willingness to exchange ideas and negotiate differences. It can generate conflict and call for skills that faculty members have not necessarily developed during their careers.

Thus, the adoption of collaborative practices requires not only faculty initiative but also institutional conditions to support them, particularly regarding the accounting of workload hours.

The need for such conditions also extends to the university context. Another article mentions external obstacles that directly affect teaching practice, as can be seen below:

The professors mentioned issues regarding public educational policies and their influence on university teaching, as well as matters of funding and investment in Brazilian education and universities, and the extent to which this affects the work of faculty members. (Berger; Pereira; Costa, 2020, p. 10)

The participating teachers describe challenges they have faced in the profession, highlighting how political and financial factors shape their work. One example is CNE/CP Resolution number 2/2019, which sought to require the restructuring of teacher training education degree programs, impacting teachers' decisions and practices.

Thus, a tension becomes evident in the process of curriculum development: although the curriculum of the Chemistry teacher education program is designed by its faculty, it is also shaped by regulatory frameworks that guide and, to some extent, constrain its organization. This approach seeks to align initial teacher education with the requirements of the National Common Curricular Base (BNCC), reinforcing the expectation that future teachers will help their students in basic education develop the competencies established in that document.

The National Common Curricular Base works as a regulatory instrument that extends beyond basic education to also guide teacher training. Under the rhetoric of standardization and ensuring equal access to knowledge for all, a purported homogenization of training is produced. As Brandão, Cruz, and Fernandes (2019) point out, this disregards diverse contexts and contributes to the construction of fixed identities among students.

This political decision also has implications that range from curricular structure to the professional profile of teacher education students. The alignment of the National Common Curricular Base (BNCC) with the National Common Base for Teacher Education (BNC-Formação) limits the autonomy of teachers, schools, and teacher training programs (Costa; Cunha, 2022). This is because the development and implementation of these frameworks disregard the specific circumstances and contributions of the researchers and teacher educators who experience the realities of their universities and the contexts in which they operate.

Furthermore, homogenizing discourses, such as that of the BNCC, disregard not only the contexts in which schools and universities are situated but also the need to understand the school as a social and inclusive space. These aspects must be incorporated into initial and continuing teacher education curricula. As Teixeira Júnior and Souza (2019, p. 47) highlight:

“This demonstrates the need for higher education institutions to include, in the preparation of future teachers, issues regarding the challenges of including students with special educational needs” (Teixeira Júnior & Souza, 2019, p. 47).

Without this incorporation, the goal of an inclusive school is likely to be weakened. When these issues are meaningfully addressed, teachers are more opportunities to feel prepared to support the

learning of all students. However, as Sacristán (2017) argues, what is set out in official documents does not automatically become reality in practice; the curriculum takes shape through teachers' everyday work.

Thus, simply including the theme of inclusion in curricular texts is insufficient; it is essential for teachers to critically examine the concept and translate it into pedagogical actions. This scenario underscores the need for a critical stance toward regulations, considering both their limitations and possibilities, so that inclusion moves beyond being merely a formal principle and begins to effectively guide teaching practice.

In summary, the articles analyzed made it possible to identify the various challenges teacher educators face throughout their careers. Although many of these obstacles lack immediate solutions, collaborative practices and initiatives are evident that seek to alleviate this situation or mitigate emerging problems. Thus, this category allows for the articulation of both the primary obstacles arising in this context and their implications for teaching practice.

FINAL CONSIDERATIONS

Studies in the field of teacher education have advanced over the years, particularly in terms of understanding the role and characteristics of teachers within their respective educational contexts. Teacher educators are responsible for contributing to the development of the future teacher's professional profile. Research highlights the need to understand how these educators conduct classes in teacher training programs and how teaching knowledge is mobilized (Silva & Ferreira, 2021; Guimarães, Massena, & Siqueira, 2021). Therefore, this article aimed to analyze how publications address the teaching practice of chemistry teacher educators.

The analysis showed that faculty members' pedagogical decisions are shaped by a range of factors rather than made at random. Among these, the university context is highlighted, which dictates the scope and limitations of teaching practice; the selection of topics and content, reflecting concerns regarding relevance and curricular organization; the use of instructional resources, particularly for addressing complex material; and initiatives aimed at the professional development of future teachers, demonstrating an intentionality that extends beyond the mere transmission of knowledge. Furthermore, the analysis highlights the obstacles faced by faculty members, which directly influence these choices and the organization of university classes.

It became evident, based on the *a priori* category, that the instructor tends to tailor the course to their own intentions, meaning the prominence of a specific topic depends on what the teacher deems most important to address in class rather than necessarily what is outlined in the syllabus, corroborating Sacristán's (2017) observations regarding the gap between official document requirements and actual teaching practice.

This article highlights a research trend of addressing the challenges faced by educators, as observed in various studies spanning teaching, research, and outreach. However, a distinction exists between university faculty and those at Federal Institutes. This difference is particularly evident in the realm of research: while universities value research as a core function of the educator, accompanied by

institutional recognition, faculty at Federal Institutes report a lack of support for such activities, a situation that hinders engagement in this aspect of their work and, at times, discourages it altogether.

The review revealed a lack of studies aimed at identifying or monitoring ways to overcome existing obstacles, as well as a scarcity of research delving into the practice of chemistry teacher educators. This context raises a question: “What does the university educator's practice look like beyond the challenges they face?” This question can guide discussions in the field, such as which forms of knowledge are mobilized and how this professional's practice contributes to teacher training. Further research is needed on the relationship between the curriculum of the Chemistry teacher education program and actual teaching practice. Such studies could clarify where curriculum proposals align with or diverge from classroom realities, as well as the role of teacher educators within universities.

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The content of the research text is within the manuscript.

AUTHOR'S CONTRIBUTIONS

Author 1 – Study conceptualization, data collection, writing, data analysis, and drafting the text.

Author 2 – Study conceptualization and supervision, drafting, and revision of the final text.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest regarding this article.