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The difficulties in teaching chemical solutions: a dialogic analysis of academic abstracts

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ABSTRACT

This paper investigates how academic discourse constructs the topic of difficulties in the teaching-learning process of Chemical Solutions. From the perspective of Dialogic Discourse Analysis (DDA), this study analyzes a corpus consisting of three scientific paper abstracts from the Chemistry Education field. The qualitative-interpretivist analysis focuses on identifying the voices, axiological positions, and dialogic relations that constitute the utterances. The results demonstrate that the discourse on the topic is not univocal, manifesting in at least three different discursive projects: one that anchors the problem in students' prior conceptions, valuing diagnosis; a second that emphasizes the adaptation of teaching praxis to specific contexts; and a third that positions research as a resource for teacher education. It is concluded that DDA is a powerful tool for unveiling the tensions and silences within the scientific discourse of the field, revealing different ways of framing and valuing pedagogical challenges.

KEYWORDS: Chemistry Education; Chemistry Solutions; Dialogic Discourse Analysis; Academic Discourse; Teacher Education.

As dificuldades no ensino de soluções químicas: uma análise dialógica de resumos acadêmicos

RESUMO

Este artigo investiga como o discurso acadêmico constrói a temática das dificuldades no processo de ensino-aprendizagem do conteúdo de Soluções Químicas. À luz da perspectiva da Análise Dialógica do Discurso (ADD), analisa-se um corpus constituído por três resumos de artigos científicos da área de Ensino de Química. A análise, de cunho qualitativo-interpretativista, foca na identificação das vozes, dos posicionamentos valorativos e das relações dialógicas que constituem os enunciados. Os resultados evidenciam que o discurso sobre o tema não é unívoco, manifestando-se em, pelo menos, três diferentes projetos de dizer: um que ancora o problema nas concepções prévias dos estudantes, valorizando o diagnóstico; outro que enfatiza a adaptação da práxis docente a contextos específicos; e um terceiro que posiciona a pesquisa como subsídio para a formação de professores. Conclui-se que a ADD é uma ferramenta potente para desvelar as tensões e os silêncios do discurso científico da área, revelando diferentes formas de enquadrar e valorar os desafios pedagógicos.

PALAVRAS-CHAVE: Ensino de Química; Soluções químicas; Análise Dialógica do Discurso; Discurso Acadêmico; Formação de Professores.

INTRODUCTION

The learning of chemical concepts represents a recognized and, to some extent, persistent challenge, especially regarding the content of "solutions," present in the syllabus of the second year of High School. The literature consistently points to this content as a core of conceptual and operational difficulties for students (Albano & Delou, 2024; Elguesabal, 2021; Hemann et al., 2024; Santos & Carneiro, 2023). Such obstacles are multifactorial, ranging from the abstract nature of particles and interactions at the microscopic level, which requires considerable abstraction effort, to the inherent conceptual complexity of the topic, which demands the integration of Physics knowledge and the application of mathematical calculations.

Aggravating this scenario, the difficulty in transiting and articulating the multiple levels of representation in Chemistry – macroscopic, microscopic, and symbolic (Johnstone, 1993) – acts as a central barrier, being frequently associated with students' alternative conceptions, such as the misunderstanding of the particulate nature of matter in solution (Catiavala et al., 2022). Additionally, methodological and structural factors, such as the predominance of traditional teaching approaches, the lack of contextualization, the scarcity of experimental activities, and the lack of adequate laboratory infrastructure, contribute to the perpetuation of the problem. In this sense, the relevance of investigating the ways in which this theme is discursively treated lies not only in the importance of solutions content as a basis for Chemistry but also in its wide application in everyday life and technology (Albano & Delou, 2024; Assai & Bedin, 2024).

Given this panorama, academic discourse in the field of Chemistry Education seeks not only to diagnose problems but also to propose, discuss, and validate strategies for overcoming them (Assai & Bedin, 2024; Elguesabal, 2021; Silva et al., 2024). It is precisely on this discourse that the present article focuses, proposing to analyze how the discourse on learning difficulties in chemical solutions in high school is constructed. The corpus of analysis consists of a set of three abstracts of scientific articles dealing with the referred theme.

The central objective of this work is, therefore, to analyze, from the perspective of Dialogic Discourse Analysis (DDA), how difficulties in learning chemical solutions are thematicized and discursively constructed in the selected abstracts, seeking to understand the voices and dialogic relations that constitute them. The choice of DDA as a theoretical-methodological framework is justified by its capacity to go beyond formal linguistic analysis (Stella & Storto, 2025), understanding the utterance as a social, historical, and ideological practice. In this perspective, proposed by Bakhtin and the Circle, language materializes in concrete utterances, considered links in the chain of discursive communication (Bakhtin, 2016; Brait, 2016; Lima, 2021, 2023; Voloshinov, 2018).

Every utterance, even an abstract, is unique, emanates from subjects situated in a sphere of human activity, and is constituted dialogically, responding to previous utterances and anticipating future responses (Bakhtin, 2016; Brait, 2016; Voloshinov, 2018). DDA allows, thus, investigating academic discourse beyond its textual surface, revealing the interactions of social voices (the voice of the researcher, of the theory they mobilize, of the research they cite, of the current educational policies, etc.) and the axiological positions that constitute it. It is, therefore, a productive theoretical lens to explore how the authors of the abstracts, even in a concise textual genre, dialogue with previous literature and with different pedagogical approaches to frame and signify the problem of learning difficulties in Chemistry.

With a view to achieving the proposed objective, this work is organized into four more sections, in addition to this introduction. In the following section, we deepen the theoretical-methodological framework, detailing the concepts of Dialogic Discourse Analysis that ground the analysis. The third section presents the methodological procedures, including the criteria for corpus selection and the steps of the analysis. Next, in the fourth section, we present and discuss the results of the analysis of the abstracts. Finally, in the final considerations, we resume the main findings, point out the implications of the study, and suggest directions for future research.

THEORETICAL-METHODOLOGICAL FRAMEWORK

The analysis of the discourse on the difficulties in the teaching-learning of chemical solutions, as manifested in the selected abstracts, will be carried out under the perspective of Dialogic Discourse Analysis (DDA). Among the various possible textual analysis approaches in the field of Science Education, including those already discussed in this journal (Vieira & Almeida, 2021), this approach, grounded in the works of the Bakhtin Circle, focuses on language in its concrete and social manifestation, differentiating itself from linguistic approaches that focus only on the abstract system of language (Boenavides, 2022; Brait et al., 2025). The objective of DDA, or metalinguistics, is to understand the functioning of living language, in use, in the various spheres of human activity.

The pillar of this perspective is the concrete utterance, considered the real unit of verbal communication. Unlike the abstract units of language, such as the word or the sentence, the utterance is a totality of meaning: it possesses authorship, expresses a position, and is delimited by the alternation of speaking subjects, always awaiting a responsive attitude from the other (Bakhtin, 2016; Voloshinov, 2018). In this study, each scientific article abstract will be treated as a concrete utterance, a singular unit of analysis representative of a position in the academic sphere (Lima, 2023).

Language itself is, therefore, conceived as a social event, materialized in utterances that only exist in dialogic communication. Every utterance is intrinsically dialogic: it responds to previous utterances and is oriented toward a future response, constituting a link in the continuous chain of communication (Voloshinov, 2018). This principle is fundamental to the present research, as it will allow for the analysis of how abstracts on difficulties in Chemistry dialogue with previous research, with pedagogical theories, and with other discourses circulating in society regarding teaching and learning.

Utterances do not arise in a vacuum; they are organized into speech genres, which are relatively stable types of utterances elaborated by each sphere of human activity. The sphere analyzed here is the scientific-academic one, which has elaborated, among others, the "article abstract" genre. Like every genre, it possesses a thematic content, a verbal style, and a compositional structure that are characteristic of it and that both enable and restrict the author's "will-to-say" (Bakhtin, 1997; 2016).

This intentionality of the author, that is, their "will-to-say," is inseparable from their axiological position, meaning their value judgment on the discourse topic. There are no neutral utterances (Bakhtin, 2008; 2016). The analysis will, therefore, seek to identify how the authors' evaluative positioning manifests in the selection of linguistic resources (style) and in the text organization (compositional construction) to characterize learning difficulties – whether as a student's problem, a method problem, a curriculum problem, among other possibilities.

Fundamental to this analysis is the polyphonic nature of discourse. Every utterance is double-voiced, or rather, polyphonic, as it is traversed by multiple social voices (Bakhtin, 2016; Lima, 2021, 2023). "Every discourse is inevitably oriented toward other discourses and participates '[...] in a kind of large-scale ideological discussion: it responds, refutes, or confirms something, anticipates possible responses and criticisms, seeks support, and so on' (Voloshinov, 2018, p. 219)".

Thus, the dialogic analysis will seek to identify and "listen to" the different voices that constitute the discourse of the abstracts. The investigation will attend to the voice of the researcher-author themselves, as well as to the voice of theoretical discourse, which echoes concepts and authors from Chemistry, Chemistry Education, and DDA itself. In addition to these, the presence of the voice of official discourse will be analyzed, manifest in curricula and educational documents, and, crucially, the voices of the subjects of pedagogical practice: that of the students, as represented and interpreted by the researchers, and that of basic education teachers, when their practices are thematized.

These dialogic relations between voices can be explicit, as in citations, or implicit, as in allusions or in a hidden polemic, in which disagreement with another discourse manifests subtly (Bakhtin, 2018). Finally, it is worth highlighting that dialogic analysis is not the application of a rigid method, but an interpretive process in which the researcher also assumes a dialogic stance with their corpus. It is a movement of approaching to understand the utterance in its singularity and distancing to reflect on how it participates in a broader social and ideological dialogue (Lima, 2021).

The application of the dialogic perspective to the field of Science Education, and specifically to Chemistry Education, proves to be particularly productive. The scientific-pedagogical discourse is not merely a vehicle for the transmission of concepts, but a space of clash between different voices: the voice of consolidated scientific theory, the voice of students' prior conceptions, the voice of the textbook, and the voice of curricular policies. Understanding Chemistry teaching as a process of initiating students into a new and complex speech genre, with its own valuations and rules, allows the researcher and the teacher a broader view of learning challenges, treating them not as mere “errors,” but as part of a complex dialogic process of appropriating a new way of seeing and speaking the world.

In summary, this theoretical framework guides the analysis based on the understanding of language as a dialogic, historical, and social phenomenon. The focus lies on the abstract as a concrete utterance, seeking to interpret the social voices and dialogic relations that discursively construct the theme of difficulties in teaching chemical solutions, revealing the axiological positions that sustain this construction.

METHODOLOGICAL PATH

This research is characterized by a qualitative approach of an interpretivist nature (Denzin & Lincoln, 2006), grounded in the theoretical-methodological assumptions of Dialogic Discourse Analysis (DDA). The objective does not lie in the quantification of data, but in the in-depth understanding of how the discourse on learning difficulties in Chemical Solutions is constructed, valued, and disputed in concrete utterances of the academic sphere.

It is necessary here to justify the choice of the "abstract" speech genre as the corpus of analysis, a central decision for the objectives of this work. Far from being understood as a preliminary or incomplete version of the article, the abstract is treated here, from the

perspective of DDA, as a concrete and autonomous utterance (Bakhtin, 2016). It constitutes a speech genre with a specific social function: to present and legitimize the research before the scientific community. In this space of maximum condensation, voices are strategically selected, axiological positions are affirmed, and the dialogue with the field takes place in an intense and direct manner. The option for this cutout, therefore, is not a limitation, but a deliberate choice to investigate the power of the theory itself in unveiling the complex discursive architecture in the most visible and widely circulated face of academic production.

The research corpus consists of three scientific article abstracts, the full texts of which are available in Appendix A. The selection started from a search in the CAPES Periodicals Portal (with a temporal frame from 2020 to 2025) using the descriptors "ensino de química" [chemistry teaching] AND "soluções" [solutions]. The initial search returned a total of 33 works. After applying inclusion criteria – (i) being a complete scientific article; (ii) having the content of Solutions as a central focus; and (iii) addressing Basic Education – a set of 8 pre-selected articles was reached. From this set, the final selection of the three abstracts that make up the corpus was intentional and paradigmatic. The choice did not aim at quantitative representativeness, but at the exploration of distinct and recurrent discursive facets in the field, which were revealed in the analysis: the focus on the diagnosis of prior conceptions (Hemann et al., 2024), the emphasis on intervention through a didactic sequence (Campos et al., 2022), and the perspective of teacher education as a subsidy to practice (Alves & Ribeiro, 2021).

The analysis of the corpus followed procedures inspired by the very nature of DDA, starting from the broader social strata to the linguistic materiality. The analytical path began with a floating reading of each abstract for immersion in the material and understanding of the utterance in its totality. In a second moment, the recurrent thematic axes were identified, focusing on how "learning difficulties" and "proposals for overcoming" were articulated. Based on these axes, the mapping of the social voices (of the researcher, of the theory, of the research subjects, etc.) that constituted each utterance was proceeded. Finally, the analysis deepened into the interpretation of the axiological positioning and the investigation of hidden polemics, seeking to unveil the discursive tensions and the values underlying the construction of each text.

ANALYSIS AND DISCUSSION: DISCOURSES ON TEACHING SOLUTIONS

In this section, we undertake the dialogic analysis of the corpus, aiming to investigate how academic discourse on learning difficulties in Chemical Solutions is constructed. The analysis is organized into thematic axes that emerged from reading the utterances, seeking to unveil the voices, axiological positions, and dialogic relations that constitute each abstract.

THE CONSTRUCTION OF THE "PROBLEM": THEMATIZING LEARNING DIFFICULTIES

The first axis of analysis focuses on how the abstracts thematize and frame the "problem" of teaching Solutions. It is observed that, although all start from a common premise — the existence of significant challenges —, they do so by mobilizing voices and valuing distinct aspects of the phenomenon.

In Abstract 1 (A1), the problem is constructed from the learner's perspective, with an explicit focus on students' "prior conceptions". The discourse of this abstract double-

voices a strong research tradition in Science Education, which values diagnosis as a primordial stage of the pedagogical process. By stating that the questionnaire was structured based on "specific categories of learning difficulties", the utterance dialogues directly with an already consolidated theoretical-methodological discourse, which seeks to categorize and understand students' gaps in understanding, such as the difficulty in "articulating the macroscopic and submicroscopic levels". The valuation (axiology) here is clear: the student's prior knowledge is not a vacuum, but a territory with "partial ideas and conceptual misconceptions" that needs to be known to be overcome.

Abstract 2 (A2), while also recognizing the challenge, shifts the initial focus from the student to the intrinsic nature of the content and the method. The problem is presented as a challenge where Chemistry involves "mathematical tools that are frequently difficult for students" and presents a "high degree of abstraction". The voice that predominates here is that of a broader pedagogical discourse, which recognizes the epistemological barriers of certain disciplines. The discursive solution to this problem is the "correlation of content with everyday themes" and the adaptation of strategies for the emergency context of the pandemic. The evaluative positioning, therefore, falls on teaching praxis and its capacity for adaptation and contextualization as a way to mitigate a problem inherent to the content.

In turn, Abstract 3 (A3) frames the problem from an investigative perspective on teaching practice. The guiding question — "how the didactic strategies and activities of Chemistry teachers are configured and expressed" — positions the "problem" not so much in the student or the content, but in the need to understand and, consequently, intervene in the teacher's action. The utterance dialogues with the field of teacher education and professional development, a recurrent theme of great interest in the debate on science teaching, including in this journal (Nascimento et al., 2021), especially when mentioning PIBID. The objective of "contributing to the resolution of problems" through an "educational product" reveals an axiological position that values academic research as a tool for direct support to the teacher's pedagogical practice in the classroom.

POINTING OUT "SOLUTIONS": THE CONSTRUCTION OF PEDAGOGICAL PROPOSALS

The way each utterance discursively constructs a "solution" to the problem of learning difficulties is directly linked to how it framed the problem itself. The pedagogical proposals reveal an intense dialogue with different theoretical currents and value distinct actions on the part of the teacher and students.

In Abstract 1 (A1), the solution to the "gaps in understanding" emerges as a direct consequence of the diagnosis. The discourse is constructed around a procedural logic: first, it is necessary to "identify prior conceptions" to then plan the intervention. The voice echoing in this utterance is that of a constructivist-based pedagogy, which understands learning as a restructuring of pre-existing mental schemas. The valuation of this approach also refers to the voice of authors like Ausubel and Moreira who state that prior knowledge (previous experiences and knowledge) is fundamental for the construction of meaningful learning (MOREIRA, 2011). This finding is explicit when the authors affirm the "importance of diagnosing prior conceptions as a starting point". The act of "diagnosing" is, therefore, axiologically positioned as a scientific practice fundamental for the consolidation of meaningful learning.

From this diagnosis, the proposal for action materializes in the defense of "investigative strategies" and "experimental activities". By choosing these terms, A1 engages in a hidden polemic with merely transmissive or theoretical teaching approaches.

It is important to emphasize that the hidden polemic pointed out here does not reside in the practice of the experimental activity itself, which can assume multiple formats, but in the enunciative act of qualifying it as 'investigative'. In the discursive field of Science Education, the adjective 'investigative' is loaded with value and double-voices a pedagogical tradition that opposes teaching based on the mere transmission and memorization of concepts. By choosing this term, the author aligns their work with a specific current and, implicitly, distances themselves from others, constructing their positioning through this strategic lexical choice.

The valuation is positive and directed towards an active teaching practice, which promotes investigation instead of the simple exposition of content. The final objective, of "promoting the overcoming of these difficulties", ties the discursive path together, positioning investigative strategies not as an end in themselves, but as the most effective means to achieve the "construction of more robust and contextualized scientific knowledge". The discourse of A1, therefore, constructs a cohesive narrative where the rigorous diagnosis of students' conceptions legitimizes and orients the adoption of an investigative praxis.

If Abstract 1 anchors its proposal in the need for a prior diagnosis, Abstract 2 (A2) constructs its solution from the need for adaptation to an adverse context — emergency remote teaching. The utterance starts from the recognition of the "challenge" that the theme represents, but quickly points to a pragmatic and contextual solution: the "correlation of content with everyday themes". The voice manifesting here is that of a pedagogy that values contextualization as a tool for engagement, with the promise of "adding motivational character" to learning.

The materialization of this proposal occurs through the elaboration of a "didactic sequence (DS)", which is described as a multifaceted solution, including "different tools, including synchronous and asynchronous classes, videos, reports, titration simulator, and Socrative questionnaire". The discourse of A2, therefore, values the diversity of instruments and the teacher's flexibility as a response to the limitations imposed by the pandemic. The success of this approach is validated in the text by the results presented: the strategy generated "cognitive gains" considered "significant" and had a positive reception, as the students "liked the activities".

Unlike A1, which focuses on "mapping" the difficulty, A2 focuses on "overcoming" the difficulty through engagement and the application of a diversified and contextualized methodology. The axiological positioning of A2 resides, therefore, in the valuation of innovation and teaching resilience in the face of challenges, presenting the Didactic Sequence not only as a teaching tool but as proof of a successful experience of pedagogical adaptation. In this sense, the very choice of a "Didactic Sequence" as a solution instigates a hidden polemic with more traditional and linear teaching practices. By highlighting the need to diversify tools and correlate with everyday life to generate motivation and "cognitive gains", the utterance, even if implicitly, assesses approaches that do not follow this same path as insufficient or less satisfactory.

Finally, Abstract 3 (A3) presents a third discursive path for the construction of the "solution". The utterance starts from an explicit desire to "contribute to the resolution of problems" of teaching, but conditions its proposal on a prior investigation of teaching practice. The choice of participants, "four supervisor teachers of the Institutional

Scholarship Program for Teaching Initiation (PIBID)", is a discursive act that broadens the scope of the proposal. By focusing on PIBID supervisors, the utterance establishes a dialogue not only with the in-service teacher but also, implicitly, with initial teacher education.

The "solution" here is materialized in a very concrete form: an "educational product" in the form of a "didactic sequence". The proposal, therefore, does not aim only at the supervisor's practice, but also at the training of the undergraduates they guide. The prevailing voice is that of applied research, which seeks to generate tangible results to "support the teacher in their pedagogical practice". The axiological positioning is clear: research that not only describes reality but acts upon it, serving as a bridge between academia and the school, and strengthening the teacher education cycle, is valued.

THE GAPS IN DISCOURSE: SILENCES AND POSSIBLE HORIZONS

An attentive dialogic analysis turns not only to the voices present but also to the significant silences of an utterance. By examining the corpus as a whole, some discursive gaps are perceived, that is, themes expected in the contemporary debate on teaching that are not explicitly mobilized by the authors to reinforce their arguments, revealing the boundaries and priorities of the analyzed discourse.

A first notable gap is the absence of an explicit dialogue with national curricular policies, such as the National Common Curricular Base (BNCC). Although A2 mentions the need for adaptation to an emergency context and A3 is linked to an institutional program like PIBID, there is no direct double-voicing in the abstracts with the official discourse of the BNCC to legitimize their pedagogical proposals. This absence is significant, as the official document frequently serves as a voice of authority to justify innovative practices or the development of specific competencies. This silence may suggest that, for these authors, the legitimization of their proposals occurs more through dialogue with pedagogical theory and local practice than through adherence to a prescriptive national policy.

Another relevant silence concerns the material and structural conditions of the school. With the exception of A2, which contextualizes its research in "emergency remote teaching", the abstracts do not thematize the infrastructure conditions of the school, such as laboratories or access to technologies, as a determinant factor for learning difficulties or for the feasibility of the proposed solutions. Although A1 values "experimental activities", it does not discuss the existence (or lack) of a laboratory to carry them out. This silence may indicate a discourse that prioritizes the student's cognitive aspects (A1) and the teacher's pedagogical strategy (A2, A3), placing material conditions in the background or assuming them as given.

This discursive silencing is relevant, as it reveals an axiological positioning that, by focusing on the teacher's pedagogical strategy as the engine of change, ends up attenuating the responsibility of public policies and school management in ensuring conditions for quality teaching. The emphasis on “how to teach” thus overlaps with the discussion on “what to teach with”, a recurrent tension in Brazilian educational discourse that the analyzed utterances opt not to thematize directly.

Finally, a gap is observed regarding continuous teacher education. While A3 demonstrates a concern with initial training by linking to PIBID, the discourse on the need for continuous education so that "in-service" teachers can apply investigative strategies (A1) or multiple digital tools (A2) is not explicitly addressed. A2 mentions that the

pandemic "forced education professionals to adapt their strategies", but does not enter into the discussion of whether these professionals had the necessary formative support for such.

These gaps do not diminish the value of the analyzed works, but, on the contrary, illuminate their discursive projects. It is fundamental to highlight that pointing out these silences is not a criticism of the quality of the original works, but rather an analysis of what the 'abstract' genre prioritizes enunciating. The fact that material conditions or curricular policies are frequently silenced in this first utterance of research presentation is a relevant discursive datum, which reveals much about how the field frames and values the different factors influencing the teaching-learning process.

DIALOGIC SYNTHESIS: TENSIONS AND CONSONANCES IN ACADEMIC DISCOURSE

When placing the three utterances in direct dialogue, tensions and consonances emerge that reveal the complexity of the field of Chemistry Education. A tension emerges, for example, between the discourse that locates the origin of the problem in the student's cognitive structures, demanding a diagnosis (A1), and discourses that focus on action and teaching strategy as the main route of solution (A2 and A3). While the former values "mapping" the difficulty, the others value "acting" upon it through planned interventions. On the other hand, there is a clear consonance between A2 and A3 in valuing the "didactic sequence" as the ideal speech genre to materialize the pedagogical solution, indicating a trend in the field. This heterogeneity of voices and approaches demonstrates that the academic discourse on teaching Solutions does not seek a single answer but constitutes a living field of debate, where different discursive projects dispute the meaning of how best to understand and transform educational practice.

MAPPING SOCIAL VOICES: BETWEEN DIAGNOSIS AND INTERVENTION

A deeper dialogic analysis allows mapping the predominant social voices that constitute the utterances, revealing not only what is said, but *from where* it is spoken. In the analyzed abstracts, it is possible to identify the predominance of two major pedagogical voices that construct the researcher-author in different ways: the diagnostic voice and the pragmatic-interventionist voice. Both, in turn, rely on a third common voice, that of theory, as a form of legitimation.

The diagnostic voice is the one that resonates most in Abstract 1. It materializes in a lexicon that refers to the field of health sciences and learning psychology, with terms such as "diagnosis", "specific categories of difficulties", "conceptual patterns", and "gaps in understanding". The subject-author constructed by this voice is that of the researcher-analyst, who positions themselves to observe, categorize, and understand a phenomenon (prior conceptions) as an essential step before any intervention. It is a voice that values scientific investigation as an act of precise mapping of the student's reality.

In counterpoint, the pragmatic-interventionist voice predominates in Abstracts 2 and 3. This voice is constituted by a lexicon of action and application, such as "didactic sequence", "tools", "educational product", and "supporting the teacher". The subject-author here is that of the researcher-proposer, who, although starting from a problem, quickly moves to the construction and validation of a practical solution. The valuation is not in the act of mapping the problem, but in creating an instrument to resolve it. It is a voice that legitimizes itself through its direct contribution to pedagogical practice.

Both pedagogical voices, although distinct in their focus, rely on the same voice of authority to legitimize themselves in the academic field: the voice of theory. Whether by mentioning "Discursive Textual Analysis" (A1) or by implicit reference to project-based pedagogies (A2 and A3), the utterances double-voice with theoretical discourse to confer rigor and validity to their statements. This voice functions as a guarantor, a safe place from which both diagnosis and intervention can be enunciated as scientific practices and not as mere activism or opinion.

FINAL CONSIDERATIONS

This article sought to investigate how academic discourse constructs the theme of learning difficulties in Chemical Solutions. Based on the Dialogic Discourse Analysis (DDA) of three scientific abstracts, it evidenced that this discourse is not univocal, but manifests itself in at least three different discursive projects: one that anchors the problem in students' prior conceptions, valuing diagnosis as a starting point for intervention (A1); another that emphasizes the adaptation of teaching praxis through diversified strategies as a response to an adverse context (A2); and a third that positions research as a bridge for initial and continuing teacher education through the development of educational products (A3). It was also possible to perceive that there are significant silences in these discourses, such as the little exploration of the school's material conditions and a still incipient dialogue with national curricular policies.

The implications of this study are of a theoretical-methodological and pedagogical nature. From a theoretical-methodological point of view, the work demonstrated the productivity of DDA for the field of Chemistry Education, revealing itself as a powerful tool to unveil the voices, values, and ideological tensions that constitute texts in the scientific sphere, going beyond a purely content-based analysis. Pedagogically, identifying the different ways of constructing the "problem" and the "solution" contributes to the field by showing that there is no single approach, inviting teachers and researchers to reflect on the foundations and consequences of their own discourses and pedagogical practices.

This reflection can materialize in practical questioning for the teacher in their classroom: Does the discourse I use to present a learning difficulty describe it as a flaw inherent to the student or as an insurmountable challenge? Do the solutions I propose in my planning dialogue with the realities and contexts of the students or only with the voices of theory and the textbook? Discursive analysis, therefore, transcends purely academic interest and presents itself as a powerful tool for professional teaching development.

However, the limitations of this work are recognized. The cutting of the corpus into three abstracts, although allowing for an in-depth analysis, does not authorize generalizations about the entire discursive field of Chemistry Education. This study, therefore, is configured as an illustrative and localized analysis.

Given this, and based on the observed discursive gaps, future research is suggested that can investigate a broader corpus, deepen the analysis of complete articles to verify if the silences pointed out here are maintained, or explore how themes such as school infrastructure, continuing teacher education, and adherence to the BNCC are (or are not) mobilized to discuss learning difficulties in the area.

APPENDIX A – ANALYZED ABSTRACTS

Below are the texts of the three abstracts that constitute the corpus of this research.

ABSTRACT 1

Title: Analysis of Prior Conceptions of Second-Year High School Students on Chemical Solutions.

Authors: Katiúscia Carla Viezzer Hemann, Fernanda Miotto, José Arthur Martins.

This qualitative study aimed to identify the prior conceptions of high school students about chemical solutions, using a diagnostic pre-questionnaire as the main instrument. The research was conducted with a class of 13 second-year high school students at a school in Caxias do Sul, RS. The questionnaire was structured based on specific categories of learning difficulties, including the understanding of the submicroscopic level, the differentiation between physical and chemical phenomena, the explanation of molecular solubility, and the use of chemical language. The responses were analyzed using Discursive Textual Analysis, allowing the identification of conceptual patterns and gaps in understanding. The results revealed that the majority of students have a limited understanding of chemical solutions, marked by partial ideas and conceptual misconceptions, such as the difficulty in articulating the macroscopic and submicroscopic levels and in differentiating dissociation from dissolution. These findings highlight the importance of diagnosing prior conceptions as a starting point for pedagogical interventions, contributing to the planning of investigative strategies that promote the overcoming of these difficulties. The study reinforces the need for educational practices that integrate experimental activities and investigation, aiming at the construction of more robust and contextualized scientific knowledge.

Keywords: Prior conceptions, chemical solutions, chemistry teaching, discursive textual analysis.

ABSTRACT 2

Title: Student~Teacher~Learner Reflections Throughout a Didactic Sequence for Teaching Solutions in Chemistry Classes During Emergency Remote Teaching.

Authors: Renato Maciel Campos, Priscila Tamiasso-Martinhon, Célia Sousa, Angela Sanches Rocha.

Teaching science subjects at the high school level, such as chemistry, constitutes a challenge because, in addition to involving the use of mathematical tools that are frequently difficult for students, they can present a high degree of abstraction. In this sense, the correlation of content with everyday themes can help in understanding and add motivational character. Therefore, in this work, a didactic sequence (DS) was elaborated to approach the theme of solutions as programmatic content of the chemistry discipline, which was applied in the 3rd year of high school at Cap-UFRJ, in the year 2021, within the scope of emergency teaching. The COVID-19 pandemic forced education professionals to adapt their pedagogical strategies so that teaching would not be interrupted, and the elaborated DS relied on different tools, including synchronous and asynchronous classes, videos, reports, titration simulator, and Socrative questionnaire. The results of student performance and their impressions of the DS obtained through questionnaires indicated that the class's cognitive gains on chemical solutions were significant and that they liked

the activities. Undergraduates from IQ/UFRJ who accompanied the classes also raised positive aspects regarding the teaching praxis, which ratifies the student reports. Studies like this are important for raising reflections on teaching in times of pandemic, with the use of technologies.

Keywords: experience report, student~teacher~learner experienciation, remote teaching.

ABSTRACT 3

Title: A Proposal for a Didactic Sequence for Teaching Solutions.

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This work is an excerpt from a master's research and aims to contribute to the resolution of problems surrounding the concept of Solutions in High School. In this sense, the guiding question of the research is presented: how are the didactic strategies and activities of Chemistry teachers configured and expressed when reporting on the teaching of the Solutions concept they carry out in Basic Education? The research participants were four supervisor teachers of the Institutional Scholarship Program for Teaching Initiation (PIBID) in Chemistry of the Chemistry Degree course at the Federal University of Mato Grosso (UFMT). Thus, to elucidate the guiding question, qualitative research methodology is used, having the case study as an approach. The instruments for data collection were: online questionnaires, semi-structured interviews, articles related to the teaching of Solutions, textbooks, and the application of information and communication technology (ICT). Thus, with the purpose of contributing to the resolution of teaching and learning problems surrounding this concept, an educational product is proposed as a teaching strategy, by means of a didactic sequence, in an attempt to support the teacher in their pedagogical practice.

Keywords: Chemistry Teaching. Educational Product. Didactic Sequence. Teaching Solutions.

NOTES

Translation from Portuguese to English provided by Cleiton Constantino Oliveira, holding a Degree in Letters - English from the State University of Rio Grande do Norte (UERN). Contact: cleitonufsc@gmail.com

REFERENCES

Albano, W. M., & Delou, C. M. C. (2024). Principais dificuldades descritas na aprendizagem de química para o Ensino Médio: revisão sistemática. *Debates em Educação*, *16*(38). https://periodicos.ufmg.br/index.php/debateseducacao/article/view/16890

Alves, H. R., & Ribeiro, M. T. D. (2021). Uma proposta de sequência didática para o ensino de soluções. *Insignare Scientia*, *4*(4), 371–394. https://periodicoscientificos.ufmt.br/ojs/index.php/reamec/article/view/9748/pdf_1

Assai, N. C. de, & Bedin, E. (2024). Resolução de problemas no ensino de química: uma revisão integrativa. *Diálogo Educacional*, *22*(75), 1957–1982. https://periodicos.pucpr.br/dialogoeducacional/article/view/31143/26903

Bakhtin, M. (2016a). Os gêneros do discurso. In M. Bakhtin, *Os gêneros do discurso* (pp. 11–70). Editora 34.

Bakhtin, M. (2016b). O texto na linguística, na filologia e em outras ciências humanas. In M. Bakhtin, *Os gêneros do discurso* (pp. 71–107). Editora 34.

Bakhtin, M. (2018). *Problemas da poética de Dostoiévski* (5ª ed., P. Bezerra, Trad.). Forense Universitária.

Boenavides, D. L. P. (2022). Publicação e recepção das obras do Círculo de Bakhtin no Brasil: a consolidação da análise dialógica do discurso. *Bakhtiniana. Revista de Estudos do Discurso*, *17*(4), 104–131. https://revistas.pucsp.br/index.php/bakhtiniana/article/view/56378

Brait, B., Souza, G. T., Amorim, M., Faria e Silva, A. P. P., Pistori, M. H. C., Rosa, C. G., Stella, P. R., & Storto, L. J. (2024). Bakhtin e a Linguística: um diálogo iniciado nos anos 1920. *Bakhtiniana. Revista de Estudos do Discurso*, *20*(1). https://revistas.pucsp.br/index.php/bakhtiniana/article/view/66039

Brait, B. (2013). Olhar e ler: verbo-visualidade em perspectiva dialógica. *Bakhtiniana. Revista de Estudos do Discurso*, *8*(2), 43–66. https://revistas.pucsp.br/index.php/bakhtiniana/article/view/16568

Campos, R. M., et al. (2022). Reflexões discente-docente-aprendente ao longo de uma sequência didática para ensino de soluções em aulas de química durante o ensino remoto emergencial. *Química Nova na Escola*, *44*(1), 69–79. https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/59802/43225

Catiavala, H. S. A., et al. (2022). Concepções de estudantes de licenciatura em ensino da química sobre os conceitos de solução, soluto e solvente. *Recima21*, *3*(11), e3112613. https://recima21.com.br/index.php/recima21/article/view/2613

Denzin, N. K., & Lincoln, Y. S. (Orgs.). (2006). *O planejamento da pesquisa qualitativa: teorias e abordagens* (2ª ed.). Artmed.

Elguesabal, R. S. (2022). *Uma sequência didática para o ensino de soluções com enfoque CTS a partir do soro caseiro* [Dissertação de Mestrado, Universidade de Caxias do Sul]. https://bdtd.ibict.br/vufind/Record/URGS_c530131023d15082e2774b92e904cd20

Hemann, K. C. V., Miotto, F., & Martins, J. A. (2024). Análise das concepções prévias de estudantes do segundo ano do Ensino Médio sobre soluções químicas. *Scientia cum Industria*, *13*(2), e241313. https://sou.ucs.br/etc/revistas/index.php/scientiacumindustria/article/view/13366

Johnstone, A. H. (1993). The development of chemistry teaching: A changing response to changing demand. *Journal of Chemical Education*, *70*(9), 701–705.

Lima, S. C. (2021). Ensino de inglês na escola pública em perspectiva indisciplinar e dialógica. *Revista da Anpoll*, *52*(2), 138–156. https://revistadaanpoll.emnuvens.com.br/revista/article/view/1556

Lima, S. C. (2023). O discurso acadêmico do professor de inglês em perspectiva dialógica. *DELTA: Documentação de Estudos em Linguística Teórica e Aplicada*, *39*(4), e202339455200. https://www.scielo.br/j/delta/a/SmbcJnyXdfcJD7LkgyNYbZt/

Moreira, M. A. (2011). *Aprendizagem significativa: a teoria e textos complementares*. Editora Livraria da Física.

Nascimento, T. G., Massena, E. P., & Leal, G. G. (2021). Formação inicial de professores de ciências e biologia: uma análise de autoscopias. *ACTIO: Docência em Ciências*, *6*(3), 1-22. https://doi.org/10.3895/actio.v6n3.13300

Santos, J. P. A., & Carneiro, C. E. A. (2023). A Educação de jovens e adultos no contexto do ensino de química: uma revisão de literatura sobre as temáticas desenvolvidas. *ACTIO: Docência em Ciências*, *8*(1), 1-25. https://doi.org/10.3895/actio.v8n1.14484

Silva, S. F., Ferreira Júnior, J. M., Paiva, M. M. P. C., & Colares, R. P. (2024). Metodologias ativas no ensino de química. *Revista Ibero-Americana de Extensão e Pesquisa*, *6*(2), 219–232. https://ojs.novapaideia.org/index.php/RIEP/article/view/404

Stella, P. R., & Storto, L. J. (2025). Bakhtin e a Linguística: um diálogo iniciado nos anos 1920. *Bakhtiniana. Revista de Estudos do Discurso*, *20*(1), e66039p. https://doi.org/10.1590/2176-4573p66039

Vieira, K. A., & Almeida, M. J. P. M. (2021). Relações entre textos de divulgação científica da revista Ciência Hoje e livros didáticos para o ensino de química. *ACTIO: Docência em Ciências*, *6*(3), 1-24. https://doi.org/10.3895/actio.v6n3.14562

Volóchinov, V. (2018). *Marxismo e filosofia da linguagem: problemas fundamentais do método sociológico na ciência da linguagem* (S. Grillo & E. V. Américo, Trads.). Editora 34.

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