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Research Article

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Emerging perspectives on equity: reflective writing and social justice in preservice chemistry teachers

Summary

Reflective practice is a crucial component of initial teacher education (ITE), particularly during the practicum or residency phase, as it can guide preservice teachers' pedagogical praxis toward social justice and equity. Based on the written work of residents in a Chemistry Teaching Program, this article analyses the challenges and opportunities that reflection offers for developing this awareness. Through a qualitative study using interpretive analysis of two residents' final projects, we investigate how their reflections on chemistry teaching reveal an emerging awareness (or lack thereof) of social justice and equity dimensions. The findings indicate a predominance of focus on technical and didactic challenges and the use of descriptive and dialogic reflective writing modalities. While signs of sensitivity toward equity emerge—particularly in the concern for all students' understanding and pedagogical clarity—explicitly critical reflection on the structural dimensions of social justice is still incipient or absent. It is concluded that, although reflective practice constitutes fertile ground, initial teacher education (ITE) programmes need to implement more intentional strategies and tools to guide future teachers in connecting their didactic reflections with an active commitment to equity and social justice in the science classroom.

Keywords: reflective practice, initial teacher education (ITE), social justice; educational equity

Volume 9 Issue 1 - 2026

Guillermo Cutrera
Science Education Department, Faculty of Exact and Natural Sciences, National University of Mar del Plata, Buenos Aires, Argentina

Correspondence: Guillermo Cutrera, Science Education Department, Faculty of Exact and Natural Sciences, National University of Mar del Plata, Buenos Aires, Argentina, Funes 3350. CP: 7600

Received: May 30, 2026 | **Published:** June 15, 2026

Introduction

Initial teacher education (ITE) is a crucial stage for developing professionals capable of mastering disciplinary content and pedagogical strategies while understanding and responding to the complex social and cultural realities that classrooms face.[1] In this article, we focus on preservice chemistry teachers' reflective writing during ITE, specifically in the practicum or residency phase, where the tensions between theory and practice, and between disciplinary demands and classroom realities, become particularly salient. Reflective practice has been widely recognized as a fundamental pillar in this context, as it encourages future teachers to critically examine their actions, beliefs, and the contexts in which they teach in order to improve their work and foster ongoing professional development.[1]

At the same time, in recent decades, awareness has grown about the imperative for education to actively contribute to building more just and equitable societies.[3] This directly challenges teacher training, posing the challenge of preparing educators who are competent in their discipline, sensitive to inequalities, and committed to promoting social justice and equity in their educational settings.[4] The question thus arises of how to articulate the established tradition of reflective practice with this imperative of social justice, especially in the training of sciences such as chemistry teachers, where epistemological and didactic challenges often occupy a central place in residents' concerns. This articulation is particularly challenging, as approaching equity and social justice from a teaching perspective involves navigating complex and nuanced terrain, or 'turbulent waters,' as the literature describes.[5]

While the literature recognizes the potential of reflection to uncover and challenge inequities,[6] there is a need to explore further how this potential manifests itself—or could be fostered—in the concrete outputs of preservice teachers. Reflective writing, such as class journals, critical incident analyses, or final residency projects, provides privileged insights into future teachers' thought processes, concerns, and emerging awareness of these dimensions.[7] However, it is not guaranteed that reflection will spontaneously lead to an in-depth analysis of social justice and equity dynamics. It may remain more descriptive or technical if no formative intentionality guides it in that direction.[8]

Given this background, this paper aims to analyze, based on the reflective written work of residents in the Chemistry Teaching Program, the challenges and opportunities that reflective practice offers for developing pedagogical awareness and praxis oriented toward social justice and equity in initial teacher education (ITE), particularly during the practicum/residency phase.

This study is justified by the importance of understanding how future chemistry teachers, through their reflective processes mediated by writing, begin to construct a critical stance toward the inequalities that may manifest in the teaching and learning of science. The findings can offer valuable input for designing strategies and training mechanisms in science education that strengthen teachers' capacity to become agents of change committed to more equitable and inclusive science education.

The article is structured as follows: first, the theoretical framework supporting the research is presented. Next, the results of the analysis of the written work of two residents are presented, illustrating the findings with excerpts from their reflections and summary diagrams. These results are then discussed in light of theory, the challenges and opportunities for initial teacher education (ITE) are explored, and the implications and limitations of the study are highlighted. Finally, the conclusions derived from the research are presented.

Reflective teaching practice as a path to social justice and equity in teacher training

Initial teacher education (ITE) is recognized as a privileged space to promote reflective and systematic learning that allows the future teacher to internalize a reflective practice as a mode of continuous

professional development.[9] In this context, reflection can be understood as the active, persistent, and careful examination of any belief or supposed form of knowledge in light of the foundations that sustain it and the conclusions to which it tends.[10] On the other hand, reflective practice is configured as a process by which teachers analyze what and how they taught, why they did it that way, and how they can modify their practice to improve student learning and promote more equitable environments.[11] Schön[2] delved into this notion, distinguishing between reflection in action and reflection on action, emphasizing that reflective practice is based on the teacher's system of appreciation, which includes their repertoire of values, knowledge, and theories. This process becomes crucial during initial training, as it is when future teachers begin to build and question their philosophies of education, often implicit and deeply rooted.[12]

Within the mechanisms for fostering reflective practice in initial teacher education (ITE), writing occupies a prominent place, not only as a recording technique but as a process intrinsically linked to teacher professional development. Numerous studies highlight that writing is a mediating tool that externalizes reflective thinking, making it visible, analyzable, and susceptible to deeper and more structured review, catalyzing learning from experience.[13] By putting their reflections into writing, preservice teachers can critically distance themselves from their actions, identify dilemmas and patterns, question assumptions, and connect pedagogical theory with the complexities of practice more meaningfully—a cornerstone of professional development.

The specialized literature on teacher reflection and writing analysis has identified various typologies or modalities that capture the depth and focus of the reflective process.[14] These modalities often represent a continuum of complexity and transformative potential. The first level corresponds to descriptive reflection, which involves a detailed account of the events and situations of the practice, focusing on the "what happened?" While it is essential as a starting point for reconstructing the experience, it does not promote profound change if it does not move to other levels. A second level is a dialogical or comparative reflection, where the future teacher begins to establish a dialogue with the situation, comparing it with other experiences, theoretical frameworks, or the perspectives of others. In this instance, the causes and consequences of actions are explored ("Why did it happen like this?"), dilemmas are analyzed, and pedagogical alternatives are considered. Finally, critical reflection represents the most advanced level and is closely aligned with the purposes of education for social justice. Here, reflection is directed toward questioning one's assumptions, values, and beliefs, as well as those of the educational system, and analyzing the ethical, social, and political implications of teaching practice. Power relations and structural inequalities are examined, and a conscious effort is made to align pedagogical actions with principles of equity and justice.[4]

Through this commitment to critical reflection, writing helps teachers become agents of change. To support this process, specific tools guide this reflection. One example is the 'Equity Compass' in STEM education, a framework with categories and questions to help practitioners examine their beliefs, decisions, and teaching choices. It aims to "support practitioners to engage in critical reflection towards more equitable practice across a range of different ISL settings and activities".[15]

Recognizing and promoting these different forms of reflective writing is essential in initial teacher education (ITE), as they allow educators to guide future teachers toward a deeper and more critical understanding of their role and their potential to build more just and effective teaching practices.

The importance of cultivating this reflective practice, particularly at its critical levels and mediated by conscious writing processes, from the beginning of the educational journey, lies in its potential to go beyond the optimization of pedagogical techniques, becoming a powerful tool for questioning and transforming educational realities in terms of social justice and equity. The transition towards a reflective practice that serves social justice implies that educators critically examine their beliefs and the social, cultural, and political contexts in which their work is inscribed.[4,6] By fostering critical self-reflection, teachers can identify and challenge inequities, adapting their approaches to create inclusive learning environments.[16] Research highlights that those who critically analyze their practices develop a deeper understanding of the impact of their teaching on students from diverse backgrounds.[17]

The influence of reflective practice in promoting social justice is realized through diverse applications. A central strategy is the integration of social justice themes into the curriculum,[18] raising students' awareness of inequalities and empowering them to take action. In science education, socio-scientific issues connect content with social and ethical dilemmas, fostering critical thinking and social responsibility.[19] Digital technology also emerges as an ally in addressing equity issues, enabling teachers to reflect on their biases.[20] Several factors enhance this relationship: professional development that emphasizes equity,[21] professional learning communities that offer collaborative spaces to refine justice-centred practices,[22] teachers' identity as advocates for social justice[23] and their agency to act.[24] Promoting critical consciousness is a key outcome.[23] However, this implementation faces barriers such as lack of time, resources, specific training and administrative support.[22] Overcoming these barriers requires an institutional commitment that values reflective practice as a tool for building transformative education.

Methodology

This research is framed within a qualitative paradigm with an interpretive approach, seeking to deeply understand how preservice teachers' reflective practice manifests in social justice and equity dimensions during initial teacher education (ITE), specifically in the practicum or residency phase. A case study design was employed to provide a detailed and contextualized analysis of the written productions of two residents (R1 and R2). In line with Stake's (1995) assertion, this approach offers a "vicarious experience" that can illuminate similar processes in other ITE contexts.

The primary data sources were the final reflective papers prepared by R1 and R2 as part of their practicum or residency requirements in a Chemistry Teaching Program. The residents produced these written documents as part of an assessment of their teaching practices in secondary school chemistry classrooms. They were asked to analyze a problem identified in their teaching, connecting their didactic decisions with students' learning processes. These papers were selected because they constituted extensive reflective writing, allowing future teachers to express their analyses, concerns, and lessons learned in the specific context of school placement.

The data analysis process was carried out in several stages. Initially, repeated and in-depth readings of both documents were conducted to gain a comprehensive understanding of each resident's reflections. Subsequently, the analysis focused on identifying and selecting those textual fragments that specifically responded to the research question, that is, those passages where awareness of dimensions of social justice and equity linked to their chemistry teaching practices was evident (or conspicuously absent). These excerpts were interpreted to

understand the meanings constructed by the residents, the reflective writing modalities they employed (descriptive, dialogic, emerging critical reflection), and how these related to their professional development and awareness of equity. The analysis also considered the challenges and opportunities their reflections revealed for initial teacher education (ITE) in this area.

To understand the residents' reflections, it is helpful to refer to the levels of representation of chemical knowledge, the articulation of which is key to teaching.[26] The macroscopic level refers to the properties of matter and phenomena that can be observed directly or with simple instruments. The submicroscopic level explains these phenomena in terms of the behaviour of particles, such as atoms and molecules, which are not directly visible. Finally, in the context of the residents' work, the phenomenal level refers to the qualitative description of phenomena as they are sensorially perceived, constituting the starting point for inquiry. The distinction and connection between these levels are fundamental for a deep understanding of chemistry and frame the didactic problems that the residents chose to analyse in their reflective writing.

The participants' identities were protected by pseudonyms (R1 and R2). The study focused exclusively on analysing written documents to explore the potential of reflective writing, within ITE practicum or residency, as a training tool for developing an awareness oriented toward social justice and educational equity in science teaching.

Results

This section presents and analyses excerpts from the final projects of two preservice teachers, R1 and R2, to answer the central question of this research: How do the written reflections of chemistry residents reveal an (incipient) awareness of dimensions of social justice and equity? The interpretive analysis seeks to identify how their reflections on teaching chemistry allow us to glimpse (or not, and with what nuances) such sensitization or awareness.

Case 1: Analysis of resident R1's reflections

Contextualizationn of the reflected situation

R1, a chemistry teaching resident, focused her final reflection on how she used the levels of conceptualization when teaching the construction of scientific explanations to second-year students based on experiments with ink and water. Her analysis addressed the importance of describing the phenomenon as a crucial part of the explanatory structure, as she points out: "an important part of the structure of school explanation, and therefore it is crucial to work with the description of the phenomenon prior to the stage of elaborating the explanation."

Manifestations of reflection and its connection with social justice and equity

An analysis of R1's written reflections reveals a process of intense introspection about her teaching decisions, their impact on students' understanding, and emerging professional development. The reflections reveal challenges and emerging awareness with potential connections to educational justice and equity dimensions.

Initially, R1 acknowledges having made a "didactic error" during her first class by abruptly and without due explanation introducing terms from the submicroscopic level of conceptualization while working on the phenomenological description. She reflects: *"I wanted to help the students with the explanation, and I abruptly introduced a change of level by using terms from the submicroscopic level of conceptualization and the corresponding phenomenon interchangeably without informing the students of this change, by saying that 'we saw how the ink, the ink particles, were moving through the water.'"* This reflection, which combines the description of the event with self-criticism (dialogic modality), evidences a concern for conceptual clarity. The consequences of this action were immediate, as she notes, *"This decision confused the students*," reflected in their writing, which included phrases like *"you could see the ink particles gradually mixing with the water particles*." This recognition of the direct impact of her practice on students' (mis)understanding is a crucial first step. Although her reflection does not explicitly invoke social justice, her concern about the widespread confusion and its causes directly impacts equity, as confusing teaching limits equal learning opportunities.

R1 delves deeper into this self-analysis by admitting: *"During this first class, I was not aware of my word use, and as I stated earlier, the change in level that occurred during the description was not a premeditated decision.*" This passage demonstrates a transition toward a more critical reflection on her practice, where she not only describes and analyses but also evaluates her level of awareness at the time of the action. Awareness of this "error" and its origin in a lack of foresight or conscious handling of the levels of scientific school language is an indicator of professional development. The challenge for initial teacher education (ITE) programmes is to expand this initially didactic reflection toward ways of ensuring accessible strategies for all, considering the differential vulnerability of students to such confusion.

Later, in her analysis of the second class, R1 shows how she attempted to rectify her previous practice: *"This time, I am more aware of the words I use to refer to the phenomenon and what is happening while maintaining the phenomenal level to carry out the description.*" However, she also acknowledges that her interventions, although clearer, were not *"entirely explicit [...], especially about the use of the levels of conceptualization*." This reflective honesty about one's limitations is valuable, even when trying to improve. She identifies that the decision not to make the definition of "description" explicit so as not to "cause conceptual difficulties" by working with two discursive genres at once resulted in students *"not knowing quite how to answer and confusing explanation [...] with description.*" A real pedagogical dilemma becomes evident: the tension between simplifying to avoid confusion and the need to provide explicit conceptual tools for everyone. The lack of reflection on the differential impact of this confusion based on students' cultural capital or prior skills is a formative opportunity to connect these teaching decisions with equity.

A key point in R1's professional development, visible through his writing, is his awareness of the importance of metacognition in his teaching role and the value of training tools:

"Only at this stage of analysis, after writing the class diaries, reviewing the class transcripts, and rereading those diaries in conjunction with the transcription and socializing with teachers and peers, can I see that thinking about a sequence of classes in terms of levels requires much more critical and delimited work on the content, as well as a reflective and conscious practice of didactic decision-making..."

This reflection on her learning process as a teacher is fundamental. She recognizes that internalizing reflective and conscious practice is not automatic but results from sustained work mediated by specific tools (writing, transcriptions, dialogue). This recognition is key:

intentionally oriented reflective processes could lead her to critically analyse the ethical and social justice dimensions of her teaching, transcending the technical.

R1's predominantly descriptive and dialogic reflections reveal a preservice professional striving to understand and improve her teaching practice, particularly regarding conceptual clarity and impact on her students' learning. While the dimensions of social justice and equity are not the explicit focus of her discourse, her genuine concern for *all* students' understanding and her ability to identify and critically analyze her pedagogical "mistakes" and dilemmas constitute fertile ground. The absence of explicitly critical reflection on social justice in these excerpts does not denote a lack of potential but rather an opportunity for initial teacher education (ITE) programmes to provide frameworks and questions that connect teaching reflection with broader equity and justice implications.

Case 2: Analysis of resident R2's reflections

Contextualization of the reflected didactic situation

In her final reflection, R2, also a faculty resident, analyzed the questions she posed to second-year students during physical chemistry experiments and their relationship to the intention to work on the levels of conceptualization (macroscopic, submicroscopic, and phenomenal). As she indicates, she sought to analyze how students used the terms at the different levels and whether their answers aligned with what was expected to " *lead to the construction of an explanation of the observed phenomenon.*"

Manifestations of reflection and its connection with social justice and equity

R2's written reflections reveal a meticulous effort to align her teaching intentions with her classroom actions, particularly regarding the use of language and the formulation of questions to guide students' understanding at different levels of conceptualization. Although her analysis is focused on the epistemological and didactic dimensions of chemistry teaching, it offers insights into equity and justice in access to scientific knowledge in schools.

A central aspect of R2's reflection is her constant concern about the transition between the phenomenal and submicroscopic levels and how her questions can facilitate or hinder this transition for students. She describes her initial intention in class 3: *"Beginning with a simple question at the phenomenal level seemed correct to me since it would quickly allow me to determine whether the students, upon hearing my question, would be able to interpret the level addressed and whether their answers would be consistent with that level or not* ." However, she observes that, when asked at the phenomenal level, some students respond using terms from the submicroscopic level, which leads her to a didactic decision at the time: *"Faced with these answers given by the students, I directly ask them the question: 'What do you think is happening to the gas particles?' I shift the level of conceptualization (to the submicron level) without communicating it to them implicitly."* This reflection displays a predominantly dialogic modality, where she analyses the situation, her decisions, and the student's responses. Although a spur-of-the-moment decision, the lack of explicitness in this level of change risks equity by potentially leaving students who do not follow the implicit transition behind. R2 herself seems to sense this when reflecting later on class 4, where a similar situation occurred. It concludes: *"I think on this occasion, it would have been appropriate to explain the level we were analyzing. Take a few minutes and clarify the level of conceptualization we were addressing at the time*." This awareness of the need for greater explicitness is a step toward a more inclusive practice, which seeks to ensure that all students share the same "conceptual map" of the class.

Another challenge R2 identifies and analyses is related to formulating her questions and their impact on understanding. In class 4, she realized that a question she thought was formulated at the submicroscopic level used terms from the macroscopic level: *"After analyzing the transcript, I realize this question is not correctly formulated at the submicroscopic level (which was the desired one) but rather used terms from the macroscopic level. During the class, I did not realize this.*" This reflection, which emerges from the after-action analysis (through the transcript), is crucial for her professional development. Recognizing that her verbal tools can be imprecise and generate confusion is fundamental. From a social justice perspective, the precision and clarity of teachers' language are crucial for equitable access to knowledge; a poorly formulated question can exacerbate preexisting difficulties in some students, undermining equity. Her subsequent reflection on this point, *"Now I understand that the questions should be mostly clear and as explicit as possible, leaving no room for doubt for the students*," while focusing on teaching effectiveness, correlates directly with equity in the classroom.

R2 highlights significant changes, such as the importance of *"teaching discourse genres within the physical chemistry classroom"* and the value of explicitly addressing the structure of descriptions and explanations. She acknowledges that *"it is advisable to take the time to address each discourse genre, instructing students in an orderly manner how to construct their writing*" since indiscriminate mixing can generate difficulties. This is a highly relevant connection with social justice: access to scientific discourse genres is a form of power, and explicitly teaching them democratizes that access. The realization that it is not enough to ask for an "explanation" but instead that one must be taught how one is constructed is a step toward a more equitable pedagogy that does not take for granted knowledge or skills that may be unequally distributed among students.

Finally, R2 reflects on how unexpected student interventions, such as the question about the vacuum flask, led her to organize her lesson and made her aware that *"questions can arise that are not related to the activity [...] All of these issues can arise and defocus the lesson.*" While her initial concern is the "defocus, "recognizing the emergence of these questions and her attempt to address them can also be seen as an openness to students' curiosities and ideas, an important aspect of more dialogic and less one-way teaching. From a social justice perspective, the challenge lies in validating and channelling these interventions to benefit the entire class without losing focus.

R2's reflections, primarily descriptive and dialogic with significant moments of self-criticism, reveal a preservice teacher committed to understanding chemistry's teaching and learning processes. Her focus is on conceptual clarity, precision in her interventions, and effectiveness in her teaching strategies. The dimensions of social justice and equity emerge implicitly in her concern for everyone's understanding and the need for explicit teaching of scientific language. Her detailed analysis provides a solid basis for guiding reflection on the impact of micro-teaching decisions on the equity of learning opportunities.

Figure 1 summarizes the most relevant aspects of the reflective analysis of both residents (R1 and R2). For each case, the diagram highlights the focus of their reflection, the predominant writing styles, and the manifestations (emerging or absent) of an awareness oriented toward social justice and equity.

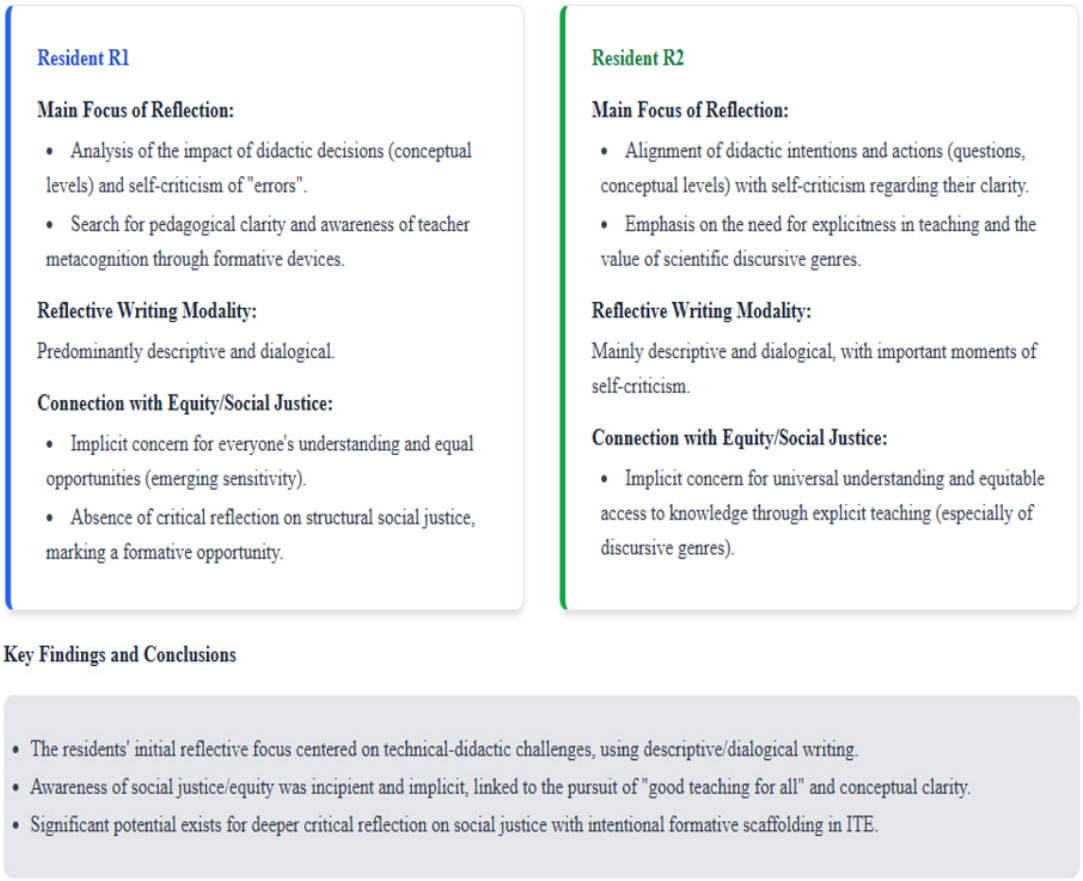

Figure 1 Summary of the Reflective Analysis of the Residents (R1 and R2): Focus, Writing Modalities and Awareness of Social Justice and Equity.

Discussion of the results

This study analyzed the written work of Chemistry Teaching Residents to identify challenges and opportunities for reflective practice in developing awareness oriented toward social justice and equity, exploring how their reflections reveal an emerging awareness of these dimensions. Cases R1 and R2 results indicate a priority focus on technical and didactic challenges, descriptive and dialogical reflection, and an emerging sensitivity toward equity. However, critical reflection on structural social justice is incipient or absent. These findings are interpreted below in dialogue with the theoretical framework, exploring implications for training teachers committed to equity.

The analysis of the cases of R1 and R2 reveals that the predominant focus of their reflection in initial training was on the technical and didactic challenges of teaching chemistry, a finding consistent with the literature on novice teachers.[27] Their reflections on teaching errors or the formulation of questions exemplify this search for 'good teaching' and the resolution of practical problems, interpreted as a natural phase where reflection on action[2] addresses urgent dilemmas. However, it is pertinent to consider whether the training devices and the instructions of the analyzed works guide the reflection mainly towards these aspects, relegating the analysis of broader social contexts or structural dimensions.[28]

Regarding writing modalities, descriptive and dialogical reflection prevailed, where residents detailed experiences and, through self-critical and analytical dialogue, sought to understand their practice and pose questions. These levels are fundamental for deeper reflective processes.[29] However, explicitly critical reflection—which questions assumptions, analyses power relations, or examines social and ethical implications regarding social justice—was incipient or largely absent. This finding suggests that, while writing is a powerful reflective tool,[13] reaching critical levels of social justice often requires specific training scaffolding that pushes beyond technical effectiveness.

Despite the absence of explicit articulation with a social justice discourse in the reflections analyzed, it is essential to highlight the "sensitivity to equity" inferred from the concerns and lessons learned by both residents. R1's distress over the confusion generated in all her students as a result of her "teaching error" and her subsequent awareness of the need for greater clarity and explicitness in teaching conceptual levels can be interpreted as a movement toward a pedagogical practice that seeks to ensure more equitable conditions of access to knowledge. Similarly, R2's detailed reflection on the importance of formulating clear questions and, especially, her recognition of the value of explicitly teaching scientific discourse genres (such as description and explanation) point to an understanding that access to language and modes of communicating science is not a homogeneous starting point for all students.

Intentionally teaching these genres, as she proposes, is a practice that can be considered a democratizer of scientific knowledge in schools. These manifestations of sensitivity toward equity do not

always translate into explicit critical reflection on the structural dimensions of social justice, which can be understood, in part, by the inherent complexity and multiple nuances that teachers must navigate when addressing these issues in their practice.[5] Therefore, while valuable, these indications require caution, recognizing that the transition toward a praxis fully oriented toward social justice is an arduous and nonlinear process.

The literature on teacher education and social justice[4,6] emphasizes that a genuine equity orientation transcends the pursuit of "good teaching for all" and delves into a questioning of the structures, power relations, and cultural assumptions that perpetuate inequalities. In the cases studied, the concern for general understanding did not extend to analyzing how students' difficulties might be linked to their diverse cultural capital or trajectories, nor how some practices might inadvertently privilege sure students. The question then arises whether these concerns for clarity and universal understanding bridge a more critical reflection on social justice, perhaps a necessary stage before addressing systemic equity dimensions. However, without explicit formative intervention, reflection risks remaining at a technical-practical level without questioning the roots of inequalities or the social purposes of science education. Connecting knowledge for teaching with a deep understanding of students in their diverse contexts and science's social purposes becomes fundamental here.

The reflective writing device, consisting of the final analysis works of a didactic problem, played an important role in shaping the reflective processes of R1 and R2. In line with the theoretical framework,[13] writing allowed the residents to externalize their thinking, reconstruct experiences, identify didactic dilemmas, analyze their actions, and become aware of their knowledge for professional teaching and learning. The written productions facilitated a predominantly descriptive and dialogical reflection, fundamental for their development, as evidenced by the identification of a 'didactic error' by R1, the critical examination of the formulation of questions, and the teaching of discursive genres by R2.

However, when considering the potential of writing for critical reflection oriented toward social justice, the characteristics of the framework may have limited its scope. It is possible that the assignment, by focusing on a "didactic problem" chosen by the residents, oriented the reflection primarily toward internal aspects of practice and disciplinary content without sufficiently encouraging the exploration of social, cultural, or political dimensions or their connection to equity. As Faller, Lundgren, and Marsick[14] point out, the proposed scaffolding directly influences the depth and focus of the reflection.

To enhance reflective writing towards social justice, prompts should be more explicit and structured,[4] inviting residents to analyze their practices from a perspective of equity and inclusion, identify and question biases, connect teaching dilemmas with the sociocultural contexts of students and the school,[4] and explore the ethical and political implications of their pedagogical decisions. The need for this specific support and guidance to develop a critical reflective practice oriented towards social justice in initial teacher education (ITE) is underlined by several studies.[13] This could include using structured prompts or adapting tools such as the ' Equity Compass ', which helps guide critical reflection toward social justice in STEM educators.[15] Thus, the writing device would strengthen the didactic analysis and cultivate a social justice perspective.

The analyses of R1 and R2 reflections, while demonstrating a technical-didactic focus and an initial or implicit connection with dimensions of social justice and equity, illuminate crucial challenges and opportunities for initial teacher education (ITE). Although a concern for effectiveness and conceptual understanding is an essential starting point, transitioning toward a reflection that embraces social justice requires intentional and explicit training support. The main challenge is to overcome the tendency for reflection to remain isolated in the classroom without connecting didactic problems with broader sociocultural contexts or structures that perpetuate inequities. In the cases studied, the problematization of events in terms of social justice did not arise spontaneously, which is consistent with barriers such as lack of time, specific training, or limited institutional support,[22] in addition to the residencies' focus on immediate didactic effectiveness.

However, the residents' concern for their students' understanding and self-criticism reveal fertile ground. Initial teacher education (ITE) can take advantage of these opportunities by designing reflective writing tools with specific prompts that guide analysis based on equity, inclusion, questioning biases, and the differential impact of decisions. It is crucial to mainstream a social justice perspective throughout training, including the use of socio-scientific issues,[18,19] and to foster a teacher identity and agency committed to social justice, perceiving future teachers as agents of change.[24] Likewise, spaces for collaborative reflection and action should be promoted,[22] and conceptual frameworks of social justice, critical pedagogies, and inclusive education should be provided to enrich the depth of reflections.

The analysis of R1 and R2's reflections offers implications for Initial teacher education (ITE) in science and educational research. Primarily, it underscores the need for explicit intentionality in initial teacher education (ITE) programmes to connect reflection on disciplinary didactics with social justice and equity issues. Although the residents displayed notable descriptive and dialogical reflection on technical-pedagogical challenges,[29] the transition to critical reflection on contextual variables, power, or inequalities was not spontaneous. This suggests that ITT programs in science cannot assume that strong didactic competence automatically leads to a praxis-oriented toward social justice. Therefore, curricular spaces must integrate frameworks and tools for future teachers to interrogate their practices from an equity perspective. The residents' concerns for clarity and understanding for all and their appreciation for the explicit teaching of discursive genres are valuable anchors for deeper discussions on equitable access to scientific knowledge.

Furthermore, the findings imply that reflective writing tools, as currently designed, tend to privilege practical didactic analysis and may therefore limit the scope of preservice teachers' reflection. To better harness their potential for social justice, these tools need to be enriched with prompts that invite residents to consider the differential impact of their pedagogical decisions, analyse biases, and link classroom challenges to broader social issues.[19] An explicit goal should be to promote writing modalities that progressively move toward critical reflection and critical thinking,[31] encouraging preservice teachers to question assumptions, power relations, and the ethical and political implications of their practice. This study also opens up lines of future research, such as longitudinal studies on the evolution of reflective practice toward social justice or explorations of the impact of specific training interventions within initial teacher education (ITE).

While this work focused on two cases, not seeking statistical generalization but rather "transferability"[32,33] and "naturalistic generalization"[34] through in-depth understanding, it is important to acknowledge other limitations. The data are final projects influenced

by academic guidelines, not necessarily capturing all the spontaneity of preservice teachers' reflection, and the researcher's perspective inevitably mediates interpretation. Nevertheless, the study offers valuable contributions to understanding and enhancing reflective practice toward social justice in initial teacher education (ITE). The potential of reflective practice as a tool for equity is fully realized when it is cultivated with clear pedagogical and political intentionality from the beginning of ITE and is explicitly oriented, during the practicum or residency, toward questioning inequalities and imagining more just forms of science teaching.[35]

Conclusion

This study is based on the reflective written work of Chemistry Teaching Residents, which analyzed the challenges and opportunities reflective practice offers for developing pedagogical awareness and praxis oriented toward social justice and equity in initial teacher education (ITE). The central question guiding this inquiry was: In what ways do residents' written reflections on their chemistry teaching practices reveal an emerging awareness (or lack thereof) of the dimensions of social justice and equity present or possible in the classroom? The analysis of the cases of residents R1 and R2 suggests that their reflections, although rich in addressing technical-didactic dilemmas and in the self-assessment of their teaching strategies, manifest an awareness of the dimensions of social justice and equity that is still in an incipient and predominantly implicit state, more linked to the search for "good teaching for all" than to an explicit questioning of the structures or contexts that generate inequality.

It is concluded that the chemistry residents analyzed focused their initial reflection on didactic challenges through descriptive and dialogic writing. Although they demonstrated sensitivity toward equity (concern for clarity and explicit teaching of discursive genres), the transition to critical reflection on systemic injustices was not spontaneous. Reflective writing tools are powerful but require greater formative intentionality to guide awareness toward social justice. This study shows that initial teacher education (ITE) must more actively promote critical reflection that transcends didactics, equipping future teachers to connect their work with the ethical, social, and political dimensions of education for equity.

Acknowledgments

None.

Conflicts of interest

The author declares there is no conflict of interest.

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Citation: Cutrera G. Emerging perspectives on equity: reflective writing and social justice in preservice chemistry teachers. *Open Access J Sci.* 2026;9(1):310–317. DOI: 10.15406/oajs.2026.09.00314