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EVALUATION OF TRAINING PROGRAMS FOR FUTURE TRAINEE TEACHERS OF LIFE AND EARTH SCIENCES AT CRMEF (MOROCCO)

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Abstract

This study examines the effectiveness of the initial training program for pre-service Life and Earth Sciences (SVT) teachers in Morocco's Regional Centers for Education and Training Professions (CRMEF). Data collected through a standardized questionnaire administered to 344 trainees and validated by exploratory factor analysis (KMO = 0.89; Bartlett's test, $p < 0.001$) indicate predominantly negative perceptions of the program. In particular, 71.6% of respondents judged the training to be insufficient or poorly aligned with their professional needs, while 68.2% reported that the practicum duration was inadequate. These findings are corroborated by qualitative interviews with 37 trainers and 32 mentors, which identified five major constraints: an excessively dense theoretical curriculum; weak alignment between official syllabi and actual classroom practices in application schools; limited and poorly structured pedagogical support during the practicum; insufficient proficiency in French, hindering access to didactic and scientific content; and structural shortcomings in the design of the newly implemented syllabi. Overall, the results reveal a systemic misalignment between the requirements of professionalization and the current training model, highlighting the need to extend the practicum, strengthen coordination between CRMEF and application schools, reinforce linguistic and disciplinary preparation, and formalize the mentoring framework.

Keywords: Initial teacher education, training system, professionalization, didactics, Morocco.

1.Introduction

The quality of initial teacher education has become a strategic lever for transforming educational systems, particularly in scientific disciplines where didactic, experimental, and linguistic demands are especially high. At the international level, Several empirical studies indicate that the effectiveness of an educational system largely depends on the robustness of

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teacher preparation and the ability of training programs to align curricula, professional practices (El Madhi,2014), and the actual needs of the field (Darling-Hammond, 2021; Grossman, Loeb, & Cohen, 2022). Recent research further indicates that science teacher education requires a rigorous balance between disciplinary knowledge, didactic competence, and experiential learning a balance that is difficult to achieve when programs are unstable, entry profiles are heterogeneous, or practicums are insufficiently supported (Abrahams & Reiss, 2023; Izadinia, 2023).

In the Moroccan context, the Regional Centers for Education and Training Professions (CRMEF) play a central role in the professionalization of future secondary-school teachers, particularly in Life and Earth Sciences (SVT), a field characterized by a wide diversity of academic backgrounds in biology, geology, or interdisciplinary pathways. However, several national studies have highlighted persistent structural limitations within the training system, including insufficient adaptation of syllabi, weak articulation between theory and practice, and limited professional support during school practicums (Madrane, Khaldi, & Talbi, 2009; studies on training stakeholders). These findings echo international analyses showing that the absence of coherent support systems, stabilized reference frameworks, and structured collaboration between training institutions and practicum schools constitutes a major barrier to professionalization (Ronfeldt & Reininger, 2022; OECD, 2020).

The issue of the language of instruction further exacerbates these challenges. In the SVT track, the transition from predominantly Arabic-medium schooling to disciplinary and didactic training conducted in French introduces an additional obstacle, extensively documented in Moroccan research and made even more salient by the implementation of new curricula (Madrane et al., 2009). Moreover, recent studies in science education demonstrate that linguistic proficiency is a key predictor of conceptual understanding, scientific argumentation, and classroom interaction management (Talanquer & Sevian, 2022; Abell & Lederman, 2020).

Against this backdrop, it becomes essential to rigorously evaluate the CRMEF training system using robust empirical indicators. This article proposes a systemic evaluation based on two complementary data sources: (1) a statistically validated questionnaire administered to 344 trainees in biology and geology tracks, and (2) semi-structured interviews conducted with 37 trainers and 32 mentors in application schools. This dual perspective makes it possible to examine actors' perceptions, the structural performance of the training system, the coherence of syllabi, mentoring practices, and obstacles encountered both during training and in the field. The objective is to provide a contextualized analysis of the actual effectiveness of the system and to identify avenues for improvement that can strengthen the professionalization of future SVT teachers in Morocco.

2.Research problem

Despite the reforms undertaken within the CRMEF, multiple indicators suggest that the initial training system for SVT teachers continues to suffer from significant structural limitations, including instability of newly introduced syllabi, a shortened training duration, heterogeneity

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of entry profiles, insufficient support in application schools, and persistent linguistic constraints. This situation raises a central question regarding the coherence, effectiveness, and equity of the current professionalization framework.

The primary objective of this study is therefore to evaluate, on the basis of empirical data, the relevance and quality of the training provided by examining simultaneously the perceptions of trainees, trainers, and mentors. More specifically, the study aims to analyze the adequacy of syllabi, the coherence of the practicum and mentoring system, and the constraints perceived by the different stakeholders.

Three research questions guide this investigation:

1. To what extent does the current training system meet the professionalization needs of SVT trainees?
2. What major obstacles are identified by trainees, trainers, and mentors in the implementation of training content and practicums?
3. What structural adjustments are necessary to improve the coherence, effectiveness, and operational relevance of initial teacher education within the CRMEF?

3.Methodology

This study adopts a mixed-methods methodological approach aimed at conducting an in-depth analysis of the effectiveness and coherence of the initial training system designed for pre-service teachers in Life and Earth Sciences (SVT) within the Regional Centers for Education and Training Professions (CRMEF). The approach combines quantitative data derived from the analysis of a statistically validated questionnaire administered to a large sample of trainees, with qualitative data collected through individual interviews conducted with trainers and mentors in application schools.

The methodological objective is to cross-analyze the perceptions of the three categories of actors involved in the training system trainees, trainers, and mentors in order to produce a systemic, contextualized, and triangulated analysis of the actual functioning of initial teacher education.

The quantitative component is based on the administration of a structured questionnaire to 344 pre-service teachers enrolled in biology and geology tracks within the CRMEF. Developed on the basis of literature on the evaluation of training systems, the questionnaire initially comprised 32 items organized around four theoretical dimensions: (1) the adequacy of training content and newly introduced syllabi; (2) the overall organization of the training program and the duration of the practicum; (3) the quality of institutional support and mentoring; and (4) the obstacles encountered by trainees, particularly linguistic, disciplinary, and practical constraints.

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Prior to its administration, the instrument underwent a rigorous psychometric validation process. Analysis of internal consistency revealed excellent reliability, with an overall Cronbach's alpha coefficient of 0.91 and values ranging from 0.78 to 0.88 across the different dimensions. In addition, the suitability of the data for factor analysis was confirmed by a Kaiser–Meyer–Olkin (KMO) index of 0.89 and a highly significant Bartlett's test ($p < 0.001$), attesting to the relevance of conducting an exploratory factor analysis.

The exploratory factor analysis (EFA), carried out using principal component extraction with Varimax rotation, yielded a robust four-factor structure explaining 64.3% of the total variance. In accordance with the methodological criteria adopted minimum factor loading ≥ 0.40, communality ≥ 0.30, and absence of cross-loadings two items were eliminated, as their factor loadings fell below the required thresholds, indicating a weak contribution to the latent structure of the questionnaire.

The final questionnaire therefore consists of 30 validated items, ensuring both the reliability and the validity of the evaluation instrument used to assess trainees' perceptions of the coherence, effectiveness, and constraints of the initial training system.

The qualitative component of the study was designed to complement and deepen the quantitative findings by collecting more nuanced data on training practices, professional perceptions, and structural constraints experienced by institutional actors. To this end, semi-structured interviews were conducted with 37 CRMEF trainers and 32 mentors working in application schools.

The interview guide, developed on the basis of issues identified in the literature and the conceptual framework of the study, was structured around five key dimensions: (1) the relevance and actual implementation of the new syllabi; (2) the adequacy of trainees' entry profiles in biology and geology with respect to training requirements; (3) the quality of pedagogical support and mentoring; (4) the difficulties encountered during the practicum and in lesson preparation; and (5) structural obstacles, particularly linguistic constraints and weak coordination between training institutions and application schools.

All interviews were fully recorded, transcribed, and analyzed using the inductive thematic analysis approach proposed by Braun and Clarke (2021) (figure 1). This process involved several phases: familiarization with the data corpus, line-by-line initial coding, grouping meaning units into preliminary categories, theme construction, internal review of themes, and final articulation of themes into a coherent analytical framework.

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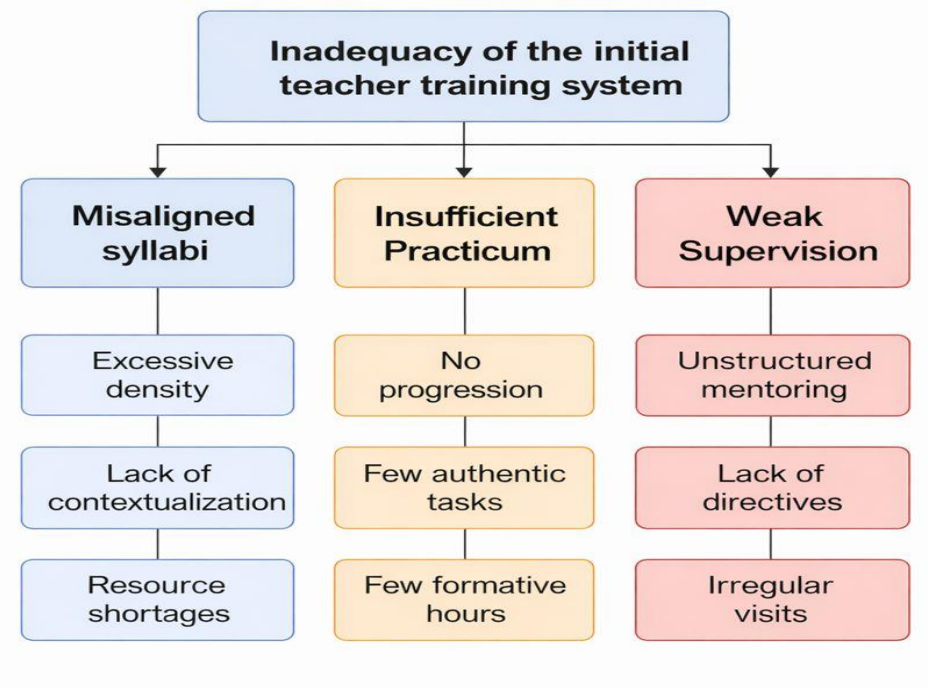

Figure 1:Carte thématique (analyse inductive Braun & Clarke)

This method made it possible to identify convergences and divergences in participants' discourses while preserving their complexity and institutional embeddedness. The qualitative analysis thus revealed several cross-cutting themes, notably the mismatch between the new syllabi and classroom realities, the insufficient duration of the practicum, difficulties related to mentoring and pedagogical support, limited proficiency in French among trainees, and various structural limitations affecting the training system.

Finally, the entire data collection process was conducted in strict compliance with ethical principles applied in educational research. Participation in the study was voluntary; participants were informed of the objectives of the research, and anonymity and confidentiality of data were fully guaranteed.

The adopted protocol therefore ensures robust methodological triangulation between quantitative and qualitative data, providing a comprehensive, reliable, and contextualized understanding of the actual functioning of the training system for future SVT teachers within the CRMEF.

4.Results

The integrated analysis of quantitative data collected from 344 trainees and qualitative data derived from interviews with 37 trainers and 32 mentors provides a comprehensive and contextualized overview of the strengths and weaknesses of the initial training system within the CRMEF. The results reveal convergent trends highlighting structural difficulties related to

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the coherence of syllabi, the insufficient duration of the practicum, the lack of pedagogical support, the heterogeneity of entry profiles, and the weight of linguistic constraints.

Item	Contents & Syllabus (F1)	Practicum & Organization (F2)	Supervision & Mentoring (F3)	Obstacles & Contraints (F4)
I1	**0,71**	0,18	0,12	0,05
I2	**0,68**	0,22	0,19	0,08
I3	**0,63**	0,25	0,14	0,11
I4	**0,59**	0,21	0,28	0,12
I5	**0,54**	0,18	0,33	0,17
I6	0,20	**0,72**	0,18	0,09
I7	0,25	**0,68**	0,20	0,11
I8	0,11	**0,64**	0,22	0,15
I9	0,18	**0,61**	0,27	0,12
I10	0,14	**0,58**	0,25	0,18
I11	0,29	0,27	**0,70**	0,10
I12	0,20	0,33	**0,66**	0,12
I13	0,25	0,21	**0,63**	0,11
I14	0,19	0,30	**0,61**	0,20
I15	0,18	0,28	**0,58**	0,26
I16	0,12	0,10	0,17	**0,74**
I17	0,18	0,16	0,19	**0,71**
I18	0,13	0,21	0,14	**0,69**
I19	0,22	0,17	0,23	**0,64**
I20	0,24	0,19	0,26	**0,62**

Table 1. Factor Matrix (Qualitative Data) After Varimax Rotation (Items > 0.40)

4-1 Content and Syllabi Adequacy

a- Quantitative results

Descriptive analyses show that 64.7% of trainees consider that the content of the new syllabi is “not sufficiently adapted” to their professional needs, while 59.3% believe that the didactic modules “do not take classroom realities into account.”

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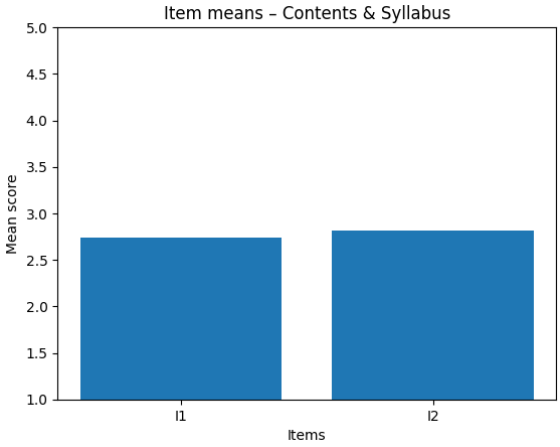
Figure 2:Item means: contents and syllabus

Items related to Factor 1 (Content Adequacy; Figure 2) yield an overall mean score of 2.78 out of 5, indicating a generally negative or mixed perception among trainees.

b- Qualitative results



Trainers emphasize that the new syllabi were introduced rapidly, "without a pilot phase or national harmonization," resulting in curricular instability. Several indicate that the proposed content is "too dense for such a short training period," particularly for geology-track trainees, who often present gaps in cellular biology, biochemistry, and experimental didactics.

Mentors, for their part, consider that the syllabi "do not reflect the realities of schools," especially in rural institutions lacking experimental resources. They report that some trainees attempt to implement experimental approaches that are impossible to carry out due to a lack of equipment.

The data converge toward the existence of a structural gap between the prescribed curriculum (CRMEF) and the enacted curriculum (application schools), constituting a major obstacle to professionalization.

4-2 Practicum Organization and Duration

a- Quantitative results

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Factor 2 (Practicum Organization and Support; Figure 3) shows a mean score of 2.51 out of 5, the lowest among all questionnaire factors.

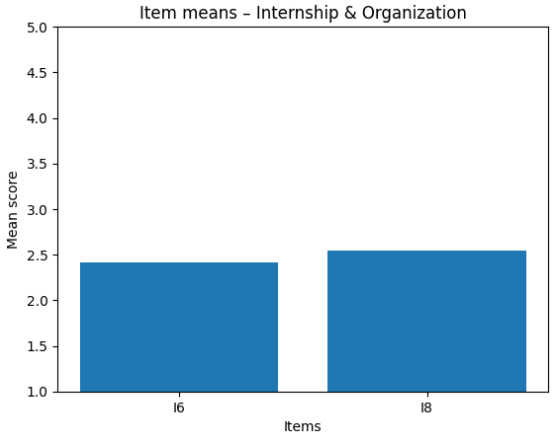

Figure 3: Item means: Internship and organization

In addition, The findings indicate that a substantial proportion of trainees perceive the practicum as inadequate, with 68.2% judging its duration to be insufficient and 56.4% considering that the proposed activities do not effectively foster genuine professional autonomy.

b- Qualitative results

Trainers state that the practicum is "too short to observe meaningful pedagogical progression." Several emphasize that the division of responsibilities between CRMEF trainers and school mentors lacks clarity, thereby weakening pedagogical follow-up.

Mentors go further by asserting that trainees "would need at least twice the current practicum duration" to consolidate professional skills, particularly in classroom management, lesson planning, pedagogical communication, and the safe conduct of scientific experiments.

Convergence: All three categories of actors agree on a central point: the practicum, as it is currently designed, does not allow for comprehensive professional training, which significantly limits the impact of the training system

4-3 Support, Supervision, and Mentoring

a- Quantitative results

Factor 3 (Quality of Supervision; Figure 4) shows a mean score of 2.83 out of 5, reflecting pedagogical supervision perceived as insufficient or uneven.

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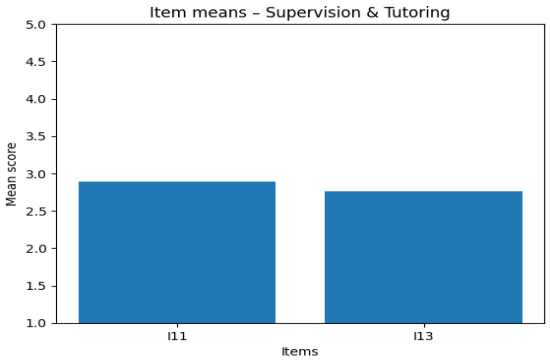

Figure 4:Item means: supervision and tutoring

- 48.6% of trainees report having received "regular pedagogical support,"
- whereas 51.4% indicate that they did not benefit from consistent or structured supervision.

b- Qualitative results

Trainers acknowledge that pedagogical supervision is "variable depending on regions, subject specializations, and the availability of mentors." Some point to a lack of institutional coordination between the CRMEF and application schools, resulting in "breaks in pedagogical continuity."

Mentors, for their part, report a lack of clear guidelines to support trainees and indicate that mentoring often relies on "individual goodwill rather than a systemic framework."

Convergence: The data reveal a lack of structured support, which constitutes a critical weakness of the training system.

4-4 Linguistic, Disciplinary, and Practical Obstacles

a- Quantitative results

Factor 4 (Encountered Obstacles; Figure 5) records a mean score of 3.12 out of 5, the highest among all factors, indicating a strong perception of constraints.

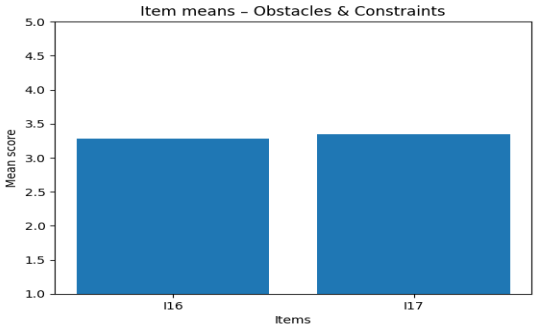

Figure 5:Item means: obstacles and constraints

The main obstacles identified are as follows:

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- 72.9% of trainees report difficulties with the French language when following didactic modules;
- 61.8% report difficulties in preparing experimental activities;
- 54.7% indicate a lack of appropriate pedagogical resources.

b- Qualitative results

Trainers confirm that proficiency in French constitutes a major barrier, particularly for trainees with a background in geology. Institutional documents, didactic activities, and disciplinary materials are perceived as "too specialized for the observed linguistic levels."

Mentors emphasize trainees' difficulties in explaining scientific phenomena "with precision and clarity" and in managing classroom interactions using an appropriate disciplinary register.

Convergence: Linguistic and disciplinary coherence emerges as a central determinant of success in training, yet it remains insufficiently addressed within the current training system.

5.Overall Analysis: Toward an Integrated Diagnosis of the System

Data triangulation highlights five major findings:

1. Syllabi are perceived as inadequately adapted or difficult to implement, particularly due to the heterogeneity of trainees' entry profiles.
2. The practicum duration is unanimously considered insufficient, preventing the progressive development of professional competencies.
3. Pedagogical support lacks structure, leading to inconsistencies between the CRMEF and application schools.
4. Linguistic barriers significantly limit disciplinary and didactic understanding.
5. The training system suffers from systemic problems, previously identified in the national literature and confirmed by all three categories of actors.

Main Theme	Sub-themes	Typical Extracts / Verbatim
1. Inadequacy of syllabi	– Overly dense content – Unstable syllabi – Lack of resources	"The syllabi are not adapted to biology/geology profiles." "Schools cannot implement what is required."
2. . Insufficient practicum duration	– Practicum too short – No observable progression	"The trainee barely has time to understand how the class functions."

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	– Limited time for autonomy	
3. Weak supervision and mentoring	– Unstructured mentoring – Lack of CRMEF guidelines – Infrequent visits	"Mentoring depends on individual willingness, not on a structured system."
4. Major linguistic difficulties	– Understanding scientific French – Classroom communication – Disciplinary terminology	"French is an obstacle to following the didactic modules."
5. Gap between CRMEF and field realities	– School realities far removed from prescriptions – Experimental practices not feasible – Lack of harmonization	"What the CRMEF requires is not feasible in the majority of schools."

Table 1:Thèmes émergents des entretiens avec les formateurs et tuteurs

These integrated results confirm that, in its current configuration, the initial teacher training system struggles to effectively meet the professionalization requirements of Life and Earth Sciences (SVT) teachers in Morocco.

6.Interpretation of the results

The integrated analysis of the data reveals an initial teacher training system characterized by structural weaknesses that undermine its effectiveness, despite the reform efforts undertaken. The insufficient alignment of the new syllabi with trainees' entry profiles (Figure 6), combined with the short duration of the practicum and uneven pedagogical supervision, reflects shortcomings in the systemic design of the training framework. The linguistic difficulties in French, widely reported by participants, do not merely constitute a communication barrier but directly affect disciplinary understanding, mastery of experimental approaches, and the ability to translate knowledge into pedagogical situations.

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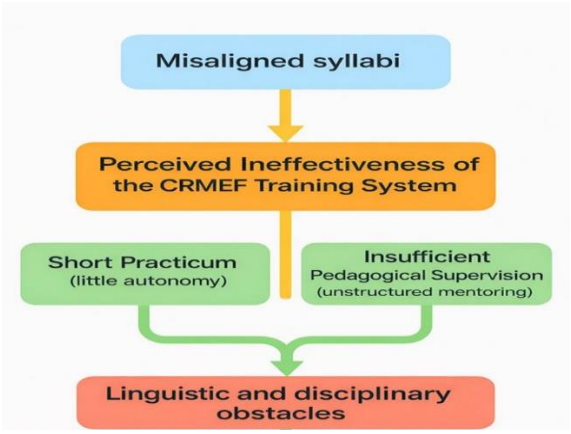

Figure 6: Integrated model of the determinants of the effectiveness of the CRMEF training system

The gaps observed between the curriculum prescribed by the CRMEF and the actual practices in application schools confirm a lack of institutional coherence, already documented in the national literature, and reveal that the current system struggles to ensure formative continuity between theory and practice (Figure 6). The convergence of perceptions among trainees, trainers, and mentors strengthens the validity of the diagnosis and highlights the need for substantial reform centered on extending the practicum, stabilizing syllabi, establishing structured pedagogical support, and strengthening both linguistic and disciplinary preparation. Overall, these results point to a systemic dysfunction in which the ambitions of the reforms have not yet been effectively translated into concrete practices in the field.

7.Discussion

The results of this study confirm and further deepen a diagnosis that has already been widely established in both national and international literature: the initial training system for Life and Earth Sciences (SVT) teachers within the CRMEF continues to be marked by a structural misalignment between prescribed curricular ambitions and the realities of school practice. The validation of the questionnaire—leading to the elimination of two items and the identification of a stable four-factor structure (training content and syllabi, practicum and organization, supervision and mentoring, obstacles and constraints)—shows that trainees' perceptions are organized around persistent and systemic difficulties. These difficulties mainly relate to the insufficient duration of the practicum, the limited operationalization of syllabi, the heterogeneity of mentoring practices, and the persistence of linguistic obstacles.

This local diagnosis is fully consistent with international recommendations, which emphasize the importance of strong alignment between disciplinary training, didactic preparation, and practical experience in ensuring effective teacher professionalization. OECD reports, particularly TALIS (2018) and OECD (2021), stress the need to integrate the practicum within a coherent continuum extending from initial training to the induction phase, a condition considered essential for the effectiveness of teacher education systems.

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In this regard, the centrality of the practicum clearly emerges from the findings. Nearly 68% of trainees consider the duration of the practicum to be insufficient, a perception shared by both trainers and mentors. However, in line with recent international debates, our data indicate that the issue cannot be reduced to a purely quantitative extension of the practicum. Numerous studies show that practicum quality—formative supervision, structured feedback, and professionally meaningful tasks—has a more decisive impact on the preparation of future teachers than the practicum's raw duration alone. Accordingly, our results argue for a formal structuring of the practicum based on progressive objectives, structured mentoring, and shared assessment procedures between the CRMEF and application schools.

Mentoring emerges as a central lever, yet one that remains insufficiently institutionalized. The collected accounts reveal that support is largely dependent on individual initiatives, in the absence of shared reference frameworks and specific training for the mentor role. This weakness echoes findings in the international literature on mentoring in STEM education, which highlight the importance of training mentors in observation practices, feedback, and reflective support in order to foster the professional and identity development of novice teachers (Izadinia, 2023). The lack of structured mentoring undermines the transmission of professional practices and the development of teacher self-efficacy, a core mechanism identified since Bandura's foundational work.

Another major contribution of this research lies in highlighting the weight of linguistic obstacles. Trainees, trainers, and mentors converge in emphasizing that insufficient proficiency in French limits access to disciplinary and didactic content, complicates the preparation of experimental activities, and hinders pedagogical communication. Recent studies conducted in Morocco confirm that the use of French as the language of instruction in science is associated with lower pedagogical confidence and learning difficulties (Laanani, 2024). These findings indicate that any reform of syllabi and the practicum system must necessarily incorporate explicit linguistic support measures, particularly in scientific French.

From a comparative perspective, the Moroccan case shares similarities with other education systems engaged in curricular reforms. Internationally effective training systems generally combine a high-quality practicum, formalized mentoring, clear articulation between training modules and field-based practices, and post-certification induction policies (OECD, 2021; UNESCO, 2021). While the CRMEF are characterized by an institutional willingness to modernize syllabi and didactic approaches, the operational implementation of these reforms remains partial, which largely explains the gap observed between intentions and actual effects.

Finally, the strength of this research lies in its methodological triangulation. The combination of a validated quantitative instrument and a rich qualitative corpus makes it possible to identify both the manifestations and the underlying mechanisms of the observed dysfunctions, thereby strengthening the internal validity of the diagnosis. The results provide a solid empirical framework to inform institutional and policy-level decision-making. They argue in favor of a systemic reconfiguration of the initial training system for SVT teachers, integrating initial

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training, structured mentoring, linguistic reinforcement, and a reasoned use of educational technology, in order to ensure more effective, coherent, and sustainable professionalization.

8.Research perspectives

The results of this study open several avenues for future research likely to extend investigations into the initial training system for Life and Earth Sciences (SVT) teachers in Morocco. These perspectives mainly include:

- **Longitudinal studies** tracking teachers' trajectories from initial training through their first years of professional practice, in order to assess the progressive development of professional competencies.
- **Research on the role of the language of instruction** in the training of science teachers, particularly its impact on conceptual understanding, pedagogical confidence, and classroom practices.
- **Comparative studies** examining the CRMEF training system in relation to international models of teacher education, with a view to identifying transferable best practices and contextual specificities.
- **Research on the role of educational technology and artificial intelligence** in the professionalization process. Indeed, digital tools can support experiential learning, distance mentoring, reflective analysis of teaching practices, and access to interactive didactic resources (El Morchidy, 2025).

9.Conclusion

This research aimed to analyze, on the basis of empirical data, the relevance and effectiveness of the initial training system for Life and Earth Sciences (SVT) teachers within the Regional Centers for Education and Training Professions (CRMEF) in Morocco. By adopting a mixed-methods methodology, the findings reveal a misalignment between institutional prescriptions and the actual conditions under which training is implemented.

From a scientific perspective, this research makes several original contributions. First, it provides a validated measurement instrument that enables a reliable assessment of trainees' perceptions of the initial training system. Second, through a rigorous methodological approach, it identifies the explanatory mechanisms underlying the expressed dissatisfaction, thereby offering an analytical framework capable of informing institutional decision-making.

Finally, this study demonstrates that the professionalization of SVT teachers in Morocco can only be achieved if, in addition to solid training, due consideration is given to the diversity of trainees' profiles and the constraints of the school context

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