

Professional Development of Beginning Teachers in Life and Earth Sciences (LES) in Morocco: A Multi-Stakeholder Analysis of the Training-to-Practice Transition

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ABSTRACT

Background : The professional induction phase of beginning teachers represents a critical period, characterized by the transition from the knowledge and skills acquired during initial teacher education to the practical demands of classroom practice. This study focuses on beginning teachers of Life and Earth Sciences (LES) in Morocco, an institutional context that remains underexplored in the international literature.

Objectives : This research aims to analyze the professional development process of beginning LES teachers from a multi-stakeholder perspective, by identifying perceived gaps between initial training and professional practice, as well as the key dimensions shaping their professionalization.

Methodology : A convergent mixed-methods research design was adopted. Qualitative data were collected through 34 semi-structured interviews with LES pedagogical inspectors from seven Regional Academies and 52 interviews with teacher educators from nine Regional Centers for Education and Training Professions (CRMEF). These data were complemented by a quantitative questionnaire survey administered to a sample of 127 beginning LES teachers recruited in 2023. Qualitative data were analyzed using thematic analysis, while quantitative data were subjected to descriptive statistical analyses.

Results : The analysis reveals conceptions of professional development structured around three core dimensions: didactic and disciplinary mastery, adaptation to contextual constraints, and the adoption of a reflective stance. Quantitative findings highlight significant gaps between competencies developed during initial training and the demands of classroom practice, particularly in the areas of classroom management, implementation of experimental inquiry-based approaches, and assessment of student learning.

Conclusion : The study underscores the need for stronger articulation between initial teacher education, institutional support mechanisms, and the realities of

classroom practice. It advocates for the development of collaborative and sustained support structures from the very beginning of teachers' careers in order to ensure sustainable professionalization. This research contributes to the literature on teacher induction by providing a context-specific analysis and emphasizing the importance of a systemic and integrated approach to continuous professional development.

Keywords : Professional development; Beginning teachers; Professional induction; Initial teacher education; Life and Earth Sciences; Moroccan context; Mixed-methods research; Multi-stakeholder analysis.

Introduction

The professional induction of beginning teachers represents a major challenge for the quality of educational systems and has received sustained attention in the international literature on educational sciences. This critical period, commonly referred to as the induction phase, is characterized by tensions between the knowledge acquired during initial teacher education, institutional prescriptions, and the complex demands of classroom practice, profoundly influencing teachers' professional identity construction and retention in the profession (Flores, 2020; Kelchtermans, 2019). Professional development is thus conceptualized as a dynamic and situated process, encompassing both formal and informal learning within communities of practice (Avalos, 2018; Hadar & Brody, 2023).

In the specific field of science education, these challenges become even more complex. Teaching Life and Earth Sciences (LES) requires the mastery and integration of multiple competencies, including the didactic transposition of evolving scientific knowledge, the management of inquiry-based and practical activities, and the pedagogical treatment of socio-scientific issues (Högström, 2024). For novice teachers, the transition to real classroom contexts is often accompanied by heightened difficulties related to material, organizational, and contextual constraints (Duit & Treagust, 2021; Sadler & Zeidler, 2020).

The Moroccan context, shaped by structural reforms in teacher education, provides a relevant setting for analysis. While the Regional Centers for Education and Training Professions (CRMEF) and the pedagogical inspection system constitute the main institutional pillars of teacher preparation and support, several reports highlight the need for stronger articulation between initial training, professional accompaniment, and the realities of school settings (OECD, 2021; UNESCO, 2022). However, few studies have adopted a multi-stakeholder approach to examine this process in the specific case of LES teachers.

This research seeks to address this gap by analyzing the transition from initial training to entry into the profession in Morocco through the triangulation of perspectives from LES teacher educators (CRMEF), pedagogical inspectors, and beginning teachers. The study pursues three main objectives: (1) to elucidate the conceptions of professional development mobilized by these actors, (2) to identify the priority competencies perceived as essential for successful professional induction, and (3) to assess the relevance of institutional support mechanisms. This approach makes it possible to shed light on the logics, tensions, and expectations that structure the professionalization pathways of beginning teachers within a specific educational context.

Methodology

1. Research Design

This study is based on a **convergent mixed-methods research design with qualitative dominance**, combining qualitative and quantitative data to examine the professional development of

beginning teachers of Life and Earth Sciences (LES). This methodological choice responds to the complexity of the phenomenon under investigation, which encompasses individual, institutional, and professional dimensions that are difficult to capture through a single methodological approach (Fetters, 2013; Avalos, 2018).

Priority was given to the qualitative component in order to gain an in-depth understanding of the conceptions, professional practices, and logics of action of pedagogical inspectors and teacher educators from the Regional Centers for Education and Training Professions (CRMEF), who play a central role in the training and support of beginning teachers. Complementarily, the quantitative component documents the lived professional experiences of beginning teachers themselves and identifies general trends related to their needs, difficulties, and perceptions of the training they received.

The integration of the qualitative and quantitative strands follows a logic of **methodological triangulation**, thereby enhancing the internal validity and interpretive robustness of the findings (Denzin, 2017).

2. Research Context

The study was conducted within the context of the Moroccan teacher education system, which is characterized by an institutional articulation between initial teacher education, provided by the Regional Centers for Education and Training Professions (CRMEF), and professional support during entry into the profession, primarily ensured by pedagogical inspectors and school-based educational actors. This institutional configuration provides a particularly relevant framework for analyzing early-career professional development, as the transition from training to actual teaching practice is both formally structured through institutional mechanisms and confronted with multiple organizational, pedagogical, and territorial constraints.

These structural tensions significantly shape the processes through which beginning teachers appropriate professional practices, adjust to the realities of school contexts, and engage in the dynamics of professionalization during the early stages of their careers (OECD, 2021; El Haddad & Belhaj, 2022).

3. Sampling Strategy

Participant selection was based on a **purposeful and criterion-based sampling strategy**, aimed at engaging actors directly involved in the training and support mechanisms for beginning Life and Earth Sciences (LES) teachers, while ensuring institutional and territorial diversity of perspectives (Patton, 2015).

Pedagogical inspectors: Thirty-four pedagogical inspectors from seven Regional Academies of Education and Training (AREF) participated in the study. Their responsibilities in pedagogical supervision, professional evaluation, and support of beginning teachers position them as key actors in institutional regulation processes.

CRMEF teacher educators: Fifty-two teacher educators from nine Regional Centers for Education and Training Professions (CRMEF) were included. Their involvement in didactic and pedagogical instruction, as well as in the supervision of teaching practicums, places them in a privileged position to analyze the articulation between initial teacher education and the demands of classroom practice.

Beginning teachers: A questionnaire was administered to 127 Life and Earth Sciences teachers recruited in 2023 and at an early stage of their careers. The inclusion of this group makes it possible to account for the lived experiences of the primary beneficiaries of training and support mechanisms, in line with recent recommendations on professional induction (Flores, 2020).

4. Data Collection

4.1. Semi-Structured Interviews

Qualitative data were collected through **semi-structured interviews** conducted with pedagogical inspectors and Life and Earth Sciences (LES) teacher educators. This methodological choice made it possible to access participants' professional representations, actual practices, and logics of action, while ensuring comparability across interviews through the use of an interview guide structured around common thematic areas (Kvale & Brinkmann, 2015).

The interview guide was developed based on the scientific literature on the professional development of beginning teachers and on a conceptual framework grounded in the cross-analysis of perspectives from actors involved in professional training and support processes (Lhoste & Schneeberger, 2018). The interviews focused in particular on conceptions of professional development, competencies perceived as priorities at the beginning of the career, analyses of existing support mechanisms and their limitations, as well as suggested avenues for improvement. Interview durations ranged from 45 to 75 minutes, and all sessions were audio-recorded with the participants' informed consent.

4.2. Questionnaire

A **self-administered questionnaire** was designed to collect beginning LES teachers' perceptions of their initial training and the professional support they received upon entering the profession. The questionnaire included closed-ended questions based on Likert-type scales addressing perceived professional preparedness, difficulties encountered, and the perceived effectiveness of support mechanisms, as well as open-ended questions allowing respondents to freely express their needs and concerns (Bryman, 2016).

The construction of the questionnaire drew on validated instruments from the literature on teacher professional induction. These instruments were adapted to the Moroccan institutional context and to the didactic specificities of Life and Earth Sciences in order to ensure content validity and contextual relevance (Mukamurera et al., 2020).

5. Data Analysis

Qualitative data derived from the interviews were analyzed using a **thematic analysis approach**, combining inductive and deductive coding procedures in accordance with the framework proposed by Braun and Clarke (2021). An initial phase of open coding made it possible to identify meaningful units, which were subsequently grouped into categories and organized into analytical themes aligned with the theoretical framework of the study.

Quantitative data were subjected to **descriptive statistical analyses** (frequencies and means) in order to identify general trends related to the professional experiences of beginning teachers. Responses to the open-ended questionnaire items were integrated into the qualitative analysis to enrich interpretation and to contextualize the quantitative findings.

The integration of qualitative and quantitative data was carried out during the interpretative phase through **cross-data triangulation** of the perspectives of pedagogical inspectors, teacher educators, and beginning teachers. This process enabled the identification of convergences and divergences across actors and contributed to strengthening the credibility of the findings (Denzin, 2017).

6. Ethical Considerations and Scientific Rigor

The study was conducted in accordance with established ethical principles in educational research. Participation was voluntary, informed consent was obtained from all participants, and anonymity as well as data confidentiality were strictly ensured.

The scientific rigor of the study was strengthened through the diversification of data sources and participant groups, in-depth contextualization of the research setting, the use of illustrative verbatim excerpts, and the systematic comparison of perspectives across actors. These procedures are consistent with the quality criteria for qualitative research defined by Lincoln and Guba (1985) and contribute to enhancing the credibility and robustness of the findings.

Results

1. Conceptions of Beginning Teachers' Professional Development

1.1. Inspectors' Perspectives

The thematic analysis of the 34 interviews conducted with Life and Earth Sciences (LES) pedagogical inspectors made it possible to identify **three dominant conceptions of beginning teachers' professional development**.

Table 1. Inspectors' Conceptions of Beginning Teachers' Professional Development

| Dominant conception | Description | Frequency (%) |
|---------------------------------------|--|---------------|
| Didactic and disciplinary mastery | Ability to design coherent teaching sequences, master Life and Earth Sciences content, and implement scientific inquiry approaches | 44,1 |
| Adaptation to real classroom contexts | Classroom management, material constraints, and student heterogeneity | 32,4 |
| Development of a reflective stance | Capacity for critical analysis of one's practice and self-regulation | 23,5 |
| Total | | 100 |

The results indicate that **didactic and disciplinary mastery** constitutes the conception most frequently mobilized by inspectors. **Adaptation to real classroom contexts** is also widely emphasized, particularly in relation to the management of teaching situations and organizational constraints. By contrast, the **reflective stance** emerges as a less frequently mentioned dimension and is primarily associated with a gradual construction over the course of professional experience.

The collected accounts highlight a perceived gap between the competencies developed during initial training and their effective implementation in authentic teaching contexts, as illustrated by the following excerpt:

“The problem is not what they know, but what they are actually able to implement in real classroom situations” (Inspector, Central AREF).

1.2. Teacher Educators' Perspectives

1.2.1. Perceived Priority Competencies

The interviews conducted with 52 Life and Earth Sciences (LES) teacher educators from nine Regional Centers for Education and Training Professions (CRMEF) highlight several competencies considered to be **priorities in the professional development of beginning teachers**.

Table 2. Priority Competencies Identified by Teacher Educators

| Priority competency | Percentage of mentions (%) |
|-------------------------------------|----------------------------|
| Life and Earth Sciences didactics | 82 |
| Theory–practice articulation | 76 |
| Scientific inquiry-based approach | 69 |
| Assessment of student learning | 58 |
| Classroom and laboratory management | 46 |
| Total | 100 |

The results reveal a clear **hierarchization of competencies** perceived as priorities by Life and Earth Sciences (LES) teacher educators. **LES didactics** emerges as the most frequently cited competency (82%), highlighting its central role in teacher professionalization. The **articulation between theory and practice** (76%) and the **scientific inquiry-based approach** (69%) further confirm the importance attributed to contextualized pedagogical practices aligned with the epistemology of the discipline.

Assessment of student learning (58%) appears as an intermediate-level competency, whereas **classroom and laboratory management** (46%) is relatively less prioritized, suggesting that it is perceived as more strongly associated with professional experience acquired over time. Overall, these findings indicate a dominant orientation toward **didactic and reflective competencies** at the core of the quality of LES teaching.

1.2.2. Perceived Limitations of Initial Teacher Education

Teacher educators also identify several **structural limitations of initial teacher education** that may hinder the professional development of beginning teachers.

Table 3. Difficulties Encountered by Beginning Life and Earth Sciences Teachers

| Identified structural limitation | Percentage of teacher educators (%) |
|-----------------------------------|-------------------------------------|
| Life and Earth Sciences didactics | 71 |
| Theory–practice articulation | 65 |
| Scientific inquiry-based approach | 54 |
| Assessment of student learning | 49 |

The results highlight several **major limitations** perceived by teacher educators in current training arrangements. **Insufficient practicum duration** emerges as the primary constraint (71%), underscoring a mismatch between the demands of the profession and the time allocated to professional immersion. **Limited articulation with real classroom contexts** (65%) further confirms the difficulty of ensuring fully contextualized training.

Heterogeneity of assignment contexts (54%) and **insufficient coordination with pedagogical inspectors** (49%) reveal structural challenges that affect the coherence and effectiveness of support mechanisms. Overall, these limitations point to a need for **stronger integration between institutional training and professional realities**.

2. Beginning Teachers' Experiences

2.1. Perceived Preparedness

The questionnaire administered to 127 beginning Life and Earth Sciences (LES) teachers made it possible to examine their **perceived level of preparedness** upon entry into the teaching profession.

Table 4. Beginning Teachers' Perceived Level of Professional Preparedness

| Perceived level of preparedness | Number of respondents | Frequency (%) |
|---------------------------------|-----------------------|---------------|
| Well prepared | 28 | 22 |
| Moderately prepared | 61 | 48 |
| Poorly prepared | 38 | 30 |

The results indicate that **78% of beginning teachers report feeling moderately or poorly prepared** to perform their teaching duties upon entry into the profession.

2.2. Difficulties Encountered at the Beginning of the Career

Beginning teachers were also asked about the **main difficulties encountered in their professional practice** during the early stages of their careers.

Table 5. Difficulties Encountered by Beginning Life and Earth Sciences Teachers

| Difficulty encountered | Percentage of respondents (%) |
|---|-------------------------------|
| Classroom management | 72 |
| Organization of practical laboratory activities | 68 |
| Assessment of student learning | 61 |
| Adaptation to students' ability levels | 57 |
| Workload | 54 |

The results indicate that the most frequently reported difficulties relate to **classroom management** (72%) and the **organization of practical laboratory activities** (68%), highlighting the challenges associated with the effective conduct of teaching situations in Life and Earth Sciences. Difficulties related to the **assessment of student learning** (61%) and **adaptation to students' ability levels** (57%) reflect persistent pedagogical issues, particularly with regard to differentiation and the regulation of learning processes.

Finally, **workload** (54%) emerges as a cross-cutting constraint likely to affect the implementation of effective pedagogical practices. Overall, these findings underscore the **complexity of the professional demands** faced by teachers, particularly during the early stages of their careers.

3. Cross-Analysis of Stakeholders' Perspectives

Linking the findings derived from the interviews and the questionnaire makes it possible to develop a synthesis of the **convergences and divergences** among the different actors involved in the training and support of beginning Life and Earth Sciences (LES) teachers.

Table 6. Cross-Analysis of Stakeholders’ Perspectives (Joint Display)

| Difficulty encountered | Dominant orientation | Preferred temporality | Primary expressed need |
|---|---|-----------------------|---|
| Classroom management | Immediate classroom effectiveness | Short term | Didactic mastery and management of teaching situations |
| Organization of practical laboratory activities | Progressive development of competencies | Medium and long term | Theory–practice articulation and development of scientific inquiry approaches |
| Assessment of student learning | Supported professionalization | Induction phase | Concrete, continuous, and contextualized support |

This cross-analysis highlights **shared priorities regarding key teaching competencies**, while also revealing **differences in the temporalities and modalities of their acquisition across stakeholders**.

Discussion

This study aimed to analyze the professional development of beginning Life and Earth Sciences (LES) teachers in Morocco through the cross-analysis of perspectives from the main actors involved in teacher training and professional support. The findings reveal complex dynamics structured around differentiated conceptions of teacher professionalism, distinct temporalities of learning the profession, and persistent institutional tensions. These results align with international debates on professional induction and the development of science teachers.

1. Professional Development as a Situated and Multi-Temporal Process

A major contribution of this research lies in identifying differentiated temporalities of professional development as articulated by the actors involved. Pedagogical inspectors prioritize a logic of **immediate effectiveness**, focusing on beginning teachers’ ability to respond quickly to the demands of school contexts, particularly in terms of classroom management, implementation of disciplinary content, and compliance with institutional prescriptions. This orientation is consistent with studies showing that induction programs often emphasize short-term operational competencies perceived as necessary for the rapid stabilization of professional practices (Ingersoll & Strong, 2019; OECD, 2021).

In contrast, CRMEF teacher educators adopt a more **developmental conception of teacher professionalism**, emphasizing the progressive construction of complex competencies such as theory–practice articulation, mastery of scientific inquiry approaches, and professional reflexivity. This perspective is consistent with dominant approaches in science education research, which highlight that the appropriation of scientific practices and the didactic transposition of knowledge require time and exposure to diverse learning situations (Albe & Simonneaux, 2021; Duit et al., 2022).

The coexistence of these temporalities does not reflect a strict opposition but rather the **intrinsic complexity of teacher professional development**, which emerges at the intersection of immediate institutional requirements and longer-term learning processes. The findings therefore underscore the need for support mechanisms capable of articulating these temporalities rather than juxtaposing them.

2. Disciplinary Specificities of Life and Earth Sciences in Professional Development

The results confirm that the professional development of beginning LES teachers involves specific challenges related to the experimental and inquiry-oriented nature of the discipline. The recurrent difficulties reported—classroom and laboratory management, organization of practical activities, implementation of inquiry-based approaches, and assessment of student learning—are widely documented in the international literature on science teaching (Kind, 2019; Windschitl et al., 2020).

These difficulties reflect a mismatch between curriculum prescriptions, often ambitious in terms of scientific inquiry, and the concrete conditions of teaching, which are shaped by material, temporal, and organizational constraints. In this context, initial teacher education appears to be a **necessary but insufficient condition** for fully preparing beginning teachers for the complexity of the profession. As emphasized by Avalos (2018) and Darling-Hammond et al. (2020), the professional development of science teachers unfolds within a continuum that integrates training, practice, and reflexivity and cannot be ensured solely through the initial training phase.

The findings of this study therefore reinforce the need for **enhanced in-situ support**, enabling beginning teachers to contextualize acquired knowledge and develop adaptive competencies specific to LES teaching.

3. Crossed Perspectives and Institutional Tensions: An Issue Beyond the Moroccan Context

The cross-analysis of stakeholders' perspectives reveals institutional tensions between actors involved in training and support processes—tensions that extend well beyond the Moroccan context. The divergence observed between inspectors' expectations, centered on conformity and immediate effectiveness, and teacher educators' expectations, oriented toward long-term development, reflects a structural tension between **logics of control and logics of formation**, widely documented in international research (Kelchtermans & Ballet, 2018; Flores et al., 2021).

Beginning teachers find themselves at the core of this tension, required to simultaneously meet implicit expectations and sometimes contradictory demands. This situation contributes to the sense of professional fragility and insecurity reported by a majority of the teachers surveyed, a phenomenon frequently observed during the induction phase, particularly in scientific disciplines (Schmidt et al., 2017; OECD, 2021).

From this perspective, the Moroccan case examined in this study provides an empirical illustration of **global challenges related to teacher induction**, while offering an original contextual contribution that remains underrepresented in indexed literature.

4. Articulating Initial Teacher Education and Entry into the Profession: An Underexploited Lever

The findings reveal a lack of coordination between initial training provided by CRMEF and early-career support mechanisms. This institutional discontinuity limits the effectiveness of existing arrangements and reinforces the sense of rupture expressed by beginning teachers. However, numerous studies demonstrate that the most effective education systems are those that implement **integrated induction models**, combining mentoring, targeted professional development, classroom observation, and communities of practice (Ingersoll et al., 2018; OECD, 2021).

The results of this study suggest that the professional development of beginning LES teachers would benefit from being conceived as a **continuous institutional process**, grounded in strengthened collaboration among CRMEF, pedagogical inspectors, and schools. Such an approach would make it possible to move beyond fragmented logics and foster more coherent, progressive, and contextualized support.

5. Contributions and International Relevance of the Study

Beyond its national anchoring, this research contributes to international debates on science teacher education and induction by providing empirical evidence from a **Global South context**, which remains marginally represented in indexed journals. By mobilizing a mixed-methods design and a cross-stakeholder analysis, the study enriches existing research by showing how training reforms inspired by international models are concretely enacted within specific educational contexts.

The study also highlights the value of conceptualizing professional development as a **collective and systemic process**, involving the entire educational ecosystem rather than framing it as an individual responsibility of beginning teachers. This positioning aligns with contemporary approaches to professional development that emphasize the shared responsibility of educational systems in supporting successful entry into the profession (Darling-Hammond et al., 2020; Opfer & Pedder, 2019).

Conclusion

This study highlights the **situated, progressive, and multi-temporal nature** of the professional development of beginning Life and Earth Sciences (LES) teachers, constructed at the intersection of differentiated institutional logics. The findings reveal a persistent tension between a requirement for **immediate effectiveness**, primarily promoted by pedagogical inspectors, and a more **developmental conception of teacher professionalism** advocated by teacher educators. Positioned at the interface of these logics, beginning teachers report a prevailing sense of insufficient preparedness, particularly with regard to the practical and organizational dimensions of the profession.

Beyond the Moroccan context, this research contributes to international debates on science teacher induction by emphasizing the importance of conceptualizing professional development as a **continuum** that articulates initial teacher education, early-career support, and experiential learning.

Limitations and Future Research Directions

This study is limited by its disciplinary focus on Life and Earth Sciences and by the primary reliance on self-reported data. Future research could adopt **longitudinal designs** and incorporate **classroom observations** in order to more finely analyze the evolution of professional development during the early career phase. Exploring **integrated induction models** that promote stronger coordination between initial teacher education and institutional support mechanisms also represents a key direction for future research.

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