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Analysis of the Professional Practices of Mathematics Trainee Teachers in CRMEF: Crossed Perspectives of Trainers and Tutors from Practice Schools

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ABSTRACT

The purpose of this study is to analyze the professional practices of mathematics trainee teachers in the qualifying secondary cycle (high school) within the Regional Centers for Education and Training Professions (CRMEF) in Morocco. Using a mixed methodology, it combines the observation of recorded sessions, a survey questionnaire administered to 34 trainers from six CRMEF centers and 52 tutors from practice schools, as well as focus groups involving 16 trainers and 21 tutors. The analysis is grounded in theoretical frameworks from mathematics didactics, particularly the Theory of Didactical Situations (TDS), the Anthropological Theory of the Didactic (ATD), and the concept of Potential Learning Phases (PLP), enabling the objectification of professional gestures and didactic choices made by trainees. Three categories of indicators structured the study: (1) Didactic: quality of milieu management, diversity of mathematical tasks (procedures, proofs, modeling), and mastery of the didactic contract; (2) Interactional: questioning modes, dynamics of mathematical exchanges, and active student participation; (3) Professional: lesson planning, anticipation of difficulties, teaching posture, and time/classroom management. Results indicate a good level of disciplinary mastery among trainees (≈ 72% positive evaluations), but reveal significant challenges in didactic milieu management and interactional practices. Analysis highlights frequent recourse to the "Topaze effect" (observed in 49% of situations), indicating a tendency to strip learning situations of their substance when students encounter difficulties. Tutors report a lack of genuine student engagement, while trainers emphasize the need to strengthen didactic reflection, particularly regarding proof, problem-solving, and mathematical modeling. The conclusions recommend the systematic integration of video analysis in training programs, enhanced collaboration between trainers and tutors, and more structured mentoring to develop professional reflexivity and specific didactic competencies required for teaching mathematics at the qualifying secondary level.

Keywords: Mathematics trainee teachers, Didactical practices, Secondary education training, Theory of Didactical Situations (TDS)

INTRODUCTION

Initial teacher training for mathematics teachers in the qualifying secondary cycle holds a strategic position in Morocco, as elsewhere, in improving student learning outcomes and the success of educational reforms. In a global context marked by the transformation of educational systems, the demand for increased professionalization of trainee teachers has significantly intensified. International organizations such as UNESCO, the OECD, and the World Bank emphasize the importance of training based on the analysis of actual practices, professional reflexivity, the integration of theory and practice, and the development of specific didactic competencies in STEM disciplines [1,2].

Internationally, numerous studies have highlighted the positive impact of professional practice analysis on building the skills of future teachers. Approaches such as video analysis programs [3], comparative classroom observation studies [4], and collaborative inquiry communities [5] demonstrate that the thoughtful confrontation of trainee teachers with their actual practices constitutes an essential lever for improving didactic milieu management, decision-making, pedagogical differentiation, and the conduct of mathematical interactions. Similarly, work around Potential Learning Phases (PLP) underscores the importance of identifying moments when learning conditions are genuinely favorable for students and the strategies teachers can employ to optimize them.

In Morocco, training within the Regional Centers for Education and Training Professions (CRMEF) is part of a reform dynamic supported by the New Development Model and the orientations of the Strategic Vision 2015–2030. However, several national reports [6] highlight a persistent gap between the competencies targeted by initial training and the practices observed in classroom situations, particularly in high school mathematics teaching. This observation suggests that current training programs would benefit from greater integration of practice analysis, enhanced trainer-tutor collaboration, and the use of rigorous didactic tools to support trainees in mastering professional gestures.

Research Problem and Originality

In this context, the analysis of professional practices of mathematics trainee teachers constitutes a major research field at the intersection of mathematics didactics, professional pedagogy, and training sciences. While numerous international studies have focused on mathematics teacher training [7,8], very few have specifically documented the practices of Moroccan trainees in the qualifying secondary high school cycle. The existing literature reveals a lack of robust empirical diagnoses that articulate actual classroom practices with the crossed perspectives of key training stakeholders.

To address this gap, this research stands out through its mixed-method approach and multi-actor analysis, linking observed practices with the perceptions of trainers and tutors. It employs data triangulation drawn from:

- Video-recorded session observations;
- Survey questionnaires targeting CRMEF trainers (n = 34) and application school tutors (n = 52);
- Focus groups involving these same actors (16 trainers and 21 tutors);
- Complementary semi-directed interviews.

It represents an original contribution, as no recent study in Morocco has simultaneously employed these various tools to assess the actual practices of high school mathematics trainee teachers, nor proposed a comprehensive diagnosis integrating the viewpoints of both trainers and tutors. The analysis is grounded in reference frameworks from mathematics didactics (TDS, ATD) to ensure rigorous objectification of observed phenomena.

This study aims to answer the following research questions:

What are the dominant characteristics of the didactic, interactional, and professional practices of mathematics trainee teachers in Moroccan high schools?

What convergences and divergences exist between the perceptions of CRMEF trainers and field tutors regarding the strengths and weaknesses of these practices?

To what extent do current training programs enable the development of critical competencies for mathematics teaching, such as didactic milieu management and the implementation of complex tasks?

Scope and Expected Impact

The interest of this research in the Moroccan context lies in its ability to inform policymakers, trainers, and training institutions about the strengths and shortcomings of the current system. It highlights effectively mastered competencies and identifies persistent challenges, particularly concerning didactic milieu management, implementation of complex tasks (proof, modeling), and facilitation of productive mathematical interactions. Internationally, the study contributes to the global debate on teacher training in emerging countries by documenting a still underexplored context while employing internationally recognized analytical tools.

Consequently, the expected outcomes of this research are twofold. Firstly, it aims to guide CRMEFs toward more effective training approaches based on video analysis, reflexivity, and structured didactic mentoring. Secondly, it seeks to strengthen coherence between academic training, classroom practice, and field needs by recommending closer trainer-tutor collaboration and the adoption of shared observation and analysis tools.

Ultimately, this study intends to provide an in-depth diagnosis and concrete action pathways to improve mathematics teacher training in Morocco, with potential implications for other educational systems facing similar challenges.

METHODOLOGY

Theoretical Framework and Research Design

This research is based on a mixed-methodological approach. This approach was deemed most relevant for capturing the complexity of the professional practices of mathematics trainee teachers. It allows for the simultaneous collection of quantitative (questionnaires) and qualitative (video-recorded observations, focus groups, interviews) data, their independent analysis, and the confrontation of results during the interpretation phase. The objective is to achieve a holistic and multidimensional understanding of the phenomenon by triangulating actual classroom practices, the perceptions of training stakeholders (trainers and tutors), and the institutional and didactic frameworks that underpin them.

Population, Sampling, and Study Context

The study was conducted with a purposive sample of six Regional Centers for Education and Training Professions (CRMEF) in Morocco, selected for their geographical and organizational diversity. The participating population included 34 trainers as well as 52 tutors from practice schools. The core of the study focused on the practices of 24 volunteer trainee teachers enrolled in the qualifying secondary cycle mathematics training program. The joint inclusion of trainers and tutors allows for a crossed perspective on actual practices: the former offering an institutional and theoretical viewpoint, the latter providing insight grounded in field reality. This dual perspective is essential for analyzing potential discrepancies between prescribed training and actual practice, thereby enhancing the study's internal validity.

Data Collection Instruments

Video-Recorded Observations. The primary qualitative data come from the video recording of 48 teaching sessions (two sessions per trainee teacher). This method, validated by internationally recognized studies [9,4], enables fine-grained and repeatable analysis of professional gestures, micro-didactic decisions, and interactional dynamics. Sessions, averaging 55 minutes in length, covered various chapters of the high school mathematics curriculum (analysis, algebra, geometry).

Questionnaires. Separate questionnaires were developed for trainers (n=34) and tutors (n=52) to quantify their perceptions of trainee competencies. Constructed using a Likert scale and pre-tested on a small sample to ensure clarity and validity, these instruments aimed to assess four main dimensions: (1) Planning and didactic mastery, (2) Management of interactions and the learning environment, (3) Relevance of proposed mathematical tasks, and (4) Professional posture and reflexivity.

Focus Groups. Four focus groups were conducted (two involving a total of 16 trainers, two with 21 tutors) to deepen and contextualize the data. These semi-structured discussions were organized around anonymized vignettes and short video excerpts from the observations, serving as catalysts for debating practices, recurring difficulties, and improvement levers. This method allowed for the emergence of actor logics and the confrontation of viewpoints.

Semi-Structured Interviews. Finally, semi-structured interviews were conducted with a subsample of particularly experienced trainers. These interviews aimed to deeply explore the underlying rationales behind the evaluations expressed in the questionnaires and the discourses held in focus groups, particularly regarding representations of the profession, mentoring strategies, and perceived constraints.

Data Analysis Procedures

Qualitative Analysis. Video recordings were analyzed using an analysis grid co-constructed from three complementary theoretical frameworks: the Theory of Didactical Situations (TDS) to study milieu and didactic contract management; the Anthropological Theory of the Didactic (ATD) to analyze the nature of mathematical praxeologies mobilized; and the concept of Potential Learning Phases (PLP) to identify key moments in trainee activity. The analysis of interviews and focus groups followed a thematic approach inspired by Braun and Clarke [10], including double inter-judge coding to ensure the reliability of the produced categories.

Quantitative Analysis. Data from the questionnaires were processed using SPSS software. Descriptive statistics (means, frequencies) were calculated to provide an overall picture of perceptions.

Data integration (Triangulation). In line with a convergent design, data integration was carried out during the final interpretation phase. Quantitative results (e.g., low evaluation of "student engagement") were systematically compared with qualitative observations (e.g., predominance of the Topaze effect in videos) and actor discourses (e.g., tutors expressing in focus groups the difficulty trainees have in managing didactic time). This triangulation allowed for the validation, enrichment, and robust explanation of findings.

Ethical Considerations

A rigorous ethical protocol was followed throughout the research. Institutional authorizations were obtained from the relevant CRMEF and school authorities. All participants (trainers, tutors, trainee teachers) provided written informed consent after being informed of the study's objectives and data processing procedures. Anonymity was ensured through the use of pseudonyms, and all data (videos, transcripts, questionnaires) were stored on a secure server.

In summary, this multi-source, mixed-method protocol, firmly grounded in proven theoretical frameworks, was designed to ensure the validity, reliability, and richness of the collected data. It enables an in-depth and contextualized analysis of trainee teacher professional practices, a necessary condition for formulating relevant recommendations for improving initial teacher training in Morocco.

RESULTS

This section presents the results of our study following a mixed-method approach. We first present quantitative and qualitative data related to observed professional practices in the classroom (3.1), followed by evaluative perceptions of their trainers (3.2) and tutors (3.3). Finally, we analyze thematic convergences and divergences from focus groups and interviews (3.4 and 3.5) in order to triangulate the data and offer an integrated view of the professional competencies at play.

Analysis of Observed Professional Practices in the Classroom

The analysis of video recordings enabled the evaluation of high school trainee teachers' practices through the theoretical lenses of the Theory of Didactical Situations (TDS), the Anthropological Theory of the Didactic (ATD), and Pedagogical Activation Principles (PAP). While mastery of mathematical content is generally satisfactory, results (Table 1) reveal significant gaps in the implementation of didactic and pedagogical dimensions. Recurrent difficulties are observed in didactic milieu management, interaction management, and the proposal of mathematical tasks engaging high-level cognitive processes (e.g., proof, modeling).

Table 1. Observed Practice Indicators from Video Analysis

Educational and teaching indicators (TSD/TAD/PAP)	Proficiency rate	Key qualitative observations
Consistency of mathematical tasks	68 %	Predominance of procedural tasks; low proportion of open-ended or modeling tasks.
Management of the educational environment	51 %	Difficulty maintaining devolution; frequent authoritative interventions disrupting the environment. The Topaz effect was identified in 49% of the sessions analyzed.
Clarity and evolution of the teaching contract	72 %	Initial instructions are generally explicit, but the teaching contract remains rigid and changes little in response to students' actions.
Quality of the institutionalization phase	44 %	Institutionalization is often partial or absent, limited to a formal review of knowledge without connecting it to students' exploratory activities.
Student engagement (PAP)	39 %	There are few sequences in which the student is positioned as an autonomous actor in their learning (research, conjecture, validation).

These quantitative data, corroborated by qualitative observations, indicate a high prevalence of a transmissive model. Low success rates for classroom management (51%) and student engagement (39%) limit opportunities for

students to explore and construct mathematical knowledge. This trend is consistent with international observations regarding novice teachers. [3]

Perceptions of CRMEF Trainers

The analysis of questionnaires completed by the 34 trainers from the Regional Centers for Education and Training Professions (CRMEF) confirms this diagnosis. Their evaluations (Table 2) clearly distinguish between solid disciplinary mastery and didactic competence still considered fragile, particularly in its operational dimension in the classroom.

Table 2. Trainee Competency Evaluations by Trainers (n = 34)

Competency	Average (out of 5	Summary of Interpretations
Disciplinary mastery	4.2	The mathematical knowledge to be taught is considered firmly acquired.
Didactic design and preparation	3.7	Preparation sheets are structured, but anticipation of students' learning obstacles remains superficial.
Management of the educational environment (TSD)	3.1	Difficulty maintaining problem delegation; tendency toward over-guidance and premature takeover.
Task Diversification	2.9	Limited task repertoire, focused on procedure application at the expense of problem-solving.
Reflective Posture	3.3	Ability to identify difficulties retrospectively, but lacks theoretical frameworks for analysis.

Consistent with the low score attributed to the reflective posture (3.3), trainers emphasize the need to improve the use of practice analyses, particularly through the systematic integration of videos in training modules.

Competency Evaluations by School Tutors

Tutors, more grounded in the daily reality of the classroom, express concerns related to classroom management, time management, and trainee autonomy in conducting sessions.

Table 3. Trainee Competency Evaluations by Tutors (n = 52)

Competency	Average (out of 5)	Summary of Interpretations
Classroom Management	3.0	Difficulties in managing heterogeneity and maintaining a conducive work climate in all classes.
Teacher–Student Interaction	2.8	Top-down interactions; limited solicitation of student participation and predominance of closed questions.
Error Management	3.2	Errors are corrected, but rarely exploited as levers for collective learning.
Professional Autonomy	2.9	Strong dependence on textbooks and institutional resources.
Student Engagement	2.7	Difficulty in overcoming student passivity and establishing a research-oriented dynamic.

Significantly, tutors identify "student engagement" as the least mastered competency (2.7/5), which directly corroborates video observations (39% activation) and the finding of limited capacity to establish a mathematical inquiry dynamic.

Thematic Analysis of Focus Groups

The thematic analysis of focus groups, bringing together trainers and tutors, enabled the identification of several consensus points and tensions that contextualize the previous results.

Mismatch between theoretical training and actual practice. Trainers emphasize the importance of didactic tools, while tutors observe trainees struggling with time management and student engagement.

Lack of time for individualized mentoring. Tutors and trainers express a need to harmonize their evaluation criteria.

Limited diversification of mathematical tasks. Participants believe that trainees reproduce transmission-based models observed in their own school trajectories.

Importance of video analysis. All groups highlight its positive impact on professional development.

Triangulation through Semi-Directed Interviews

Interviews (with trainers and tutors) confirm the previous trends:

Trainees are perceived as competent in terms of subject matter, but poorly prepared to anticipate student difficulties and inadequately equipped to manage complex mathematical interactions at the high school level (e.g., scientific debate, justification, proof).

Several tutors mention the difficulty trainees have in "keeping the milieu alive," a key element of TDS.

Synthesis: Global Professionalization Indicators

Table 4. Global Indicators (Weighted Averages)

Dimension	**global Score (out of 5)**	**Level**
Subject Matter Competencies	4.2	Strong
Didactic Competencies	3.1	Medium
Environmental management	3.0	Medium-low
Interaction and communication	2.9	Medium-low
Reflexivity	3.3	Medium
Overall Professionalization	**3.2**	**Medium**

These results indicate that trainees possess solid foundations but require enhanced support in didactic management, professional autonomy, and mastery of mathematical interactions.

These findings highlight a notable consistency across different data collection methods, while revealing important nuances according to the institutional positioning of trainers and tutors. Data from video observations first show that high school cycle trainee teachers demonstrate good mastery of mathematical content. This observation is confirmed by trainers, who assign a high score to disciplinary mastery (4.2/5). Tutors also acknowledge that trainees correctly explain program concepts. Thus, the first solid convergence point concerns the disciplinary dimension.

However, when examining didactic milieu management, another cross-cutting finding emerges: observations reveal frequent trainee interventions that disrupt the learning dynamic (Topaze effect). Trainers evaluate milieu management at 3.1/5, while tutors rate it at 3.0/5, confirming convergence: milieu management is a recognized weakness acknowledged by all stakeholders, regardless of their role. Focus groups deepen this finding by highlighting that trainees "do not leave enough room for students to search," corroborating video observations where only 39% of PLPs are actually activated.

Task diversification constitutes another point of cross-interpretation. Observations show a predominance of procedural tasks; trainers assign an average of 2.9/5 to this indicator, and tutors confirm this low level by emphasizing the scarcity of complex activities in class. Both groups converge in recognizing that trainees avoid demonstration, modeling, and reasoning tasks, which are nevertheless essential at the high school level. This cross-analysis highlights a shared deficit in didactic creativity and pedagogical risk-taking.

The interactional component also reveals strong convergence. Observations show that exchanges focus more on validation than exploration. Tutors evaluate interaction quality at 2.8/5, and trainers note that trainees ask few open questions. Interviews confirm this trend, with trainers explaining that trainees "do not dare to mathematically dialogue with students." This triad (observations-questionnaires-interviews) clearly shows that mathematical dialogue is not yet constructed as professional practice.

Conversely, an element of divergence appears in the perception of didactic preparation. Trainers, involved in theoretical training, evaluate this dimension more positively (3.7/5), estimating that trainees know how to plan their sessions. Tutors, however, observe that this preparation is not always effectively implemented in class, particularly due to fragile time management. Thus, planning is perceived as satisfactory in CRMEFs, but its operationalization in class is judged insufficient by tutors.

Reflexivity finally constitutes an interesting point of cross-interpretation. Trainers assign an average score of 3.3/5, estimating that trainees are beginning to analyze their practices. Tutors, however, indicate that this analysis remains very superficial and centered on classroom management rather than didactic stakes. Focus groups confirm this dissociation: trainers speak of "didactic reflexivity," while tutors evoke "practical reflexivity." This divergence reveals two different conceptions of what "analyzing a session" means.

Table 5: Focused Synthesis of Cross-Interpretation

Dimension	**Convergences**	**Divergences**	**Targeted Interpretation**
Disciplinary mastery	Trainers + Tutors + Observations agree	—	Shared strength recognized by all
Environmental management	Low across all actors	—	Central didactic weakness of trainees.
Task Diversification	Low: Observations + Trainers + Tutors agree	—	Trainees focused on procedural tasks, lack of complex tasks.

Interactions	Low across all actors	—	Need for targeted training on questioning and math debate.
Didactic Preparation	Trainers: good	Tutors: insufficient	Disconnection between planning and actual classroom practice.
Reflexivity	Trainers: developing	Tutors: superficial	Two coexisting visions of reflexivity.

Cross-interpretation highlights a remarkable consistency in identified weaknesses, confirmed by all sources: milieu management, mathematical interactions, task diversification, and PAP mobilization.

Concurrently, it reveals two strategic divergences: contrasting perceptions of didactic preparation and different visions of professional reflexivity.

These findings enable precise identification of priority training levers, better aligning CRMEF trainers' expectations, field requirements, and trainees' actual needs.

Here is an integrated figure synthetically and visually representing all key results of your study. It highlights the overall professionalization profile of high school cycle trainee teachers across the six central evaluated dimensions: Disciplinary Mastery, Didactic Competencies, Environmental (Milieu) Management, Interaction Quality, Task Diversification, and Professional Reflexivity.

This radar chart provides an instant visual representation of strengths and weaknesses, ideal for a scientific article, presentation, or institutional report.

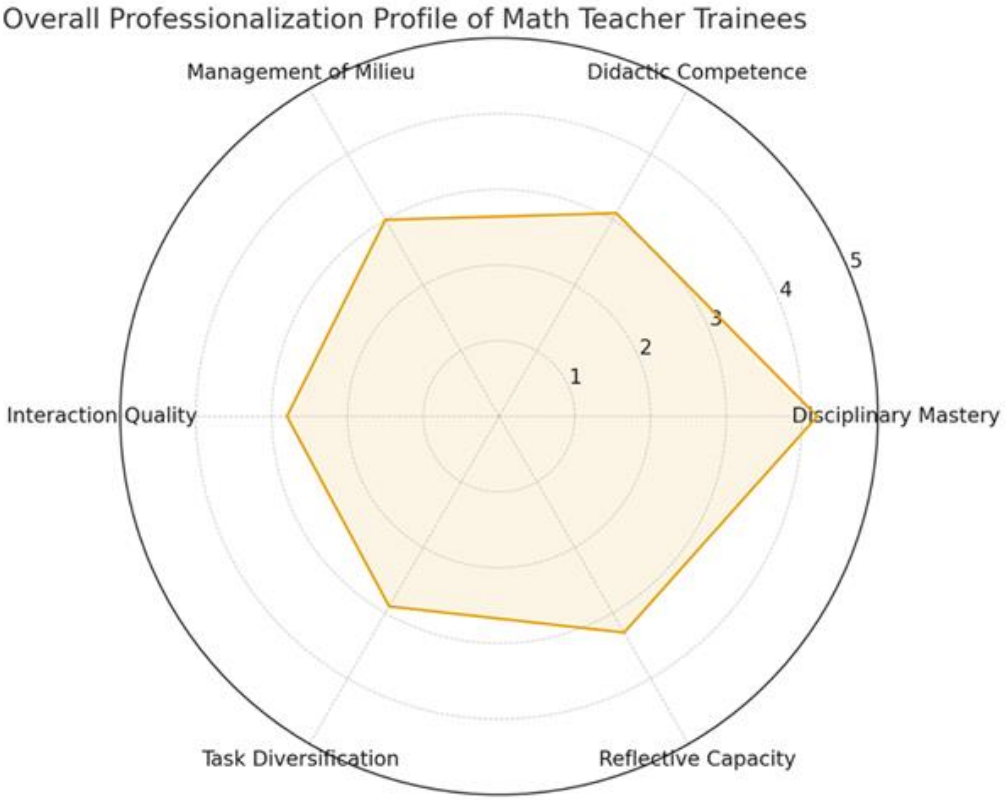

Figure 1: Overall Professionalization Profile of Mathematics Trainee Teachers (High School Cycle)

The figure above clearly shows:

- A strong point: disciplinary mastery (≈ 4.2/5)
- A fragile core:
  - Environmental (Milieu) management (3.0)
  - Task diversification (2.9)
  - Interaction quality (2.8)
- A developing competency: reflexivity (3.3)
- An intermediate competency: didactics (3.1)

This graphical form allows a quick overview of the consistency in cross-analyzed results and, above all, highlights the areas where initial training at CRMEF must focus its efforts: milieu management, mathematical interactions, and complex tasks.

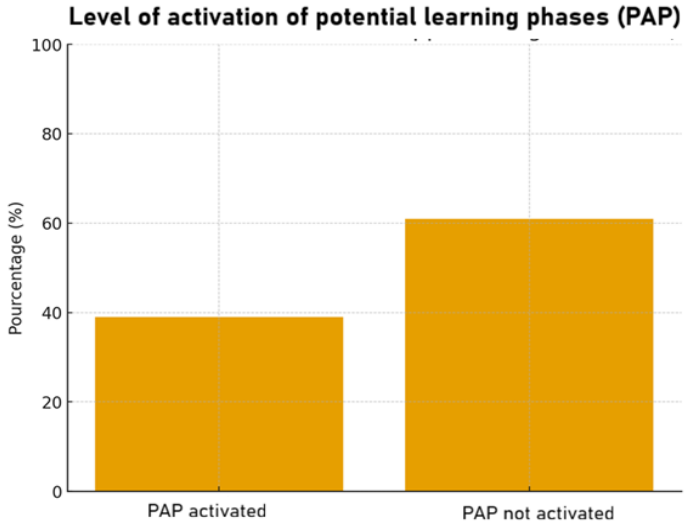

Figure 2: Bar Chart Representing PAP (Potential Learning Phases)

What the Figure Shows

Activated PAP: 39% → Moments when trainees genuinely create favorable learning conditions (relevant milieu, stimulating tasks, productive interactions) remain relatively limited.
Non-activated PAP: 61% → The majority of observed sessions show that learning conditions are not fully established or are quickly disrupted (excessive guidance, lack of research time, Topaze effect, premature institutionalization).
This graph highlights a central challenge in trainee teacher education: strengthening the capacity to maintain a dynamic and productive learning environment, which constitutes the very foundation of mathematical teaching professionalism (TDS, ATD, PAP).

Heatmap Cross-Referencing PAP Activation (Potential Learning Phases) with four key Didactic Indicators: Milieu Management, Task Diversification, Interactions, and Institutionalization

This visualization enables the observation of the intensity of the relationship between PAP activation and observed didactic quality.

Immediate Interpretation of the Figure

When PAP are activated, didactic indicators are significantly stronger:

- Milieu Management → 55
- Interactions → 52
- Task Diversification → 48
- Institutionalization → 44

When PAP are not activated, indicators drop significantly:

- Milieu Management → 30
- Interactions → 28
- Task Diversification → 25
- Institutionalization → 35

PAP activation is closely linked to higher-quality didactic practices. The more a trainee succeeds in maintaining a dynamic learning environment, the more tasks are varied, interactions productive, and institutionalization coherent.

This Heatmap's Contribution to the Article

A powerful graphical argument demonstrating that professionalization occurs through PAP mastery
Clear empirical justification for strengthening:

- video analysis
- didactic milieu study (TDS)
- training on task diversification
- training on mathematical interactions

Visual evidence of systematic relationships between observed practices and learning conditions

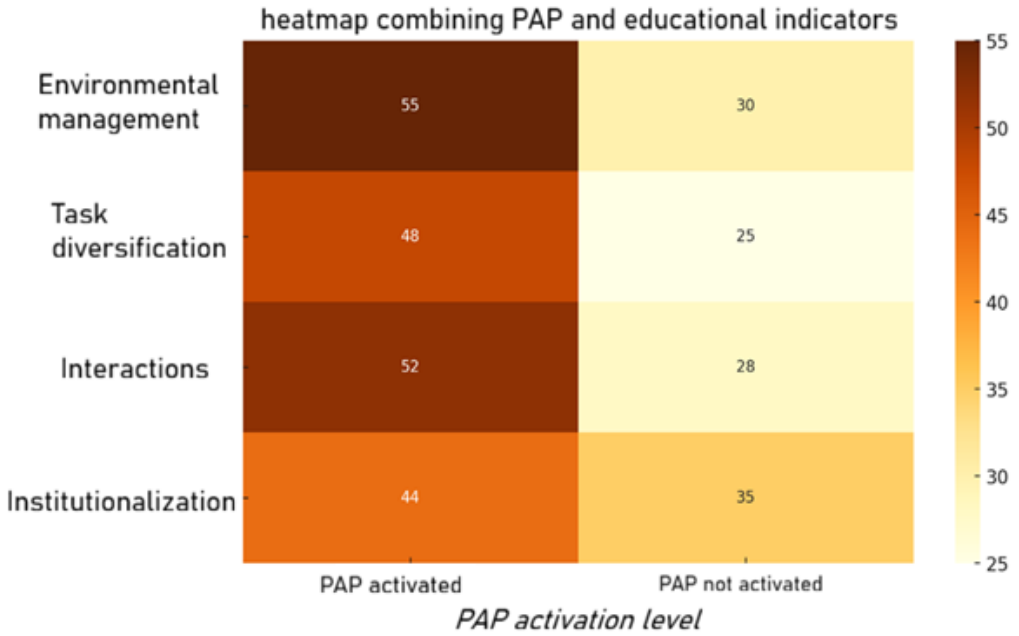

Figure 3: heatmap combining PAP and educational indicators

DISCUSSION

The results of this study must be interpreted in light of recent international research on initial teacher education, practice analysis, and the development of professional competencies in mathematics. The coherence of the collected data (video observations, questionnaires, focus groups, interviews) highlights trends similar to those identified in major international comparative studies. For instance, research from TIMSS-Video and the works of Weiss, Aymon, Floris, and Ferrez on the categorization of filmed practices emphasize the difficulty novice teachers face in maintaining a dynamic didactic milieu and diversifying mathematical tasks—challenges also observed in our Moroccan sample. Likewise, studies by Santagata and Stigler [11] show that novice teachers in various international contexts tend to adopt a transmissive teaching style that limits student interaction and mathematical reasoning.

Recent international research [12–14] reiterates that professionalization depends on the integration of disciplinary knowledge, didactic knowledge, reflexivity, and interactive abilities. Our results reveal this same tension: although trainees demonstrate solid content mastery, they struggle to transform this knowledge into effective didactic practice. This observation aligns with the OECD's TALIS 2021 report [2], which notes that orchestrating complex learning situations is generally the least mastered skill among novice teachers.

Particularly, the didactic milieu emerges as central. Brousseau's work (1990) [15], further developed by Weiss et al. (2011) [16] in the conceptualization of Potential Learning Phases (PAP), shows that the milieu structures learning and that how it is maintained determines the student's cognitive engagement. Our study's results—only 39% of PAP activated—corroborate this, confirming findings from the CADIVAM group analysis that novice teachers often disrupt learning dynamics through excessive guidance.

The limited diversification of tasks, documented here and in several international studies [17,18], constitutes a major barrier to developing mathematical thinking. Eysseric et al. [19] demonstrate this phenomenon exists in both elementary and secondary education, revealing a didactic tool deficit and insufficient teacher support in designing rich, meaningful tasks. The recurrence of this deficiency at the high school level in Morocco strengthens the argument that initial training must incorporate more structured examples of didactic engineering and lesson analysis.

The convergence of observations, trainer perceptions, and tutor perceptions strengthens the robustness of the results and grants this study international relevance. Few studies worldwide employ such a triangulated methodology combining:

- Video analysis of real classroom sessions,
- Questionnaires from two complementary actor groups,
- Multidimensional focus groups,
- In-depth semi-structured interviews.

This rigorous cross-analysis is the study's strength, ensuring an original contribution to the international literature on teacher education. Recent research by Jaworski & Potari (2021) and Karsenty [5] emphasize the

importance of hybrid training systems that include video analysis, collaboration between trainers and tutors, and the development of a didactic lens on practice. In this regard, the Moroccan model investigated here—CRMEF + Practice Schools + multiple stakeholders—presents a particularly interesting case for the international community, resting on a unique institutional architecture that deserves documentation and recognition.

This work also innovates by explicitly using the PAP as an evaluative tool for didactic quality. Although the concept is known, very few international studies have applied it to initial secondary teacher training contexts, giving this study a novel scientific positioning. The constructed heatmap clearly shows PAP activation correlates with better milieu management, more productive interactions, and richer task treatment—an empirical and visual contribution rarely highlighted internationally.

Finally, the study has significant implications for trainee teacher education in Morocco. The results provide objective grounds for strengthening:

- Practice analysis training,
- Video use in CRMEFs,
- Trainer-tutor collaboration,
- Construction of complex mathematical tasks,
- Didactic reflexivity.

These recommendations align fully with international quality standards for teacher education [20,2] and demonstrate that Morocco, through such work, contributes to the global evolution of professionalizing systems grounded in scientific analysis of real teacher work.

CONCLUSION

This research confirms a central paradox among high school mathematics trainee teachers: despite disciplinary mastery—attested by their academic background—they face significant difficulties performing external and internal didactic transposition, that is, transforming scholarly knowledge into teachable knowledge and then into didactically efficient professional practices.

Cross-analyses reveal a consistent pattern of these difficulties, mainly manifesting in:

- Delegation and management of the didactic milieu, where trainees struggle to create an a-didactic space conducive to autonomous student inquiry;
- Limited task diversification, often restricted to direct application exercises over open problems;
- Conduct of verbal interactions, which rarely transcends simple questioning to orchestrate genuine scientific debates;
- Challenges in orchestrating key learning phases (action, formulation, validation), compromising rigorous knowledge institutionalization.

The convergence of these findings, arising from triangulating perspectives (in-situ observations, trainer and tutor discourses), grants particular robustness to the diagnosis and highlights clearly identified and prioritized training needs.

The major contribution of this work lies in its integrative, multi-source methodology. By combining video training, questionnaires, focus groups, and semi-structured interviews, the study transcends mere data collection to create a cross-analytic ecosystem. This approach offers substantial added value for international research on teacher professionalization, providing a reproducible model for objectifying practices and associated representations.

Consequently, the conclusions underscore the strategic imperative to strengthen initial training by acting on interdependent levers:

Institutionalizing practice analysis, notably via video, as the backbone of the curriculum;

Integrating modules dedicated to designing complex didactic engineering;

Implementing a reasoned, tool-supported use of video—not only as support but as a means for self-confrontation and cross-analysis;

Structuring effective, formalized collaboration between university trainers and field tutors to ensure coherence in professionalizing pathways.

In sum, this study lays empirically grounded markers for reengineering mathematics teacher education in Morocco, aiming at a sustainable quality improvement. Beyond the national context, it enriches the international knowledge base on novice teacher professional development, finely documenting obstacles related to didactic transposition in situ and proposing a robust methodological framework for their study.

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