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Pre-Service Chemistry Teachers Practicum Experiences in Libya: Challenges, Support Needs, and Supervisors Perspectives

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Abstract: Teaching practicum is an important stage in chemistry teacher education because pre-service teachers need to apply what they have learned at the university in real classrooms while facing real constraints such as time, classroom control, safety issues, and limited school resources. This study explores practicum experiences of final-year pre-service chemistry teachers in Libya, focusing on the main challenges they face and the support they need across different school contexts. A convergent mixed-methods design was used, combining a questionnaire with semi-structured interviews to compare students' and supervisors' views. Questionnaire data were collected from 60 final-year female pre-service chemistry teachers from the Chemistry Department, Faculty of Education, University of Zawia, who were placed in 9 practicum schools (urban: n = 42; non-urban: n = 18). At the same time, nine practicum supervisors were interviewed to identify recurring difficulties and potential improvements in the practicum program. The survey showed high pressure related to classroom management and limited lesson time, difficulty in teaching abstract chemistry concepts and linking macroscopic, symbolic, and particle-level explanations, and frequent student misconceptions with lower confidence in assessing understanding. Students also reported limited lab access and school resources, and not enough satisfaction with university supervision feedback. The supervisors' interviews supported these results, pointing to clear time-loss points during lessons, crowded classes that make safety harder, and a common move to demonstration or theory-based lessons when resources are limited. Overall, the findings suggest the need for a stronger support system in practicum, including clearer mentoring, regular observation and feedback, chemistry-focused teaching resources, simple diagnostic assessment tools, and low-cost, safe lab alternatives. This study provides evidence from Libya and gives practical suggestions to improve chemistry teacher preparation and school–university cooperation.

Keywords: Chemical Representations; Formative Assessment; Mentoring and Supervision; Pre-Service Teachers; Teaching Practicum.

Introduction

Teaching practicum is widely regarded as the most influential stage of initial teacher education because it is where pre-service teachers must convert university learning into real classroom decisions while managing authentic constraints such as student behavior, limited lesson time, assessment demands, and school expectations [1], [2]. In chemistry teacher preparation, this phase is especially demanding because novice teachers must also address safety requirements and work within the practical limits of available laboratory facilities and instructional resources [3]. Contemporary scholarship further emphasizes that practicum learning is not determined by individual readiness alone; it is co-shaped by the mentoring system, the placement environment, and the quality of feedback and task support that pre-service teachers receive during planning, teaching, and reflection [4]. Work on inquiry-oriented practicum also shows that pre-service teachers and mentors often experience recurring difficulties across phases of planning, enactment, and reflection, and that improving practicum outcomes requires making the support process visible and collaborative rather than assumed or implicit [5].

In science and chemistry contexts, the practicum becomes even more sensitive to placement realities because the subject requires both disciplined conceptual explanation and access to safe practical experiences. Large-scale evidence from science teaching practice indicates that the support available to pre-service teachers can be uneven, and that many placement schools operate with limited laboratory infrastructure, equipment, and chemicals, narrowing the range of what science teaching can realistically look like during field experience [6]. In Libya, this challenge can be more consequential because practicum placements vary by school context and resources, meaning that student teachers' experiences are shaped not only by their own preparation but also by the material and organizational conditions of the schools in which they practice [7-9].

Within chemistry education specifically, recent classroom-based research continues to show how constraints in laboratory access, time, and staffing shape teachers' instructional choices. In a recent study of chemistry teachers' laboratory practices, lab activities were often positioned as supplementary, implemented in teacher-centered "recipe-style" formats, and limited by logistical and resource-related barriers, patterns that can push instruction away from inquiry and hands-on learning even when teachers value experiments [10]. For pre-service chemistry teachers, encountering these realities during practicum can influence what they attempt, what they avoid, and what they come to see as feasible chemistry teaching, particularly when safety responsibilities

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and large groups must be managed without reliable resources.

Teacher education in Libya has traditionally relied on theoretical foundations provided in colleges or universities. This can leave pre-service teachers facing serious practical challenges during practicum. The practicum is considered one of the most important courses in teacher education [11] because it provides practical knowledge and teaching experience that support the transition from student to teacher. However, pre-service teachers may still face challenges during practicum that negatively affect their professional preparation. Examining pre-service chemistry teachers' perceptions and experiences can therefore provide valuable insight into readiness for the teaching profession and can support the development of viable alternatives that make teacher education programs more effective. Furthermore, including practicum supervisors' perspectives can enrich interpretation by clarifying recurring patterns across placements and highlighting feasible supports.

At the same time, modern chemistry teaching demands competence beyond content coverage, including inquiry-oriented pedagogy and the capacity to select tasks that help students reason, explain, and connect evidence to concepts. Recent survey research on chemistry teachers' pedagogical inquiry competence suggests that many teachers still need a stronger understanding of what inquiry entails and how to enact it in practice, implying that practicum support should treat inquiry as a teachable set of routines, decisions, and assessment moves [12]. Relatedly, contemporary work with pre-service chemistry teachers in structured programs shows the value of designing learning experiences that intentionally build complex competencies through guided tasks, multiple data sources, and reflection, rather than relying solely on exposure [13].

Despite these developments, there remains limited published evidence documenting pre-service chemistry teachers' practicum experiences in Libya in a way that connects the practical constraints shaping chemistry teaching, especially laboratory feasibility and safety, school-context variation that can create unequal learning-to-teach opportunities, and the functioning of the support ecosystem, school mentoring and university supervision [14]. The present study addresses this gap by examining the practicum experiences of final-year pre-service chemistry teachers at the Chemistry Department, Faculty of Education, University of Zawia, across different school contexts, aiming to identify the most prominent challenges and the most urgent support needs and to interpret these patterns through supervisors' perspectives to inform locally feasible program improvement.

Research Methods

This study used a convergent mixed-methods design to examine the practicum experiences of final-year pre-service chemistry teachers in Libya and to triangulate questionnaire results with semi-structured interviews with practicum supervisors. The researchers collected quantitative and qualitative data during the same practicum period, analyzed them separately, and integrated them during interpretation to compare convergence, complementarity, and divergence across the two datasets [15], [16]. This design suited the study because it provided both a broad picture of student teachers' challenges and deeper explanations from supervisors about their causes and possible solutions in school settings.

The participants included 60 final-year female pre-service chemistry teachers from the Chemistry Department, Faculty of Education, University of Zawia, who completed the mandatory practicum in 9 schools: 5 urban (n = 42) and 4 non-urban (n = 18). Since all eligible student teachers were available during the practicum semester, the study used a total population sampling design. The study also included nine practicum supervisors, selected purposively because of their direct role in observing and evaluating student teachers across schools. The researchers used the urban/non-urban distribution as an analytic lens to interpret contextual differences. Data collection took place during the 2024/2025 academic year.

The researchers used two instruments: a structured questionnaire and semi-structured interviews. The questionnaire used a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) and included 12 items covering classroom management and time pressure; laboratory access and safety; teaching abstract concepts and chemical representations; assessment and student misconceptions; and mentoring and supervision. Chemistry education staff and practicum supervisors reviewed the instrument to ensure clarity, relevance, and alignment with the study objectives. The questionnaire demonstrated acceptable reliability (Cronbach's alpha = 0.86). The qualitative strand involved individual semi-structured interviews with the nine supervisors. The interview guide focused on recurring practicum difficulties, contextual differences across schools, and suggestions for improving mentoring and support. Each interview lasted about 30–45 minutes. With participants' permission, the researchers audio-recorded the interviews, transcribed them verbatim, and anonymized them using codes such as SUP1–SUP9 [17].

For analysis, the researchers used frequencies, means, and standard deviations, along with urban–non-urban comparisons, to examine questionnaire responses. They analyzed interview data through thematic analysis, moving from repeated reading and initial coding to broader themes linked to the survey domains. During interpretation, they integrated both strands through triangulation, comparing survey patterns with supervisor explanations. They treated matching results as convergent evidence and used qualitative insights to explain or extend the quantitative findings. This process helped generate evidence-based implications for improving the practicum program. The researchers also addressed ethical considerations throughout the study. Participation was voluntary, and all participants received clear information about the study's purpose before data collection. The researchers obtained informed consent, protected confidentiality, reported findings anonymously, and stored all data securely for research use only.

Results and Discussion

Practicum Context and Overall Patterns of Challenges and Support

The practicum experiences of the 60 final-year pre-service chemistry teachers revealed a consistent pattern of high instructional pressure alongside limited enabling conditions. Across placements, participants reported significant challenges related to limited lesson time and classroom management, as well as chemistry-specific pressures such as teaching abstract concepts, coordinating multiple chemical representations, and addressing frequent misconceptions (Table 1). In contrast, enabling conditions were rated comparatively low, most notably laboratory access and school teaching resources (both M = 2.43), as well as the adequacy of university supervisor feedback (M = 2.60). Overall, the practicum often positioned student teachers in a high-demand, low-support environment, consistent with evidence showing that contextual constraints and support structures shape what novices can enact and learn during field experience [18]. These patterns are particularly consequential in chemistry because teaching quality is highly sensitive to time, safety, and the availability of materials and representations; when such conditions are limited, instruction can shift toward explanation-heavy lessons and symbolic manipulation rather than evidence-based learning [19].

Table 1. Overall Student Questionnaire Results (N = 60; 5-point

Statement	SA	A	N	D	SD	M	Std. Dev
1. Classroom management was challenging.	22	25	6	5	2	4.00	1.06
2. Limited lesson time made it difficult	28	20	5	5	2	4.12	1.09
3. I had adequate access to laboratory facilities	5	10	8	20	17	2.43	1.29
4. Laboratory safety requirements were difficult to manage	18	24	7	7	4	3.75	1.20
5. Teaching abstract chemistry concepts was difficult.	26	22	6	4	2	4.10	1.05
6. Students frequently showed misconceptions.	20	25	8	5	2	3.93	1.06
7. I felt confident in assessing students' understanding	6	14	12	18	10	2.80	1.26
8. The cooperating teacher guided me sufficiently	8	18	12	15	7	3.08	1.25
9. The university supervisor provided enough feedback.	5	12	10	20	13	2.60	1.27
10. The practicum school provided the necessary teaching resources.	4	10	9	22	15	2.43	1.23
11. I need more training on using multiple representations in chemistry teaching.	24	20	8	6	2	3.97	1.12
12. Overall, the practicum prepared me well for teaching chemistry.	10	18	12	14	6	3.20	1.26

Scale scoring for mean/SD: (SA) Strongly Agree = 5,(A) Agree = 4, (N)Neutral = 3, (D)Disagree = 2, (SD) Strongly Disagree = 1. M=Mean , (Std. Dev)= Standard Deviation

Table 2. Urban vs. Non-urban Comparison (Means and Mean Difference) (Urban n = 42; Non-urban n = 18)

Domain	Urban Mean	Non-urban Mean	Δ
Classroom management challenging	3.88	4.28	+0.40
Limited lesson time affected teaching	4.14	4.06	−0.08
Adequate access to lab facilities	2.36	2.61	+0.25
Lab safety difficult to manage	3.64	4.00	+0.36
Abstract concepts difficult	4.12	4.06	−0.06
Misconceptions frequent	3.93	3.94	+0.01
Confident in assessment	2.95	2.44	−0.51
Sufficient guidance (school mentor)	3.14	2.94	−0.20
Sufficient feedback (university)	2.57	2.67	+0.10
School resources sufficient	2.50	2.28	−0.22
Need training in representations	4.07	3.72	−0.35
Practicum prepared me overall	3.19	3.22	+0.03

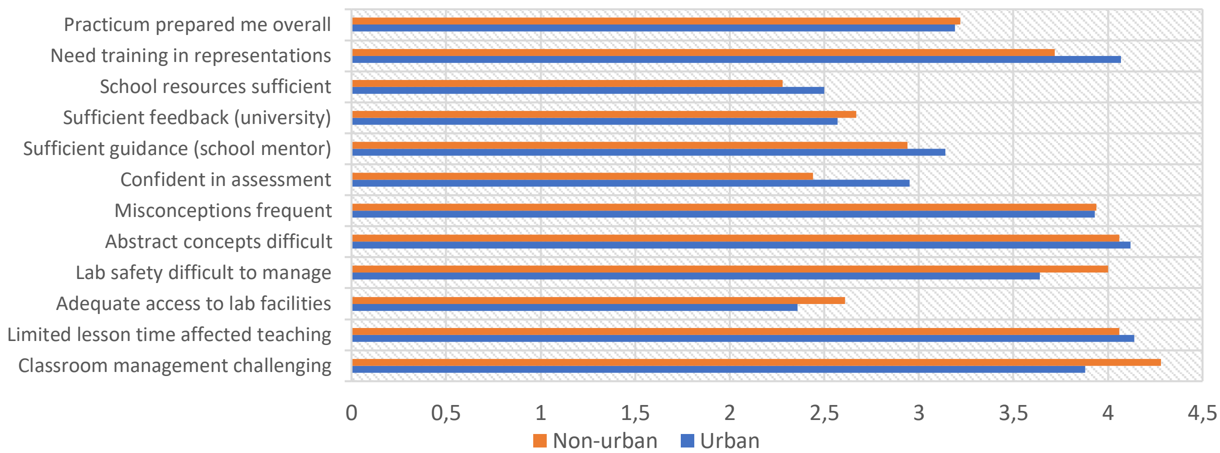

Figure 1. Urban vs. Non-urban Mean Scores by Questionnaire Item (Table 2)

Classroom Management and Time Pressure

Results indicate that classroom management and time pressure were among the most salient practicum challenges in chemistry teaching. Participants reported high difficulty managing student behavior and maintaining engagement (M = 4.00) alongside very high agreement that limited lesson time constrained effective teaching (M = 4.12). These pressures have chemistry-specific consequences because chemistry learning often requires sequential explanation, scaffolded problem-solving, and structured opportunities for students to articulate their reasoning. When time is lost, student talk and formative interaction are typically reduced, shifting instruction toward faster coverage with limited diagnostic evidence of understanding. Supervisors' accounts clarified where time pressure is produced in practice, particularly during lesson openings, transitions, and calculation-heavy segments that require repeated stepwise guidance. One supervisor noted, "They lose time quickly… in chemistry, if students don't understand one step, they get stuck, and the teacher must repeat." Another emphasized that weak routines can consume the lesson and narrow chemistry instruction: "Without routines, they spend the whole lesson controlling behavior, and chemistry becomes just copying notes."

Laboratory Access, Safety, and Resource Constraints: Pedagogical Consequences and Equity Issues

Laboratory feasibility emerged as a major structural constraint shaping chemistry teaching during practicum. Participants reported low adequacy of laboratory access (M = 2.43) and school teaching resources (M = 2.43), alongside high difficulty managing laboratory safety (M = 3.75).

In chemistry, these constraints shape the epistemic form of teaching: when laboratory work cannot be conducted safely or consistently, instruction shifts toward demonstration and theory-heavy lessons, reducing inquiry and practical skill development, consistent with contemporary chemistry-lab evidence[20][21]. Supervisors explained: "Even if there is a lab room, the materials are missing or not safe… they do a demonstration only", and emphasized the need for feasible alternatives: "They need a simple safety checklist and small-scale activities that are safe in a normal classroom."

Teaching Abstract Concepts and Chemical Representations: Pedagogical Content Knowledge (PCK) Under Pressure

Participants strongly endorsed difficulty teaching abstract chemistry concepts (M = 4.10) and the need for more training in multiple representations (M = 3.97). Supervisors explained representational breakdowns: "They can write the equation, but… they cannot connect it to particles", and noted that limited visual aids increase explanation load: "Without visual aids, they talk too much and students become confused."

Assessment, Misconceptions, and Learning Gaps: From Recall Testing to Feasible Diagnostic Practices

Participants reported frequent misconceptions (M = 3.93) alongside low confidence in assessment (M = 2.80). Supervisors observed recall-focused questioning: "Most… questions only test recall… misconceptions stay hidden", and recommended feasible strategies: "Provide… a bank of diagnostic questions… exit tickets… feedback must be short and focused".

Supervisors generally emphasized that practicum conditions were broadly similar across urban and non-urban schools, and that most constraints, such as time pressure, limited resources, and routine classroom demands, were experienced in both contexts. The main difference they highlighted concerned students' awareness and readiness to engage with chemistry learning, which was perceived to be higher in urban schools. Supervisors attributed this gap primarily to greater access to basic technological resources in urban areas such as smartphones, internet connectivity, and digital learning materials, which can expand students' exposure to scientific information and support independent learning, thereby strengthening their background understanding and classroom participation [22-24].

Integrated Interpretation: Mentoring Quality, Priority Support Needs, and Program Improvement Model

Students' priority support needs (Table 4) align closely with supervisors' themes (Table 3), indicating that practicum improvement requires strengthening the support ecosystem through structured mentoring and supervision cycles, chemistry-specific resource banks, and safe, low-cost laboratory alternatives. The joint display (Table 5) synthesizes this logic by linking core challenges (time pressure, classroom management, limited laboratory feasibility, and representational teaching difficulties) to specific supports and actionable program responses.

Table 3. Supervisor Themes and Coverage (n = 9)

Theme	n
Time pressure and pacing loss points	8
Classroom routines and engagement	7
Lab shortages and limited access	8
Safety constraints	6
Representational teaching breakdowns	7
Assessment weaknesses	6
Mentoring/supervision variability	8
Priority program improvements	9

n = Supervisors mentioning

Table 4. Priority Support Needs (N = 60)

Support need	n	%
Structured mentoring at school	38	63.3
More frequent formative university supervision	35	58.3
Chemistry-specific teaching resources	33	55.0
Low-cost lab alternatives & safety guidance	31	51.7

Training in classroom management	29	48.3
Support for assessment & misconception diagnosis	28	46.7
Preparation for teaching abstract concepts/representations	26	43.3

n= how many students (out of 60) selected/endorsed that need, **%:** the same number expressed as a percentage of the total sample (n \ 60 × 100).

Table 5. Joint Display: Challenges → Support Needs → Program Improvement Actions

Main challenge (what students face)	What support is needed	Practical program action (what to do)
Limited time and classroom management difficulties	Clear routines, pacing support, and coaching	Train student teachers on lesson openings, transitions, and pacing (microteaching); provide mentor coaching on managing engagement and time
Limited laboratory access and safety concerns	Safe, low-cost lab alternatives and basic safety guidance	Provide a practicum “lab kit” with simple, low-cost experiments; use a short safety checklist and minimum safe practical activities
Difficulty teaching abstract concepts and linking representations	Training on representations, ready teaching aids	Create a bank of diagrams/visuals/simulations; supervisors use prompts that guide macro–symbolic–submicroscopic linking in feedback
Frequent misconceptions and low confidence in assessment	Simple diagnostic questions and easy formative routines	Provide a misconception/diagnostic question bank; use hinge questions and exit tickets; use short feedback templates
Variation in mentoring and supervision quality	A structured mentoring plan and regular observation cycles	Set a minimum number of observations and feedback sessions; use a shared supervision rubric; hold short follow-up meetings
Unequal practicum conditions between schools	Standard supports for all placements	Share the same resources across all schools; apply a consistent supervision schedule for urban and non-urban placements

Table 5 summarizes the central logic of the program improvement model by linking the main practicum challenges to specific supports and actions that can realistically address them. The table shows that the pressures reported by student teachers, especially time constraints, classroom management, limited laboratory feasibility, and difficulties with abstract concepts and misconceptions, are not isolated problems; they require coordinated supports that make effective chemistry teaching possible under real school conditions [25]. In particular, the model prioritizes structured mentoring and regular observation–feedback cycles as the delivery system through which other supports become usable, because resources alone rarely improve practice without coaching and follow-up. The model also highlights the need for chemistry-specific tools (representation-rich teaching aids and diagnostic question banks) and low-cost, safe laboratory alternatives that directly address the discipline’s unique demands while meeting the constraints of Libyan schools. Overall, the joint display translates the study’s evidence into actionable steps that can reduce variability across placements, improve equity between urban and non-urban contexts, and strengthen pre-service teachers’ readiness to teach chemistry with clearer explanations, safer practical work, and feasible formative assessment routines.

Chemistry learning requires more than memorizing facts; students must connect what they observe in experiments (macroscopic level) with particle-level explanations (submicroscopic level) and chemical symbols/equations (symbolic level), while also developing safe practical skills and scientific reasoning that support meaningful understanding rather than rote procedures [26-27]. Digital and AI-supported tools may further help learners connect theory with practice and expand learning opportunities when implemented effectively [28-30]. Educational research on student performance is therefore essential for improving outcomes because it identifies where students struggle (such as abstract concepts, misconceptions, representational coordination, and assessment difficulties) and clarifies why these problems persist under real classroom constraints (including limited time, restricted laboratory feasibility, and uneven instructional feedback). Evidence also suggests that improvement requires coordinated support rather than resources alone: structured mentoring, coaching, and regular observation with feedback strengthen teaching practice and make other supports workable in classrooms and practicum settings. Moreover, learning becomes more relevant and comprehensible when connected to learners’ context and culture through meaningful local examples aligned with the curriculum. Recent research in Libyan higher education indicates that AI use in academic work offers significant opportunities, but barriers related to training, infrastructure, and institutional readiness continue to hinder effective adoption [31], [32]. Finally, learning quality is also shaped by relational and ethical dimensions such as teacher–student relationships, emotional intelligence, and moral sensitivity, which can influence classroom participation and learning outcomes alongside cognitive achievement [33-34]. In Libya, wider social and psychosocial conditions may also affect learners’ readiness and engagement [35-37]. Collectively, these research lines support curriculum and practicum development that improves alignment between aims, pedagogy, assessment, and digital transformation, while remaining responsive to the realities of school and practicum environments [38-40].

Conclusion

The study suggests that improving the quality of the chemistry practicum requires a more structured support system that enables effective teaching in real school conditions. When mentoring and supervision are planned, consistent, and focused on practical classroom needs, pre-service teachers are more likely to build confidence and develop stable teaching routines. Such support helps them move beyond “coping” with constraints and instead focus on meaningful learning, including clear explanations of concepts, linking chemical representations, and addressing student misconceptions. The findings also indicate that resources are more useful when combined with coaching and feedback, especially for assessment practices and safe, practical work in limited laboratory settings. Providing accessible teaching materials, simple diagnostic assessment tools, and low-cost, safe laboratory alternatives can reduce pressure and expand what student teachers can attempt during practicum. These results highlight the value of stronger collaboration between schools and teacher education programs to ensure that practicum expectations, mentoring roles, and supervision practices are aligned and more equitable across different school contexts.

Author’s Contribution

R. Alrwesse: led the study design, managed the quantitative data collection, conducted the statistical analyses, integrated the questionnaire and interview findings, and wrote the original manuscript draft. A. Aljarmia: contributed to conceptual refinement, oversaw the qualitative interview component, supported thematic interpretation, and provided critical revisions to improve the manuscript’s academic quality. N. Baroud: supported instrument development and refinement, assisted with data interpretation and synthesis, and reviewed and edited the final manuscript. All authors read and approved the final version of the manuscript.

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