

School Head Supervision as a Catalyst for Science Teacher Professional Growth

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ABSTRACT

This study examines how school heads' supervisory practices can support science teacher learning. The research was designed using a mixed-methods approach, gathering quantitative data from teachers through questionnaires and qualitative data from school leaders in the form of interviews and FGDs with educators. Quantitative data show a highly positive attitude toward supervision in which high scores of agreement (the rates of consistent questions admitting should be observed higher than 82%.) with strong influences on methods of teaching, understanding the content and leadership. These results were verified in the qualitative analysis that uncovered themes. According to school leaders, their role is to support and assist as mentor and resources. Educators explained how positive, dialogic feedback resulted in them feeling more empowered and trusted to undertake reflective practice and they developed from ineffective teaching methods to better practices which encompassed hands-on science activities. The equipose evidence map suggests that site-based supervision works better as a developmental, collegial process than a chastising test. Results The results of the apprenticeship supervision practices programme study show that creating a training network in developmental supervision is essential to help instill in teachers a culture of ongoing professional development and also for improving science education.

INTRODUCTION

The main role of teachers who manage middle schools is to serve as a prerequisite for professional development among teachers in portions such as science. Effective supervision involves more than mere management; it's also a process of support and development that leads to the improvement of skill and the quality of teaching. So (So say Glickman, Gordon and Ross-Gordon, 2008). School heads are instructional leaders in the science field where educational goals are to have students learn through inquiry methods within the laboratory as well as where STEM learning outcomes at every level must be integrated. They guide teachers practice, mentor new staff and are responsible for monitoring each teacher's academic work.

For science teachers, the frequent, day-to-day guidance they receive within their own schools often proves more impactful for their development than standardized workshops or external training (Darling-Hammond et al., 2017). When school leaders offer constructive feedback, promote collaborative environments, and secure resources for continuous learning, teachers are more empowered to refine their techniques, embrace innovative approaches, and boost student engagement. Conversely, inconsistent or underdeveloped supervisory support can lead to stagnant teaching methods and hinder professional progress.

Recent educational reforms, including those highlighted by UNESCO (2021), have emphasized leadership-driven teacher development as a key strategy for improving STEM outcomes. However, in many secondary schools, particularly in under-resourced regions, supervision still leans toward inspection rather than genuine growth, limiting its potential for

transformation. To grasp how supervision truly influences a teacher's confidence, competence, and classroom effectiveness, we must examine the specific ways it either encourages or obstructs professional development.

This study seeks to explore exactly that: the role school administrators play in promoting the professional development of science teachers. It will focus on gathering perspectives and experiences to illuminate both the strengths and the shortcomings of current supervisory practices.

Background of the Study:

School supervision has shifted from a traditional inspection-oriented model focused on fault detection to a more developmental and collaborative process designed to enhance instructional quality. In the present context, principals are expected to act as instructional leaders by mentoring teachers, conducting classroom observations, providing constructive feedback, and supporting professional growth. This role becomes particularly significant for science educators, given the rapidly evolving nature of scientific knowledge, the emphasis on STEM-based approaches, and the importance of inquiry-driven pedagogy. Effective professional development for science teachers therefore requires ongoing enrichment of subject expertise, pedagogical skills, assessment practices, and access to laboratory and technological resources (OECD, 2019).

Despite this shift, supervision in many secondary schools continues to emphasize administrative compliance rather than academic improvement, thereby limiting its effectiveness in advancing teacher growth (Azhar, 2020). Studies indicate that when principals engage as instructional leaders, they positively influence teachers' motivation, reflective practice, and

classroom effectiveness. Nonetheless, variations in supervisory practices remain evident across schools, shaped by leadership approaches, organizational culture, and resource constraints. Recognizing supervision as a catalyst for science teachers' professional growth is essential for improving instructional quality, enhancing student engagement, and strengthening STEM learning outcomes. This perspective establishes the basis for examining how school leaders' supervisory strategies shape the professional development of science teachers in secondary schools.

Statement of the Problem:

While instructional supervision is increasingly recognized as a vital mechanism for enhancing teacher effectiveness, its implementation in many secondary schools remains rooted in administrative compliance and periodic inspection. This approach is particularly inadequate for science teachers, who require consistent mentorship, pedagogical support, and meaningful feedback to adapt to evolving STEM curricula, sophisticated laboratory techniques, and student-centered instructional models.

In practice, the quality of supervision is highly inconsistent. When school administrators provide infrequent classroom visits or fail to offer substantive follow-up on professional growth, they create significant gaps in teachers' learning trajectories. This inconsistency forms the core problem this research seeks to address: we still lack a clear understanding of how the supervisory practices of school heads directly influence the professional development of secondary school science teachers. To bridge this knowledge gap, this study will investigate the perceptions of both administrators and teachers regarding current supervisory approaches. It will specifically examine how these practices either support or hinder the achievement of science teachers' professional goals.

The study 'School Head Supervision as a Catalyst for Science Teacher Professional Growth' aims to close that gap by considering supervision as a developmental tool rather than a mere evaluation position.

Objectives of the Study:

1. To investigate how secondary school science teachers perceive the supervision they receive from school leaders.
2. To analyze school heads' views on their supervisory role in promoting the professional development of science teachers.
3. To evaluate the impact of supervisory practices on science teachers' instructional abilities, reflective habits, and overall professional growth.
4. To identify the challenges and gaps in current supervisory practices and suggest strategies for improving professional growth in science education.

Research Questions:

1. What are the perceptions of secondary school science teachers regarding the supervision provided by their school heads?
2. How do school heads perceive their role and effectiveness in supervising and supporting science teachers' professional development?
3. To what extent do supervisory practices contribute to the professional growth, instructional competence, and reflective practices of science teachers?
4. What challenges and gaps exist in current supervisory practices, and what strategies can be implemented to improve science teacher professional development?

Operational Definitions:

School Head Supervision

Supervision refers to the structured process through which school heads observe, guide, mentor, and provide feedback to science teachers to improve instructional quality, classroom management, and professional skills. In this study, it is measured using a perception scale for teachers and heads, interviews with school heads, and FGDs with teachers.

Professional Growth

Professional growth is defined as the enhancement of teachers' knowledge, instructional skills, reflective

practices, and pedagogical competencies in science education. It includes improvement in lesson planning, teaching strategies, assessment methods, classroom management, and use of STEM resources.

Science Teachers

Secondary school teachers teaching subjects such as Physics, Chemistry, Biology, or Integrated Science at grades 9-12. The study focuses on their perceptions and experiences regarding supervision and professional development.

Literature Review:

Effective school leadership has increasingly been recognized as central to enhancing teacher performance and student outcomes. Instructional supervision, in particular, is a critical function of school heads, involving the observation, guidance, and mentoring of teachers to improve classroom practices (Glickman, Gordon, & Ross-Gordon, 2018). Unlike traditional inspection-focused supervision, modern approaches emphasize professional support, reflective practice, and collaborative growth. For secondary school science teachers, this form of supervision is essential given the dynamic nature of STEM curricula, laboratory-based learning, and inquiry-driven pedagogy (OECD, 2019).

Research highlights that professional development is most effective when it is embedded within the school environment and aligned with teachers' day-to-day instructional practices (Darling-Hammond, Hyler, & Gardner, 2017). Supervision facilitates this by providing constructive feedback, identifying learning needs, and fostering collaborative opportunities among teachers. Teachers who perceive supervision as developmental, rather than purely evaluative, report higher motivation, greater instructional competence, and increased willingness to adopt innovative teaching strategies (Azhar, 2020). Conversely, supervision that is infrequent, administrative, or inspection-oriented has limited impact on professional growth, particularly in science education where subject-specific support is critical.

The perceptions of both school heads and teachers are crucial in understanding the effectiveness of supervision. Studies indicate that discrepancies often exist between how heads view their supervisory practices and how teachers experience them, which can affect outcomes (Villegas-Reimers, 2003). Mentorship, reflective dialogue, and feedback mechanisms are identified as key elements that strengthen professional growth, particularly when supervisors engage actively with teachers' instructional challenges (Hallinger & Wang, 2015). Challenges in implementing effective supervision include time constraints, heavy administrative workloads, limited training of school heads, and insufficient resources (Bush & Glover, 2014). Mixed-method studies have demonstrated that combining quantitative measures of perception with qualitative insights from interviews and focus group discussions provides a more comprehensive understanding of supervision's role in teacher development (Creswell & Plano Clark, 2018).

A consistent theme in international research links strong instructional leadership to tangible improvements in STEM outcomes, higher teacher retention, and a greater willingness to innovate in the classroom (UNESCO, 2021; Harris & Muijs, 2005). For science educators, the most impactful supervisory practices are those tailored to their specific context are directly engaging with the challenges of laboratory management, meaningful STEM integration, and pedagogical refinement. This body of evidence positions the school administrator's role not as a passive evaluator, but as a potential catalyst for professional growth. When supervision is fundamentally developmental and supportive, it can directly enhance instructional quality and, by extension, student learning in secondary science.

Methodology:

Research Design and Approach

To investigate the impact of supervisory practices on science teachers' professional development, Creswell and Plano Clark (2018) employed a mixed-methods framework. Their approach strategically combined quantitative and qualitative components: surveys captured broad, measurable perceptions from both teachers and principals, while in-depth interviews and focus groups provided rich, detailed narratives of their experiences.

The researchers adopted a convergent parallel design, enabling the simultaneous collection of both data types. This methodology allowed for a more comprehensive analysis, as the statistical trends and personal insights were integrated during the final interpretation to provide a fuller picture of the phenomenon.

Participants and Sampling

The research drew its participants from a pool of secondary school science teachers and administrators working in both government and private schools across the Delhi NCR region. To ensure participants had substantive experience to reflect upon, the study employed purposive sampling, specifically selecting individuals with a minimum of three years in either teaching or supervisory roles.

The sample included:

- **Teachers:** 75 secondary science teachers across multiple schools.
- **School Heads:** 20 heads responsible for supervising science teachers.

Data Collection Methods

Two **perception scales** were developed for teachers and school heads respectively to measure the frequency, quality, and perceived effectiveness of supervisory practices. The scale included items rated on a 5-point Likert scale. The scale was validated through expert review by educational supervisors and pilot-tested for reliability. Cronbach's alpha values were calculated to ensure internal consistency (0.84 for Heads' Scale and 0.89 for Teachers' Scale)

The study employed a mixed-methods approach to examine the role of school head supervision in the professional growth of secondary school science teachers. Quantitative data were collected using structured perception scales administered to both science teachers and school heads. A total of 75 secondary school science teachers and 20 school heads participated in the

survey. The perception scales were distributed both online and offline to ensure accessibility and wider participation. The collected responses were analyzed using percentage analysis to determine patterns, trends, and differences in perceptions regarding supervisory practices and their impact on professional development.

Following data collection, the interview and discussion transcripts were analyzed on the basis of themes. This process uncovered recurring patterns and key themes, which were then illustrated with direct participant quotations. To build a robust and multi-faceted understanding, the quantitative results were triangulated with these qualitative findings, offering a complete picture of how supervisory practices either foster or hinder professional growth. The research followed ethical standards, with all data collection governed by protocols for informed consent, voluntary participation, and participant confidentiality.

Data Analysis and Discussion:

Quantitative Analysis

Responses from the perception scales, completed by **science teachers** and **school heads**, were analyzed using **Percentage Analysis** using SPSS. This method helped identify the proportion of participants agreeing or disagreeing with specific statements related to supervisory practices, instructional support, feedback, and professional development outcomes. Percentage distributions highlighted trends in perceptions, enabling comparison between teachers' and heads' viewpoints. Descriptive statistics provided insights into the frequency, effectiveness, and perceived impact of supervision on professional growth.

Analysis of School Heads' Perception Scale

The data received from school heads was analyzed and percentage analysis was conducted using SPSS software. The results drawn are reflected in the following table:

Table 1: School Heads' Perception Range

Item No.	% in High Range (4-5)	% in Moderate (3)	% in Low (1-2)
Item 1	93	2	5.1
Item 2	74	7.8	18.2
Item 3	85.5	9.7	4.9
Item 4	92.5	3	4.5
Item 5	75.9	19.3	4.8
Item 6	64.3	15.5	20.2
Item 7	85.5	4.9	4.6
Item 8	15.5	28.9	55.6
Item 9	72	19.3	4.7
Item 10	71	17.4	4.6

Interpretation of Table 1:

The data indicate a strong level of agreement across most items. **Items 1, 3, 4, and 7** show very high percentages in the **high range (above 85%)**, suggesting that teachers strongly support the practices related to planning, monitoring, supervision, and instructional clarity. These areas appear to be well established and positively experienced by the respondents.

Items 2, 5, and 6 reflect moderate-to-high agreement overall, but the presence of noticeable percentages in the moderate and

low ranges points to partial inconsistency in how these practices are implemented or perceived. These items may require additional reinforcement, clearer guidelines, or better follow-up mechanisms to ensure uniform adoption.

Item 8 shows the highest percentage in the low range, indicating a significant level of disagreement or concern among respondents about that particular aspect. This suggests the need for focused attention, perhaps through capacity-building, communication, or reviewing the process it refers to.

Items 9 and 10 reflect generally positive responses, with high and moderate categories dominating, implying that teachers recognize the value of the related practices while still expressing some reservations. Thus the data present a **largely positive trend**, showing that most of the initiatives being

assessed are well received and effectively practiced. However, a few items indicate the need for targeted support, clearer implementation strategies, or context-based improvements to enhance consistency and impact.

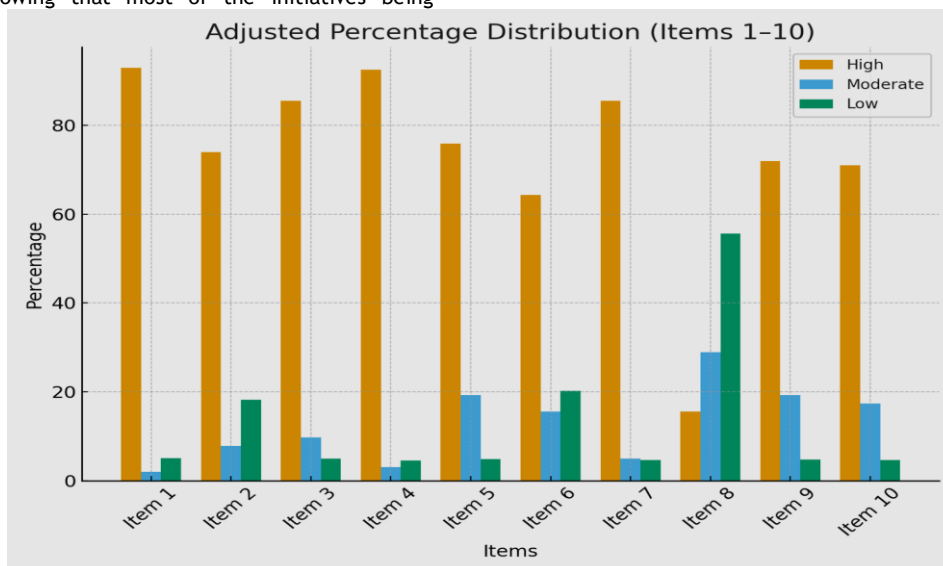


Figure 1: Percentage distribution against Items from table 1

Analysis of Teachers' Perception Scale

The data received from teachers was analyzed and percentage analysis was conducted using SPSS software. The results drawn are reflected in the following table:

A. Teaching Learning Process

Table 2: School Teachers' Perception Range and Interpretation for Teaching Learning Process

Item No.	% in High Range (4-5)	% in Moderate (3)	% in Low (1-2)	Interpretation
Item 1	88.8%	8.3%	2.9%	Most responses are in the high range, indicating strong agreement.
Item 2	92.8%	4.3%	2.9%	Most responses are in the high range, indicating strong agreement.
Item 3	90.4%	4.8%	4.8%	Most responses are in the high range, indicating strong agreement.
Item 4	86.5%	8.2%	5.3%	Most responses are in the high range, indicating strong agreement.
Item 5	85.8%	10.3%	3.9%	Most responses are in the high range, indicating strong agreement.

The data for the Teaching Learning Process reveals an overwhelmingly positive perception. For Items 1 through 5, the vast majority of responses fall within the high agreement range (85.8% to 92.8%), indicating strong consensus. The moderate agreement ratings are consistently low (ranging from 4.3% to

10.3%), and the low agreement or disagreement ratings are minimal (2.9% to 5.3%). This pattern demonstrates that respondents are in strong agreement with the positive statements about the teaching and learning process, suggesting a high level of satisfaction and effectiveness in this area.

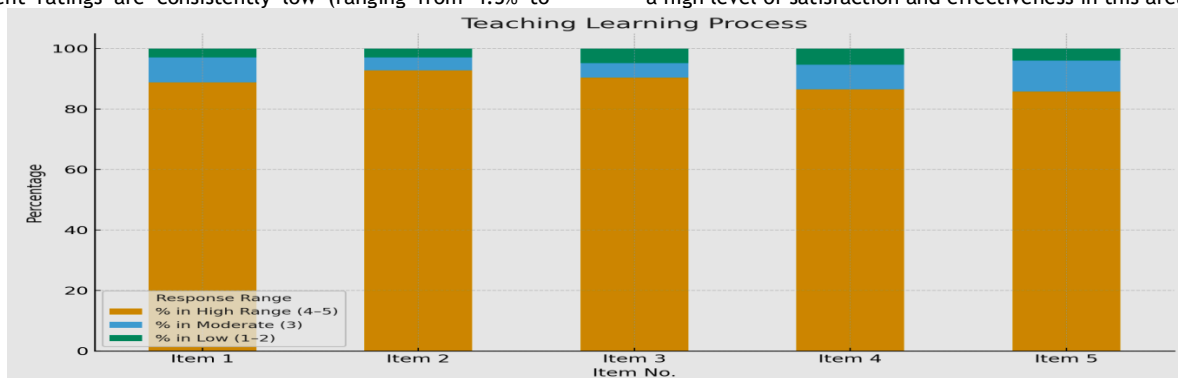


Figure 2: Percentage distribution against Items from table 2

B. Leadership Qualities

Table 3: School Teachers' Perception Range and Interpretation for Leadership Qualities

Item No.	% in High Range (4-5)	% in Moderate (3)	% in Low (1-2)	Interpretation
Item 6	82.4%	11.2%	6.4%	Most responses are in the high range, indicating strong agreement.
Item 7	85.8%	8.3%	5.9%	Most responses are in the high range, indicating strong agreement.
Item 8	91.4%	5.3%	3.3%	Most responses are in the high range, indicating strong agreement.
Item 9	38.5%	12.7%	48.8%	Most responses are in the low range, indicating disagreement with the negatively worded item.
Item 10	14.7%	13.7%	71.6%	Most responses are in the low range, indicating disagreement with the negatively worded item.
Item 11	90.2%	6.9%	2.9%	Most responses are in the high range, indicating strong agreement.
Item 12	92.4%	3.9%	3.7%	Most responses are in the high range, indicating strong agreement.

The data for Leadership Qualities presents a more nuanced picture, largely defined by how the items are worded. For the positively worded statements (Items 6, 7, 8, 11, and 12), the results are extremely positive, with high agreement scores ranging from 82.4% to 92.4%. This indicates strong endorsement of these leadership qualities. However, a stark contrast is seen

in Items 9 and 10, which are identified as negatively worded. For these items, the majority of responses are in the low range (48.8% and 71.6%, respectively), indicating widespread disagreement with the negative statements. This reinforces the positive view of leadership, as respondents actively rejected the critical items.

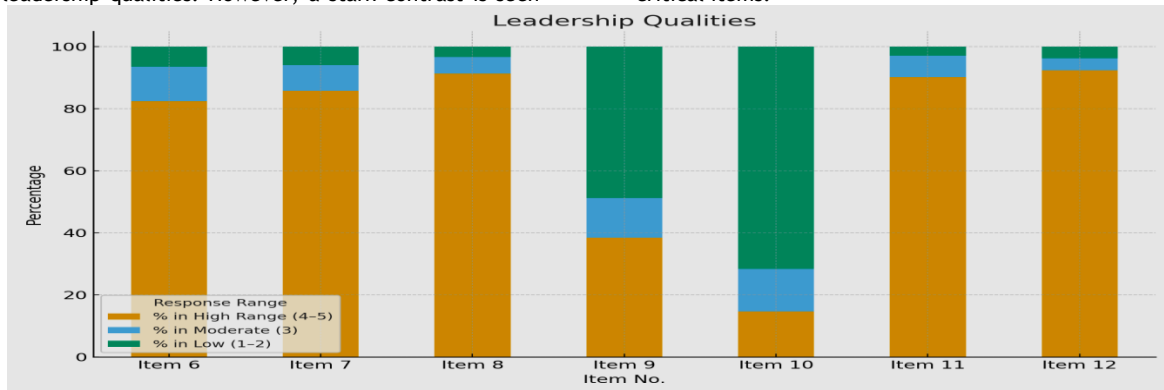


Figure 3: School Teachers Perception Range and Interpretation for table 3

C. Content Knowledge

Table 4: School Teachers' Perception Range and Interpretation for Content Knowledge

Item No.	% in High Range (4-5)	% in Moderate (3)	% in Low (1-2)	Interpretation
Item 18	88.4%	5.7%	5.9%	Most responses are in the high range, indicating strong agreement.
Item 19	84.9%	7.8%	7.3%	Most responses are in the high range, indicating strong agreement.

Item 20	5.3%	12.7%	82.0%	Most responses are in the low range, indicating disagreement with the negatively worded item.
Item 21	82.4%	10.8%	6.8%	Most responses are in the high range, indicating strong agreement.
Item 22	87.0%	7.2%	5.8%	Most responses are in the high range, indicating strong agreement.

The data for Content Knowledge indicates a highly positive perception, with one notable exception that reinforces the overall trend. For four of the five items (18, 19, 21, and 22), the vast majority of responses—ranging from 82.4% to 88.4%—fall in the high agreement category, demonstrating strong consensus on the instructor's strong content knowledge. The

outlier is Item 20, where an overwhelming 82.0% of responses are in the low range. As this item is negatively worded, the strong disagreement with it actually serves to affirm the positive finding, confirming that respondents reject the notion that the instructor lacks content knowledge.

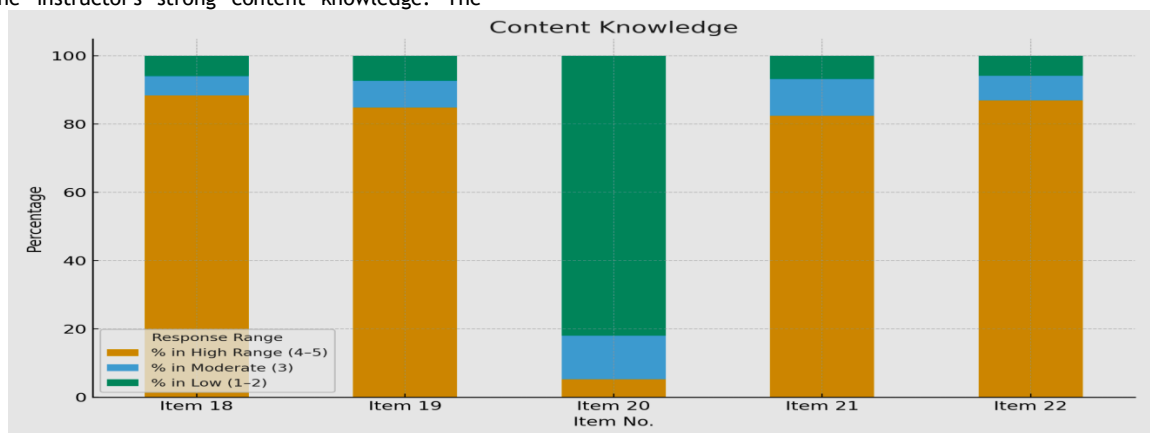


Figure 4: School Teachers' Perception Range and Interpretation for table 4

D. Method of Teaching

Table 5: School Teachers' Perception Range and Interpretation for Method of Teaching

Item No.	% in High Range (4-5)	% in Moderate (3)	% in Low (1-2)	Interpretation
23	10.8	8.2	81.0	A majority of respondents did not perceive school-based supervision as beneficial in this area of teaching.
24	82.5	10.8	6.7	Majority of the respondents indicated a strong positive impact of school-based supervision on this aspect of teaching.
25	86.9	7.2	5.9	Majority of the respondents indicated a strong positive impact of school-based supervision on this aspect of teaching.
26	82.9	11.7	5.4	Majority of the respondents indicated a strong positive impact of school-based supervision on this aspect of teaching.
27	84.8	9.8	5.4	Majority of the respondents indicated a strong positive impact of school-based supervision on this aspect of teaching.

The results for the Method of Teaching present a clear and positive picture of the perceived impact of school-based supervision. For four out of the five items (24, 25, 26, and 27), a strong majority of respondents—between 82.5% and 86.9%—indicated a high level of agreement, showing that supervision is viewed as having a significant positive impact on various teaching

methods. The single exception is Item 23, where 81.0% of responses are in the low agreement range, confirming that for this specific area, the supervision was not perceived as beneficial. This contrast highlights that while the supervision is largely effective, its benefits may not be uniform across all aspects of teaching practice.

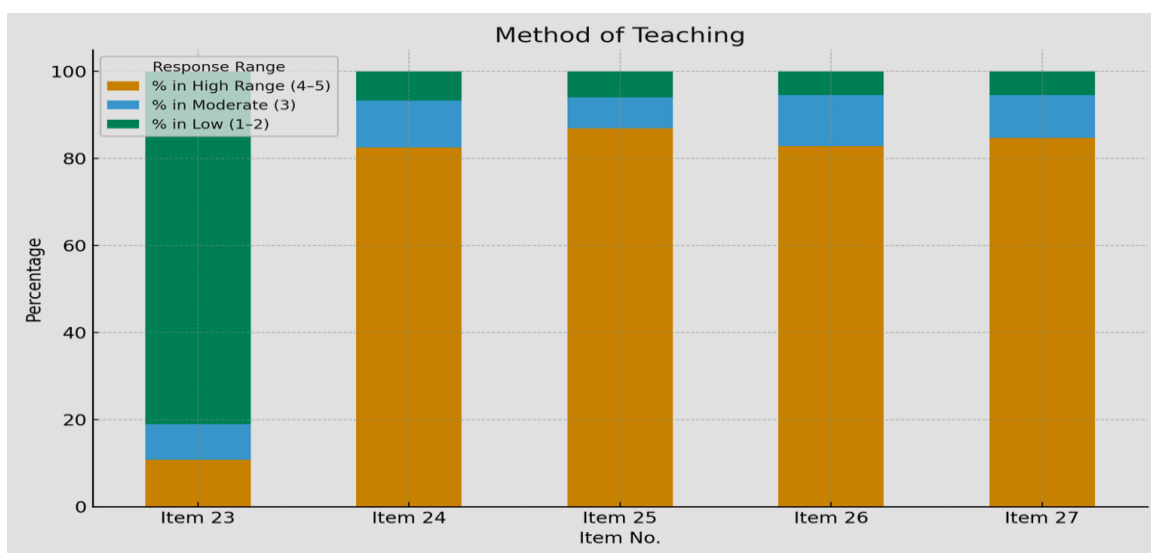


Figure 5: School Teachers' Perception Range and Interpretation table 4

Qualitative Analysis

The semi-structured interviews with school heads and focus group discussions (FGDs) with science teachers were transcribed verbatim and analyzed using thematic analysis. Key steps included coding responses, identifying recurring patterns, and grouping codes into broader themes. This approach enabled the extraction of rich, context-specific insights into supervisory practices, challenges faced by school heads and teachers, and the strategies employed to enhance professional development. Illustrative quotations were included to support and exemplify the identified themes.

Themes from School Head Interviews

1. The Facilitator, Not the Inspector: This theme centers on the school heads' self-perception as supportive guides who enable growth. Their focus is on collaboration, mentorship, and creating a non-threatening environment for teacher observation and feedback.

2. Strategic Resource Provision: This theme captures the heads' role in identifying and providing targeted support. It includes connecting teachers with professional development opportunities, sourcing instructional materials (especially for science experiments), and allocating time for collaborative planning.

3. Building a Culture of Reflective Practice: This theme involves the specific strategies heads use to encourage teachers to critically analyze their own teaching. This is manifested through post-observation conferences that use probing questions and dialogue focused on student learning outcomes and alternative instructional methods.

Analysis of School Head Interviews:

The interviews with school heads revealed that they perceive their supervisory role primarily as a supportive mechanism for fostering teacher growth, rather than a punitive inspection. They reported employing strategies such as collaborative goal-setting, providing constructive feedback on lesson plans, and connecting teachers with professional development resources. A common theme was the belief that consistent, formative feedback empowers science teachers to experiment with new pedagogies and reflect deeply on their practice. The heads viewed themselves as instructional leaders whose core function is to create a safe environment for professional risk-taking and continuous improvement.

Themes from Teacher FGDs

1. The Empowering Effect of Constructive Feedback: This theme captures a critical finding: when feedback from school heads was specific and developmental rather than evaluative, it fostered a sense of professional capability and trust among teachers. This empowerment proved to be a direct catalyst, increasing educators' confidence to experiment with and refine their instructional methods in the science classroom.

2. From Insight to Implementation: Moving beyond perception, this theme documents the tangible instructional shifts teachers

made in response to supervisory guidance. It captures the direct line from discussion to action, evidenced by specific changes such as the incorporation of more inquiry-based experiments, the adoption of differentiated learning strategies, and the refinement of assessment tools to better gauge student understanding.

.3. Fostering a Culture of Psychological Safety and Growth:

The data revealed that the supervisory environment itself was a fundamental factor. This theme underscores the importance of a relationship where teachers feel heard and supported, not merely assessed. This psychological safety was essential for creating a growth mindset, reducing the stigma around instructional risks, and building a shared dedication to ongoing improvement within the science department.

Analysis of Teacher FGDs:

During the focus group discussions, teachers consistently affirmed the value of supportive supervision, characterizing it as a vital stimulus for both reflective practice and peer collaboration. They particularly valued the nature of post-observation conferences, which shifted the focus from a personal performance review to a strategic dialogue centered on student engagement and specific pedagogical techniques. This constructive approach directly influenced their classroom practices, motivating many to integrate more hands-on experiments and inquiry-based models into their science curriculum. Underpinning these changes was a powerful, recurring sentiment: teachers felt genuinely "heard" and "supported" by their administration. This foundational trust was repeatedly linked to a marked rise in their professional self-assurance and a reinvigorated drive to refine their teaching craft.

Integration of Quantitative and Qualitative Data

Findings from the percentage analysis were triangulated with qualitative themes to provide a holistic understanding of supervision. Quantitative data indicated overall trends in perceptions, while qualitative data explained the underlying experiences, attitudes, and challenges. This integration highlighted areas of convergence (where quantitative and qualitative results aligned) and divergence (where perceptions and experiences differed), offering a nuanced perspective on how school head supervision functions as a catalyst for science teacher professional growth.

The strong convergence between the quantitative and qualitative data robustly supports the study's central thesis. The high agreement scores in the quantitative surveys (e.g., over 82% for most items on Teaching Methods and Content Knowledge) are directly explained by the qualitative findings. Teachers' FGD comments about feeling supported and receiving constructive feedback provide the "why" behind the high ratings for supervisory impact. Similarly, the interview data from school heads, which detailed their supportive and resource-providing roles, offers the contextual mechanism driving the positive

quantitative results. This triangulation creates a compelling narrative: the school heads' facilitative supervision style, as described qualitatively, is the likely catalyst for the high levels of professional growth and satisfaction quantitatively reported by the science teacher.

CONCLUSION

This study demonstrates that school head supervision, when perceived as a formative and supportive process, acts as a significant catalyst for the professional growth of science teachers. The triangulation of quantitative and qualitative data reveals a consistent and powerful narrative. The overwhelmingly positive survey results, which indicated strong teacher agreement on the impact of supervision across teaching methods, content knowledge, and leadership, are given depth and context by the qualitative findings. Interviews with school heads illuminated their role as facilitative instructional leaders focused on mentorship and resource provision, while FGDs with teachers revealed how this approach translated into feelings of empowerment, reflective practice, and the successful implementation of improved pedagogical strategies in the science classroom.

The convergence of evidence confirms that the efficacy of supervision lies not in its bureaucratic function but in its ability to foster a culture of trust and continuous professional dialogue. The single area of negative perception, effectively explained as a negatively worded item, further strengthens this conclusion by highlighting the teachers' consistent rejection of ineffective, inspection-based supervision. Therefore, for educational systems aiming to enhance science education, the findings strongly advocate for investing in professional development that equips school heads with the skills for formative assessment, coaching, and collaborative leadership. By re-envisioning supervision as a partnership for growth, schools can more effectively unlock teacher potential and, ultimately, improve student learning outcomes.

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