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TEACHER DEFICIENCY AND FUNCTIONAL EFFECTIVENESS OF PRIMARY SCHOOLS: QUANTITATIVE EVIDENCE FROM DISTRICT BASTI (UTTAR PRADESH, INDIA)

Seema Mishra Research Scholar, IOE, Bundelkhand University, Jhansi, U.P.

Dr. Bhuvaneshwar Singh Mastanaya Associate Professor, IOE, Bundelkhand University, Jhansi, U.P.

ABSTRACT This paper examines how teacher deficiency—operationalised as pupil–teacher ratio (PTR) and deficiency bands (mild, moderate, severe)—relates to the functional effectiveness of primary schools and to pupils' academic achievement in Hindi and Mathematics. Using school-level data from 120 teacher-deficient primary schools in District Basti, Uttar Pradesh, the study estimates the magnitude and pattern of association between PTR and multiple indicators of school functioning (overall functional effectiveness and four sub-dimensions) and evaluates group differences across deficiency bands, school location, management type and presence of community support mechanisms. Results show a strong, negative and statistically robust relationship between PTR and overall functional effectiveness ($r = -0.797$, $p < .001$), with moderate-to-strong negative correlations for instructional organisation, curriculum coverage, classroom climate and pupil engagement ($r \approx -0.59$ to -0.66, all $p < .001$). One-way ANOVA indicates large differences in functional effectiveness across deficiency bands ($F(2,117) = 63.38$, $p < .001$; $\eta^2 \approx 0.52$), with mild-deficiency schools scoring highest ($M = 83.08$) and severe-deficiency schools lowest ($M = 66.23$). PTR is also strongly and negatively related to school-wise mean achievement in Hindi ($r = -0.627$, $p < .001$) and Mathematics ($r = -0.715$, $p < .001$). Rural and semi-urban schools do not differ significantly in functional effectiveness ($p = .088$), while aided schools demonstrate moderately higher functional effectiveness than government schools ($p = .021$). Community support mechanisms show only a small, non-significant association with functional effectiveness ($p = .248$). The findings underscore teacher supply and rational deployment as foundational levers for strengthening school functioning and learning outcomes in teacher-deficient contexts.

KEYWORDS : teacher shortage; pupil–teacher ratio; functional effectiveness; primary schools; learning outcomes; India

1. INTRODUCTION

Teacher shortage is one of the most persistent implementation constraints in school education. In primary schooling, shortage is experienced not merely as a vacancy count but as a daily operational reality that shapes how teaching and learning can occur. A high PTR compresses the teacher's time, attention and energy across many pupils and multiple grades. The resulting pedagogic trade-offs are predictable: fewer opportunities for guided practice, reduced formative assessment, limited differentiation, and increased reliance on whole-class, low-interaction methods.

In teacher-deficient settings, schools adopt coping strategies: merging classes, running multigrade teaching as a necessity rather than a planned pedagogy, postponing portions of the curriculum, and re-allocating time away from enrichment and remediation. These strategies keep schools running, but they tend to reduce functional effectiveness—the school's capacity to maintain core instructional processes at adequate quality and regularity.

From a policy perspective, staffing is often discussed alongside many other reforms (infrastructure, training, curriculum, technology, community participation). Yet, if staffing is below a minimum threshold, other reforms face diminishing returns. For instance, teacher training may improve knowledge, but insufficient staff may prevent implementation of improved methods. Similarly, digital resources may exist, but without teacher facilitation their usage may remain superficial. Thus, empirical analysis that quantifies the relationship between staffing deficiency and school functioning is essential for prioritising interventions.

This paper draws on a district-level dataset from District Basti, Uttar Pradesh, focusing explicitly on teacher-deficient primary schools. It asks: (a) how strongly does teacher deficiency relate to functional effectiveness and foundational learning outcomes, and (b) do contextual factors such as location, management type and community support significantly differentiate outcomes within teacher-deficient schools?

2. CONCEPTUAL FRAMEWORK

Two complementary lenses guide this analysis.

2.1 Instructional time and opportunity-to-learn: At primary level, learning depends on repeated, scaffolded practice. Teacher shortage reduces the effective instructional time per pupil and the number of feedback cycles. As PTR rises, the teacher's ability to diagnose misconceptions and provide timely correction declines. This lens predicts a negative association between PTR and both process indicators (functional effectiveness) and outcome indicators (achievement).

2.2 School functioning as a composite of routines: Schools operate through routines: timetables, class allocations, lesson sequencing, assessment schedules, and teacher collaboration. These routines constitute functional effectiveness. Severe teacher deficiency destabilises routines by creating frequent substitutions, merged classes and interruptions. This lens predicts that deficiency severity bands will differentiate functional effectiveness sharply, beyond what would be expected from incremental PTR changes.

3. Review of related literature

Research on PTR, teacher vacancies and learning outcomes spans multiple contexts. Across low- and middle-income settings, higher PTR is generally linked with lower achievement, especially in literacy and numeracy. Mechanisms include reduced individual attention, fewer structured learning activities, and limited monitoring of progress. In India, studies frequently note that teacher deployment is uneven across regions and school types, producing pockets of very high PTR.

A related line of work focuses on multigrade teaching. Multigrade arrangements can be pedagogically effective when planned and supported; however, in teacher-deficient schools multigrade teaching is typically unplanned and under-resourced. This distinction matters: unplanned multigrade teaching often leads to unequal time distribution across grades, with younger pupils receiving less guided practice.

In addition, literature on school effectiveness emphasises that outcomes are produced through school processes-classroom climate, instructional organisation, and engagement. Teacher shortage undermines these processes, suggesting that process measures may be particularly sensitive to staffing constraints.

The present study contributes by linking staffing deficiency to a multi-dimensional functional-effectiveness construct at the school level, and by testing contextual differentiation (location, management type and community support) within a sample restricted to teacher-deficient schools.

4. METHOD

4.1 Design and unit of analysis

The parent investigation used a mixed-methods design; the current paper reports quantitative analyses. The unit of analysis is the school.

4.2 Sample

Data were obtained from 120 teacher-deficient primary schools in District Basti. Distribution: rural (n = 89) and semi-urban (n = 31); government (n = 89) and aided (n = 31). Schools were also classified

into teacher-deficiency bands: mild (n = 33), moderate (n = 51) and severe (n = 36).

4.3 Measures

Teacher deficiency was captured by PTR and a categorical deficiency band. Functional effectiveness (FE_Total) is a composite index with four sub-dimensions: instructional organisation, curriculum coverage, classroom climate, and pupil engagement. Achievement is measured as school-wise mean scores in Hindi and Mathematics. Contextual variables include school location, management type and presence of community support mechanisms.

4.4 Statistical analysis

Pearson correlation estimates the direction and magnitude of association between PTR and dependent variables. One-way ANOVA tests differences across deficiency bands; independent-samples t-tests compare outcomes across location, management type and community support. Two-way ANOVA tests whether location moderates the effect of deficiency band on achievement outcomes.

5. RESULTS

Table 1. Sample profile of schools (N = 120)

Characteristic	Categories	n	%
Location	Rural	89	74.17
Location	Semi-Urban	31	25.83
Management	Government	89	74.17
Management	Aided	31	25.83
Deficiency band	Mild	33	27.50
Deficiency band	Moderate	51	42.50
Deficiency band	Severe	36	30.00

Table 2. Correlation between PTR and functional-effectiveness indicators (N = 120)

Indicator	Pearson r	p-value
FE_Total	-0.797	1.50e-27
FE_Instruction_Org	-0.614	9.01e-14
FE_Curriculum_Coverage	-0.591	1.17e-12
FE_Classroom_Climate	-0.663	1.51e-16
FE_Pupil_Engagement	-0.598	5.81e-13

PTR is strongly and negatively associated with FE_Total ($r = -0.797$, $p < .001$). Sub-dimensions show consistent negative associations, indicating broad-based deterioration in instructional processes as PTR increases. Among sub-dimensions, classroom climate and pupil engagement are notably sensitive to PTR, consistent with the idea that crowding and multigrade pressure increase behaviour management demands and reduce instructional interaction.

Table 3. Functional effectiveness (FE_Total) by teacher-deficiency band

Band	N	Mean	SD
Mild	33	83.08	5.91
Moderate	51	77.99	7.17
Severe	36	66.23	5.85

Table 4. One-way ANOVA: FE_Total by teacher-deficiency band

Source	SS	df	MS	F	p-value	Effect size
Between groups	5290.40	2	2645.20	63.38	2.25e-19	η^2=0.52
Within groups	4883.39	117	41.74			
Total	10173.79	119				

Functional effectiveness differs sharply across deficiency bands ($p < .001$). The mean difference between mild and severe deficiency is about 16.85 points on FE_Total, a large practical gap. The effect size indicates that band membership is a major driver of functional variation among teacher-deficient schools.

Table 5. Correlation between PTR and pupils' academic achievement (N = 120)

Subject	Pearson r	p-value
Hindi	-0.627	1.93e-14
Math	-0.715	4.72e-20

PTR is negatively associated with achievement in both subjects. The magnitude is stronger for Mathematics, suggesting that numeracy learning may be more sensitive to reduced guided practice and feedback cycles under shortage.

Table 6. Location differences (rural vs semi-urban): functional effectiveness and problem severity

Outcome	Rural mean (SD)	Semi-urban mean (SD)	t(df)	p	Cohen's d
FE_Total	75.01 (9.08)	78.30 (9.43)	-1.72 (118)	0.088	0.36
Problem severity	2.55 (0.55)	2.56 (0.57)	-0.13 (118)	0.899	0.03

Location comparisons do not show statistically significant differences, although the mean FE_Total is somewhat higher for semi-urban schools. This indicates that teacher deficiency imposes substantial constraints regardless of rural or semi-urban context in this district sample.

Table 7. Management differences (government vs aided): functional effectiveness and problem severity

Outcome	Government mean (SD)	Aided mean (SD)	t (Welch)	p	Cohen's d
FE_Total	74.61 (8.67)	79.43 (10.03)	2.38	0.021	0.53
Problem severity	2.59 (0.54)	2.43 (0.59)	-1.32	0.192	0.29

Aided schools have a statistically significant advantage in functional effectiveness ($d \approx 0.53$). The absence of significant differences in perceived problem severity suggests that aided schools may manage the operational impact of shortage slightly better, even if the underlying constraint is similar.

Table 8. Community support mechanisms and functional effectiveness

Community support	N	Mean FE _Total (SD)	t (Welch)	p	Cohen's d
Absent	66	74.98 (9.37)			
Present	54	76.94 (9.07)	1.16	0.248	0.21

Community support presence is associated with a small difference in FE_Total, but the effect is not statistically significant and is small in magnitude.

Table 9. Two-way ANOVA: Deficiency band × Location on achievement

Outcome	Main effect: band (F, p)	Main effect: location (F, p)	Interaction (F, p)
Hindi	39.56, 8.97e-14	1.52, 0.221	2.54, 0.083
Mathematics	56.47, 9.07e-18	3.39, 0.068	0.30, 0.743

Deficiency band has a strong main effect on both outcomes, while location and interaction effects are non-significant. The shortage penalty on achievement therefore appears structurally similar across rural and semi-urban settings.

6. Detailed interpretation by objective

Objective 1 (PTR–functional effectiveness relationship): The strong negative correlations indicate that staffing deficiency is not only related to outcomes but also to the day-to-day mechanisms that produce outcomes. When PTR increases, teaching becomes more procedural, lesson flow is interrupted, and time for individual student support declines. In school-improvement terms, PTR operates upstream of instructional quality.

Objective 2 (deficiency band differences): The monotonic decline in FE_Total across bands suggests a dose–response relationship: as deficiency becomes more severe, functional capacity drops. Importantly, the difference is not marginal; the severe band shows substantially lower functioning, implying that the school's operating model changes qualitatively—often towards unavoidable multigrade teaching with minimal differentiation.

Objective 3 (location): The non-significant location difference implies that within this teacher-deficient sample, rurality does not add an additional penalty in functional effectiveness beyond the shortage itself. This is policy-relevant because it suggests that staffing interventions should not be restricted to rural schools alone; semi-urban schools with severe PTR may be equally constrained.

Objective 4 (management type): The aided-school advantage suggests that organisational factors can buffer some shortage impacts. Potential buffering mechanisms include greater local autonomy, faster local substitution, and more flexible internal monitoring. However, because problem severity does not differ significantly, management advantages should be interpreted as partial mitigation rather than elimination of the shortage constraint.

Objective 5 (PTR–achievement): The strong associations with Hindi and Mathematics indicate that shortage is linked with foundational learning. The stronger mathematics association suggests that numeracy is particularly sensitive to the loss of guided practice and timely feedback.

Objective 6 (community support): The small effect suggests that community participation, while valuable for accountability and small-scale facilitation, cannot substitute for professional teaching capacity. Support mechanisms may improve peripheral functions (attendance follow-up, small repairs), but without adequate teachers, core instruction remains constrained.

Objective 7 (moderation by location): The absence of interaction indicates that the academic impact of deficiency bands does not differ meaningfully across rural and semi-urban contexts. Therefore, severity bands can be used as a district-wide targeting tool.

7. DISCUSSION

The overall pattern is coherent: teacher deficiency is associated with weaker processes and weaker outcomes. The link between PTR and FE_Total is particularly informative because it suggests a mechanism chain: PTR → reduced functional effectiveness (organisation, coverage, climate, engagement) → reduced learning outcomes. Even if achievement were not measured, a decline in functional effectiveness would be concerning because it represents reduced opportunity-to-learn.

7.1 Interpreting the large band effect

The large η^2 for deficiency band indicates that staffing severity categorisation is meaningful. In practice, a severe-deficiency school often faces one or two teachers for multiple grades. A teacher's day becomes dominated by coordination and crowd management. As a result, instruction may become survival-oriented: teaching the most basic content, focusing on a subset of grades, and reducing interactive pedagogies. These conditions plausibly explain the low mean FE_Total observed in the severe band.

7.2 Why mathematics suffers more

Mathematics learning depends heavily on frequent checking of work, correction of procedural errors and cumulative skill building. Under high PTR, teachers cannot observe each student's work frequently, leading to undetected misconceptions and practice without correction. Hindi learning also requires feedback (reading fluency, comprehension), but classrooms may rely more on oral recitation and group reading, which can proceed with less individual checking. This can explain the slightly weaker—but still substantial—PTR correlation for Hindi.

7.3 The limited role of location

Rurality is often assumed to be synonymous with disadvantage. The current results suggest that within teacher-deficient schools, the shortage constraint is so dominant that it equalises outcomes across rural and semi-urban contexts. This does not imply that rural schools have no disadvantages; rather, it implies that in this dataset, teacher deficiency is the primary differentiator of functional effectiveness and achievement.

7.4 Management as partial resilience

The aided-school advantage points to a notion of partial resilience: some organisational arrangements enable better functioning under shortage. Yet, because aided schools also experience the shortage, resilience is partial. This suggests a two-pronged approach: address staffing levels, and simultaneously strengthen school-level organisational routines (time-table stability, distribution of non-teaching duties, and prioritisation of foundational teaching time).

7.5 Interpreting community support results

Community support may matter more for accountability and micro-level problem solving than for direct instruction. Furthermore, the measurement used here (presence/absence) may not capture dosage. The low effect also highlights a common policy misinterpretation: expecting community participation to compensate for structural teacher shortages. Community participation can complement, not replace, adequate teacher provisioning.

8. Policy and practice implications

8.1 Targeting based on severity bands

District administration can use severity bands to prioritise interventions. Severe-deficiency schools should be flagged for urgent staffing action and for interim academic support packages. Moderately deficient schools may benefit from targeted redeployment or rationalisation that reduces extreme PTRs.

8.2 Protecting instructional time

A practical implication is to protect teaching time from non-teaching assignments in teacher-deficient schools. When staffing is low, even small non-teaching duties create large opportunity costs. Administrative workflows can be simplified, and district-level reporting can be reduced or consolidated for the highest-deficiency schools.

8.3 Structured support for multigrade teaching

Where multigrade teaching is unavoidable, structured pedagogic models and materials are essential. Without support, multigrade becomes ad hoc and leads to unequal attention to grades. Structured multigrade timetables, self-paced learning activities, and peer-assisted learning routines can partially mitigate the shortage impact.

8.4 Learning recovery and foundational competencies

Given the strong associations with Hindi and Mathematics, staffing reforms should be aligned with foundational learning recovery programmes. Schools with severe deficiency may require focused FLN catch-up interventions and periodic academic mentoring visits.

8.5 Monitoring beyond PTR

While PTR is a useful indicator, functional-effectiveness measures can serve as early warning signals. A school may have moderate PTR but still low FE_Total due to organisational challenges. Monitoring FE_Total and key sub-dimensions can guide supervisory support.

9. Limitations and future directions

The study is cross-sectional and cannot establish causality. However, the size and coherence of associations are consistent with the theoretical mechanisms by which teacher shortage affects schooling. Future studies can use longitudinal data to examine how changes in staffing (e.g., after recruitment drives or transfer cycles) correspond to changes in functional effectiveness and achievement.

Because achievement is measured at school level, the results do not show how shortage differentially affects subgroups (e.g., first-generation learners, girls, or children with learning difficulties). Pupil-level analysis would allow estimation of distributional effects and equity impacts.

Finally, the community support construct was binary. Richer measurement could reveal whether high-intensity, well-structured community support programs-such as regular tutoring volunteers or structured SMC academic monitoring-produce stronger effects.

10. CONCLUSION

In teacher-deficient primary schools of District Basti, teacher deficiency is strongly associated with weaker functional effectiveness and lower achievement in Hindi and Mathematics. Differences across deficiency bands are large, indicating that staffing severity corresponds to substantially different operating conditions. Location differences are limited, while management type shows a moderate advantage for aided schools in functional effectiveness. Community support mechanisms, as operationalised here, show only small and statistically non-significant associations with overall functioning. The central policy message is clear: ensuring adequate teacher provisioning and rational deployment is foundational for improving school processes and learning outcomes in teacher-deficient contexts.

Supplementary quantitative evidence from the parent study

The thesis dataset also includes teacher-level analyses of perceived problems and coping mechanisms by teacher gender (N = 180). These analyses serve as supplementary evidence that informs interpretation but are not central to the school-level models.

Female teachers (n = 113) and male teachers (n = 67) did not differ significantly in perceived problem severity ($t = 0.66$, $p = .513$) or in coping mechanisms ($t = -0.70$, $p = .486$). Mean scores were close across genders, implying that the experience of teacher-deficiency-related stressors is broadly shared among teachers regardless of gender. This suggests that system-level constraints dominate individual demographic differences in reported experience.

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