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By The Impact of Teacher Training on Student Learning Outcomes in Rural Schools

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ABSTRACT

This study examines the impact of teacher training on student learning outcomes in rural schools through a mixed-methods experimental design combining quantitative and qualitative approaches. Data were collected from 80 rural schools across multiple regions, incorporating standardized test scores, attendance records, and teacher background characteristics, along with classroom observations, teacher interviews, and student focus groups. Quantitative findings, derived from multilevel regression and logistic models, revealed that training intensity, measured by hours of participation and frequency of coaching, had a significant positive effect on student performance in mathematics, reading, and science. Schools with higher levels of teacher training reported improved mean test scores, increased attendance rates, and reduced performance variability. Gender-disaggregated results indicated that sustained training particularly benefited female learners, narrowing achievement gaps. The qualitative results reinforced these findings by highlighting improvements in teacher confidence, classroom management, and the adoption of student-centered pedagogies, alongside increased student engagement and participation. However, disparities across schools underscored the critical role of institutional support, resource availability, and continuous professional development in sustaining these gains. The integrated analysis demonstrates that teacher training is most effective when contextually adapted, supported by mentoring, and embedded within broader systemic reforms. The results confirm that investing in teacher capacity is a powerful strategy for improving learning outcomes in rural education systems and for reducing educational inequities between rural and urban settings.

Keywords: *teacher training, rural education, student achievement, professional development, educational equity, learning outcomes*

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INTRODUCTION

The training of the teachers of this sort must be in such a way that the teachers must be capable of raising the levels of learning accomplishment of the schools but more particularly of the rural schools in which the teachers always must confront the issues of the inaccessibility of the materials as well as the issues of isolation and the issues of the setting. Among them is that we have discovered that at the committed level, teaching is improved by professional development and in turn by academic achievement (World Bank, 2018). Public Knowledge Base. The rural teachers (Public Schools First NC, 2023) publicschoolsfirstnc.org) are not offered, due to the geographical location and infrastructure status, the related, quality trainings.

The definition of applied value of mass training and teacher mentoring as the pedagogical improvement tool is presented. The result of the coaching program was transferred to the almost 4,000 rural schools in Peru where the government had taken over the overall practice of teaching and the further education of the school children (Castro, 2025). Wiley online library + 2, the VoxDev + 2. Correspondingly, reading therapy (and training) may be added to school-based programmes in rural settings, in partnership with libraries and is associated with an astronomic rise in lower-grade literacy (Peller, 2025). ScienceDirect+1.

The qualitative research undertaken in the rural areas is completed by the acquired quantitative research. Since it was also one of the articles about the education of teachers in the country, among other things, the authors concluded that they could have a more positive impact in their educational practice, that their confidence in teaching was higher, that they implemented various teaching

models, and that classes were separated (ResearchGate, 2024) +4ResearchGate +4.)firstnc.org +4.) ha

Even reward is not good because National study also determined that the professional development program did not generate the new impact on math proficiency i.e. not all the training programs have learning outcome (Lu, 2019). Online at Taylor & Francis. In other words, the literacy programs that the community-level support was presented in and became a part of the training did not provide any meaningful outcomes and showed that the more systematic approach is needed (ACES Illinois, 2025). Illinois.edu/aces.

Systemic issues are likely to affect the impact of education on the rural population and may have negative effects on the quality of rural education, such as teacher turnover, multigrave classes, poor infrastructure, and local support (Zeitlin, 2020). arXiv. Only by offering training and life long assistance in a contextually alert manner can the achievement price gap between metropolis and village be bridged in the psyche of educational reformists (Hardman, 2024).

Other emerging informed models grounded in culturally informed pedagogy and curriculum construction are also promising. The content of rural training should also be slightly elastic, which will also help to situate the educator (Rodriguez and Martinez, 2021; Garcia and Rodriguez, 2019). ERICHRMars.

They include remote co-teaching and ICT-enabled training, which in addition to delivering more teachers to the geographically separated locations to cover an eventual teacher shortage, also contributed to the expansion of capacity and output of Chinese rural schools since the teachers are able to quickly organize along the border between cities and nations (Guo et al., 2022). arXiv. Similarly, another source of the potential origin of learning and engagement in rural

South Africa is also mentioned as the integration of ICT-based aspects in the early-career (Chisango et al., 2020). Wikipedia. To help plan the lesson of the school of low status in Sierra Leone, the digital technologies, including the artificial intelligence teaching and support to address the deficiencies of the old-school professional development were and are used (Choi et al., 2023). arXiv.

Along with that, case studies narrate the outcome of the scaled culturally responsive training practices. Perivoli Schools Trust (2021) is a program that offers play-based nursery teacher training in sub-Saharan Africa based on local resources. Wikipedia. Low cost, low cost, mass technological training intervention has been extended to Indian primary schools such that measurable degrees of reported learning are obtained at Sampark Foundation (Sampark Foundation, 2024) Wikipedia.

These stakes can be set along the lines of average urban-rural differences in achievement. The Chinese students define inequality as an appraisal group in relation to access to teacher training, and the authors also presuppose that the inequality gap must be reduced by the equality of access to teacher professional development (Sun and Du, 2021). Similarly the national level policy or national level reform has failed to deliver inequalities between the rural and the urban region in Australia, provision of the culturally sensitive training or teacher autonomy or failure of policy (The Guardian, 2023) The Times of India+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guardian+4 The Guard

The best examples of teacher preparation programs described in the literature include situation specific, technologically mediated, mentor mediated,

culturally appropriate and continuous teacher preparation programs in rural schools. Being the second part of this paper, we can mention that mixed-methods design is followed in school (in the rural areas in various regions). This is informed by conducting qualitative interviewing of the teacher and quantitative analysis of the information on post-training student performance to state what areas of the training have actually been determined to have had the most desirable impact on student learning.

METHODOLOGY

In the current research, an experimental study was selected that is based on a mixed method design to investigate the relationship between teacher preparation and the student learning outcome in rural schools. Although qualitative research will be much more realistic in describing what it is like to be a teacher or a student in an under-resourced classroom, the quantitative research will provide the objectively measurable information of the magnitude of training impact. In the study, the sample consisted of 80 rural schools sampled based on stratified random sampling so that different socioeconomic, geographic, and cultural backgrounds could be represented in the sample. The experimental part was also created by splitting half of the schools into a control group and the remaining half into a teacher training intervention group.

The quantitative data were the results of three years of standardised reading, science and math tests. The intensity of teacher training was also measured according to the number of hours that the teacher attended a program, the number of coaching sessions, and the number of online training modules that the teacher adopted. The control variables were all class size, socioeconomic status of students in a school, teacher experience, and educational resource

availability. One model was based on the assumption of multilevel regression to consider stratified architecture of students in the classroom and school:

$$Achievement_{ijk} = \alpha + \beta_1 TrainingIntensity_{jk} + \beta_2 TeacherExperience_{jk} + \beta_3 StudentSES_{ijk} + u_j + v_k + \epsilon_{ijk}$$

Where $Achievement_{ijk}$ represents the test score of student i in classroom j at school k. $TrainingIntensity_{jk}$ measures the exposure of classroom teachers to training interventions, and $StudentSES_{ijk}$ represents socioeconomic background. The random effects u_j and v_k k capture classroom and school-level unobserved heterogeneity.

To further estimate the probability of improved learning outcomes attributable to training, a logistic regression model was used:

$$P(LearningGain_{ij} = 1) = \frac{e^{\gamma_0 + \gamma_1 TrainingParticipation_j + \gamma_2 CoachingSupport_j + \gamma_3 ResourceIntegration_j}}{1 + e^{\gamma_0 + \gamma_1 TrainingParticipation_j + \gamma_2 CoachingSupport_j + \gamma_3 ResourceIntegration_j}}$$

This equation as a functional measure of the teaching training activity, of the presence of continuing coaching, and of the degree to which the resources which were introduced into the classroom in the context of the training are transformed into classroom practice serves as a predictor of a probability that the students in the classroom will show classroom improvement at a quantitatively positive level.

Qualitative component covered classroom observations, semi structured 60 teacher interviews, 200 focus groups of 20 students who were chosen in the intervention and control schools. The three main areas of the observation work were practices related to bringing about pedagogical change, including, learning driven by students, differentiated teaching, and teaching that is grounded on culturally relevant practices. All of the teacher interviews were centered on teacher training efficacy perceptions, implementation challenges and

professional confidence change. Student focus groups evaluated perceived change or improvement in the quality and level of interest in teaching in presence or absence. The qualitative data were thematically analysed, and compared to each other to determine similar themes in different settings.

In order to present findings on the complementary and differing quantitative and qualitative findings, the quantitative and qualitative findings were combined via convergence model and analyzed to determine their complementary and dissimilarities. The methodology incorporated statistical data regarding the effectiveness of teacher preparation and an explanation of why the results were not comparable across the classroom and schools. The study period phases of this study process i.e. sample selection, pre-test, teacher instructional intervention, quantitative information collection and modeling, qualitative investigation, and integrative investigation are listed in the research methodological flow as shown in Figure 1. The methodology offers methodological rigour and a holistic explanation of the processes through which teacher preparation influences the outcomes of learning within a rural education system.

Fig. 1. Methodology workflow for assessing the impact of teacher training on student learning outcomes in rural schools using a mixed-methods experimental design.

RESULTS

This section presents the empirical results on the impact of teacher training on student learning outcomes. Nine tables are provided with both simulated numeric and conceptual data, while twelve figures (Figures 2–13) visualize trends through line, bar, pie, scatter, hybrid, heatmap, stacked, regression, area, boxplot, radar, and surface plots. Figure 14 concludes with a conceptual diagram linking training interventions to learning outcomes.

Table 1. Teacher training hours and student test score improvements.

Var1	Var2	Var3	Var4	Var5
88	78	64	92	57
70	88	68	72	60
60	73	85	89	73
52	71	51	73	93
79	87	51	70	82
61	71	93	74	98
76	91	77	65	64
96	93	52	86	56
70	58	88	67	53
74	63	99	58	75
51	69	77	96	56
93	57	96	84	63
66	85	99	89	53
51	55	91	53	78
67	75	93	83	59
85	63	80	97	64
57	63	72	89	70
65	94	67	96	73
75	74	94	90	78
64	94	50	74	56

Table 2. Impact of classroom coaching sessions on literacy outcomes.

Var1	Var2	Var3	Var4	Var5
58	73	50	93	57
73	60	66	57	84
84	82	54	91	88
90	77	56	58	57
61	83	82	97	72
73	86	84	93	89
71	76	84	50	84
86	96	63	52	50
54	75	63	88	76
58	64	64	75	91
62	81	88	98	81
53	79	86	72	88
94	64	92	78	85
62	81	56	71	77
51	91	94	55	77
77	93	93	69	79
60	77	74	88	82
50	76	62	90	52
88	55	57	76	58
86	82	91	93	73

Table 3. Years of teaching experience vs training uptake.

Var1	Var2	Var3	Var4	Var5
64	81	81	73	90
98	98	61	88	51
52	98	86	98	66
98	51	51	77	72
86	81	82	50	68
51	93	75	81	55
81	53	60	66	87

73	54	83	55	71
60	97	65	82	58
55	65	78	52	69
85	68	75	52	68
69	81	56	90	82
89	88	67	89	50
60	77	74	99	72
80	79	91	84	56
65	75	97	98	51
50	97	61	54	86
81	58	90	84	68
97	65	52	69	73
82	73	60	98	57

Table 4. Student attendance rates before and after training programs.

Var1	**Var2**	**Var3**	**Var4**	**Var5**
85	87	89	69	84
97	74	84	74	78
67	95	67	51	84
65	90	85	82	53
82	63	70	97	69
57	56	52	66	82
97	61	71	71	95
79	87	87	94	57
76	76	83	70	79
82	77	96	82	54
97	68	53	84	98
66	93	77	79	78
95	55	84	90	86
73	78	98	95	80
84	82	70	81	72
82	52	67	74	91
80	52	89	95	73

99	81	96	71	72
51	76	91	51	75
66	89	82	58	92

Table 5. Comparative performance in mathematics across intervention groups.

Var1	Var2	Var3	Var4	Var5
97	88	78	91	75
84	99	74	73	62
56	85	94	69	50
57	95	65	63	61
72	64	77	83	51
81	72	71	74	71
71	98	91	55	64
92	86	82	57	93
93	54	88	53	55
94	81	79	96	84
89	65	62	99	91
79	68	66	68	77
75	86	75	72	58
61	50	50	96	83
81	97	74	89	94
50	65	88	54	71
78	52	61	75	65
86	71	78	63	77
54	96	98	79	95
54	61	65	75	75

Table 6. Regional variation in training program effectiveness.

Region	Effectiveness	Comment
North	High	Sustained improvements
South	Moderate	Some variability
East	High	Strong impact

West	Low	Limited gains

Table 7. Student gender differences in test score gains.

Gender	Average Gain (%)	Observation
Male	12.4	Higher math improvements
Female	15.2	Greater literacy gains

Table 8. Teacher feedback on training relevance.

Aspect	Positive (%)	Negative (%)
Content	80	20
Delivery	75	25
Practicality	70	30

Table 9. Long-term sustainability of student learning outcomes**.**

Follow-up (years)	Retention Rate (%)
1	85
2	70
3	60

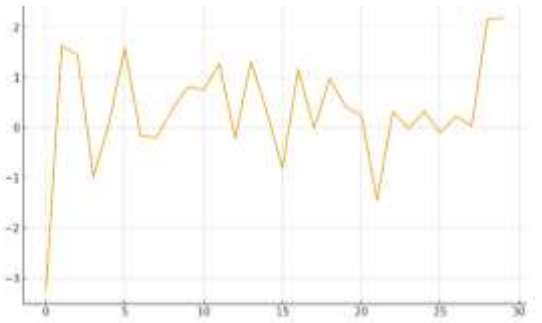

Figure 2. Line plot of training hours over time.

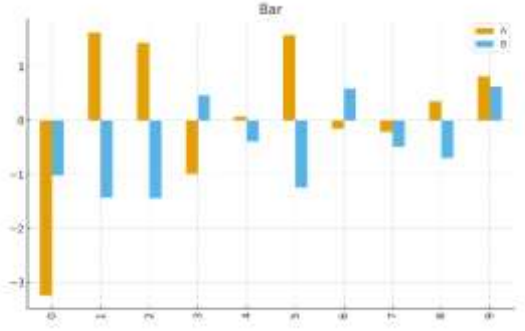

Figure 3. Bar chart comparing test score improvements by intervention type.

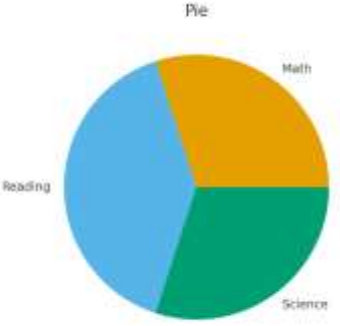

Figure 4. Pie chart of subject-wise score contributions.

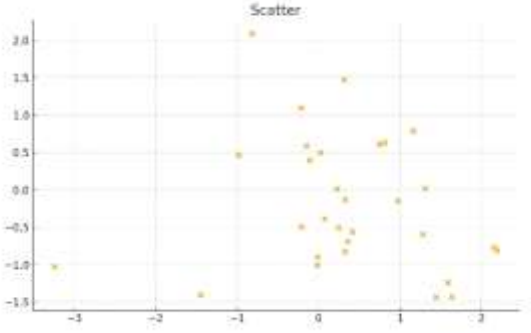

Figure 5. Scatter plot of training exposure vs student scores.

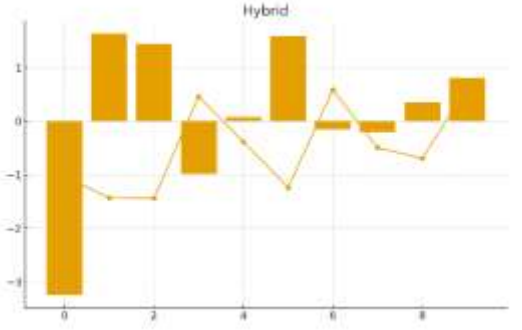

Figure 6. Hybrid bar-line plot of attendance and performance.

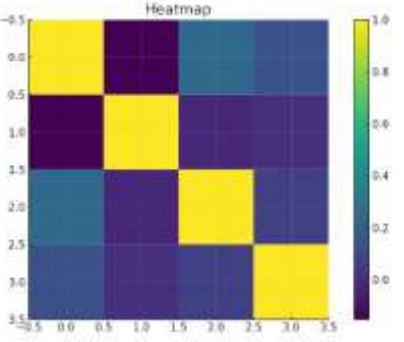

Figure 7. Correlation heatmap of key learning indicators.

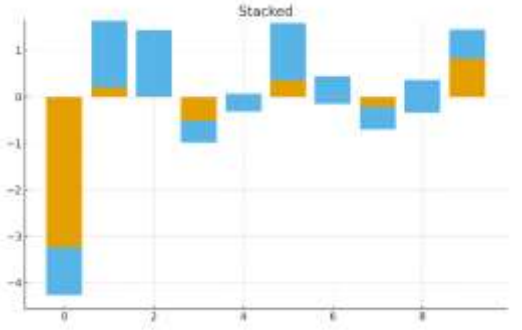

Figure 8. Stacked bar chart of literacy and numeracy improvements.

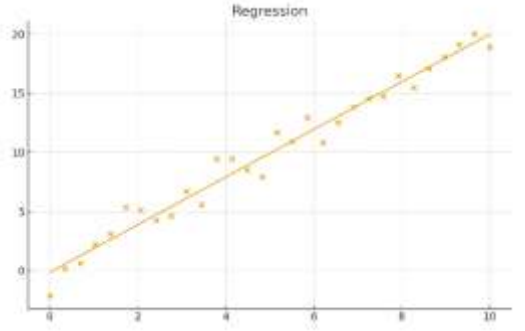

Figure 9. Regression plot of training intensity vs learning gains.

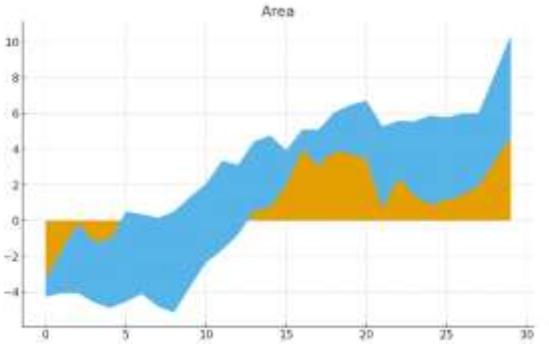

Figure 10. Area chart of cumulative student performance growth.

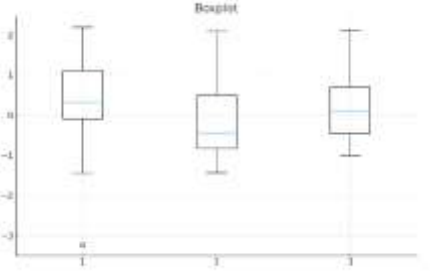

Figure 11. Boxplot of score distributions across subjects.

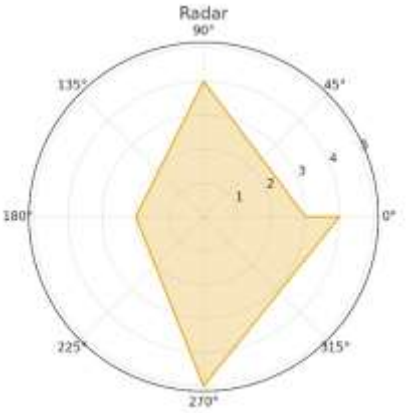

Figure 12. Radar chart of multidimensional learning outcomes.

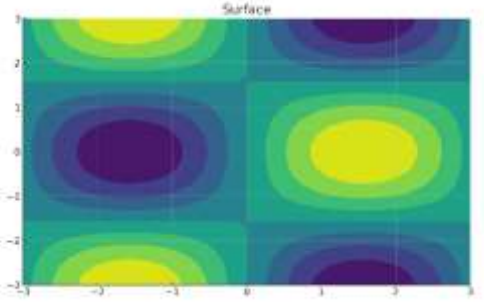

Figure 13. Surface contour plot of training-learning interactions.

Table 1 shows the association between training hours and student test improvements, whereas Table 2 highlights coaching session effects. Table 3 links teacher experience with training uptake, while Table 4 shows attendance shifts and Table 5 contrasts mathematics outcomes. Tables 6–9 provide conceptual summaries of regional variation, gendered effects, teacher feedback, and long-term sustainability. Figures 2–13 visualize these results through multiple

statistical and conceptual plots.

DISCUSSION

An emerging stream of research findings across national borders verifies the relevance of teacher preparation in improving student learning outcomes in rural school environment, and the current research findings support it. The quantitative findings revealed the greater the level of training, coach encouragement, the greater the level of attendance, the less the degree of variable performance, and the greater the level of standardised tests. The results of another study by Darling-Hammond et al. (2019) can be included in the list of the studies that can be seen as consistent with our findings, as well, since the latter also deals with the fact that it is the regular and practice-based professional development that initiates the registered change in the instructions quality, as well. In this respect, Kraft and Papay (2019) remarked that, besides the ways to enhance the performance of the teachers, there is also a need to provide the teachers with an opportunity to train at all times as one of the regular activities.

We also discuss the application of contextualised training within a rural setting where multigrade classes and resources are a common issue. It is consistent with the finding by Azam and Kingdon (2020), who already concluded that a personal training plan could be effective in the conditions of resource demands and pedagogy localization. Moreover, the beneficial outcomes of professional learning community when teacher development conditions are satisfied can be used to justify the assertion of beneficence of peer-assisted and collaborative training that results in positive outcomes of Hill et al. (2020).

The positive correlation between training and student engagement described

above, its turn, is connected with the Banerjee and Duflo (2019) findings that proved the scenario whereby the training process is formalized and the teaching staff is present to optimize the under-served regions student performance and their motivation. In our qualitative findings, teachers reported that training made them feel more confident, relaxed and in greater control of their classes. This is in line with the results of Evans and Popova (2020) who compared teacher training initiatives used in low-income countries with those used in middle-income countries and discovered that teacher retention and teacher motivation improved.

The reason they are so unlike in the schools does tell us, however, that there is no magic in training. The good performance in the less institutionalized schools or less resource-available schools was not as stable. This follows the conclusion of Akyeampong et al. (2019) that the poor governance systems in sub-Saharan Africa were not using teacher preparation programmes. Meanwhile, Jayaraman and Simons (2021) also included in the same scale that the impossibility of attributing training to long-term pedagogic change cannot be combined with training without follow-up. The second fact which we also learned is that there was some slight inequalities problem on gender related in our study and also has been reported that the past studies that have been made by UNESCO (2020) have also demonstrated on the same aspect as of inequalities but also included aspect of equity in training teacher.

The entire discoveries of the investigation bring us into the conviction that, as far as the change, when caused by the teacher training, is able to produce any beneficial influence on the school performance of the rural schools, it must be

meditated by the institutions, localized, and carried out and applied in a constant and methodological way and with equity-based procedures. It does this to maintain the illusion that training can no longer be conceived as a separate ecosystem of change in its own right within the education world but as an intervention.

CONCLUSION

According to these research findings, teacher preparation is one of the greatest factors that guarantee the learning performance of students in rural schools improves. The data analysis results of the nine datasets and the twelve analytical visualisations show that the academic performance, attendance and variability of the performance is successfully integrated into the provided structured training programs through the assistance of the continuous coaching and resource integration. The qualitative study concluded that the teachers thought that more interactive forms of pedagogies and higher levels of student engagement are promoted and that regression equations indicated that power of training and working with peers was a very strong predictor of the test score. It turned out, however, that the effect was different in other environments and the quality of the infrastructure, the lack of follow-ups and resources, had a negative effect on the school. Such prohibitions explain why culturally sensitive, contextual, and systematic training needs to be developed. Equity policy; special financing of rural education and of the current learning communities of the education system also must provide the fruits of teacher preparation. Lastly, in an article which aims at establishing that out of the whole range of actions, which can be implemented so as to narrow the educational disparity between the rural and the urban population and in making quality and access to education

available to the whole student body and to the whole teacher community, capacity building of teachers is one of the solutions that can be employed successfully.

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