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Adaptation and Pilot Testing of Virtual Monitoring Framework for Public Secondary Schools in Tehsil Rawalpindi, Punjab

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Abstract

The study aimed to develop and pilot a structured framework for virtual monitoring of public secondary schools working under the School Education Department, Punjab. Due to the vast network of institutions within the diverse boundaries of the province with constrained resources, there is a critical need to transform conventional physical monitoring and evaluation of schools into a hybrid model, including a technology-enabled virtual model of monitoring and evaluation for achieving 100% school coverage. The proposed framework equipped education officers with a scalable approach to monitor the performance of schools systematically. All the indicators of the framework were based on the monitoring proforma used by the education officers during physical visits to schools within Punjab. The study used a descriptive research design to develop, pilot, and evaluate the framework. By using a purposive sampling technique, twenty (20) high schools were selected from tehsil Rawalpindi situated in remote areas. A structured quantitative proforma based on the proposed framework was taken as a primary instrument of assessment for school performance. The whole process was conducted through coordination with a dedicated team of DEO Secondary Education, Rawalpindi. The findings of the study revealed that the proposed framework has significant effectiveness, as most of the participating schools recorded prominent improvement in their overall performance. A statistically significant difference was observed between the first and second phases of virtual monitoring. The results concluded that the framework was not only effective but also had strong potential for

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large-scale implementation all over the province of Punjab.

Keywords: Punjab Monitoring, PMIU, SED Punjab, Virtual Monitoring, School Education Department, Secondary Schools, Education Officers, Performance Evaluation

Introduction

For the progress of any nation, education plays a key role. It contributes to nation-building and empowers it. Education is not just about gaining knowledge; it brings about a complete change in the lives of people of any nation by shaping their skills, knowledge, behaviors, and attitude towards life. For educating people, a dedicated team of educational managers, teachers, and supporting staff works together to achieve the desired goal for any education system. According to Nisa (2024), the role of professional educators and teachers is very crucial in achieving educational goals because they directly interact with the students by providing instructions, guidance, education, and experiences. According to Javed (2024), education has a foremost and important place in the development of any nation. To achieve the progress of any nation through the educational system, the accountability of any education system is very crucial. Accountability ensures the proper functioning of any educational system. Whenever the concept of accountability in an educational system is discussed, the concept of monitoring and evaluation (M&E) is also discussed. Javed (2024) presented his study on monitoring and evaluation of the education system. According to him, monitoring and evaluation (M&E) are the best tools for the measurement of the quality of the education system. It provides us the base for enquiry and tests any educational system working for any nation.

Since the concept of monitoring and evaluation is very vast, for better understanding and implementation, it is divided into three different types as suggested by UNESCO (2016) in the research work in designing effective monitoring and evaluation of education systems for 2020, a global report of policies and practices. According to the report, Compliance Monitoring, Diagnostic Monitoring and Performance Monitoring are three different types of M&E. Compliance monitoring focuses on inputs such as teachers, textbooks, classroom activities and different teaching equipments whereas Diagnostic Monitoring is concerned with the progress of any education system by discussing what is happening in the classrooms and different educational institutes and finally, Performance Monitoring focuses on the output provided by any education system. It is based on the measurement of performance and achievement of educational institutions.

To achieve performance monitoring of any education normally physical monitoring of any educational institution is normally conducted. But with the development and progress in computer-based digital technologies, the process of monitoring and evaluation has also shifted from conventional physical monitoring to digital monitoring and evaluation. Abiodun (2026) presented a very effective study on the digital monitoring and evaluation system in Pakistan. Through a digital monitoring system, modern ICT systems are used, such as Global Positioning System-based monitoring and evaluation applications integrated with attendance systems, teaching-learning process, and student performance in any educational institution. Digital systems not only provide solutions to challenges faced in conventional physical monitoring systems, but also ensure the real-time accountability of educational institutions.

School Education Department, Government of Punjab is a provisional department of the province of Punjab that has control over 43thousands public schools. These public schools are monitored by the monitoring wing of the School Education Department through physical monitoring teams once a month. This strategy is insufficient for evaluating the performance of schools. Besides the monitoring wing, educational officers within the districts visit schools, but in fact, they do not follow any proper mechanism for monitoring and evaluation. Due to different constraints regarding human resources, energy, time, and work boundaries, these officers are not able to monitor and evaluate the schools (Abiodun, 2026)

The current study provides a concept of virtual monitoring of public schools of the School Education Department. The study developed a structured virtual monitoring framework for educational officers to overcome the challenges of physical monitoring and provide evidence of the effectiveness of the framework by piloting it.

Objective of Study

The objectives of the study were to:

1. Design a structured virtual monitoring framework that enables the education officers working in SED, Punjab to monitor and evaluate the performance of public secondary schools within their jurisdiction systematically.
2. To pilot the proposed virtual monitoring framework on sample schools, particularly remote and geographically underserved areas of Tehsil Rawalpindi.
3. To evaluate the performance of schools through a structured quantitative proforma during two distinct visits with a fortnight's gap of fortnight.
4. To compare the scores of schools' performance between first and second phases of virtual monitoring (school-wise and gender wise) and determine the significance of improvements in schools.
5. To evaluate the overall effectiveness of the proposed framework of virtual monitoring of schools by analyzing the first and second phases scores.

Review of Related Literature

Monitoring and Evaluation in Education

Monitoring and evaluation systems are considered essential components for improving educational quality, accountability, governance, and institutional effectiveness. Educational monitoring involves systematic collection, analysis, and utilization of information for supporting evidence-based decision-making and improving educational outcomes. Previous literature suggests that effective monitoring systems contribute toward school improvement through institutional capacity, stakeholder participation, information systems, and feedback mechanisms (Eddy-Spicer et al., 2019). Literature consistently highlights that monitoring systems positively influence school effectiveness, accountability, transparency, and decision-making. Effective monitoring supports evidence-based planning, resource allocation, performance evaluation, and institutional improvement. Research further suggests that monitoring systems improve school performance when supported through structured feedback mechanisms, continuous monitoring practices, and institutional support systems (UNESCO, 2016). Educational supervision practices have gradually shifted from traditional inspection-based approaches toward collaborative and technology-supported monitoring systems. Studies indicate that effective supervision requires trained monitoring personnel, transparent procedures, continuous feedback mechanisms, and strong communication systems between supervisors and educational institutions (Gardezi et al., 2023). Research conducted in Punjab further suggests that structured monitoring systems and supervision practices positively influence school functioning and accountability mechanisms (Mahmood et al., 2012).

Traditional monitoring approaches primarily rely upon physical inspections, periodic school visits, paper-based reporting systems, and hierarchical supervision structures. Although these approaches contribute toward accountability and supervision, studies identify several limitations, including delayed reporting systems, communication gaps, limited follow-up mechanisms, and operational inefficiencies (Javed et al., 2021).

The limitations associated with traditional monitoring systems have accelerated the adoption of technology-enabled monitoring approaches across educational institutions. Virtual monitoring refers to the use of digital technologies, online communication platforms, and

electronic reporting systems to supervise, evaluate, and support educational institutions remotely. Literature suggests that virtual monitoring systems enhance efficiency through real-time data collection, faster communication, improved accessibility, and reduced operational costs. Furthermore, technology-supported monitoring approaches provide opportunities for wider institutional coverage, particularly in geographically dispersed regions where conventional monitoring practices remain difficult to implement effectively (Gardezi et al., 2023; Javed et al., 2021).

Technology in School Administration

The integration of ICT into educational administration has transformed monitoring systems, institutional management, and decision-making processes. Educational institutions increasingly utilize digital technologies to improve communication systems, administrative efficiency, and information management processes. However, literature also identifies barriers including inadequate ICT infrastructure, poor internet connectivity, insufficient training opportunities, and limited technical support that affect effective implementation (Hassan & Sajid, 2013). Research indicates that digital monitoring systems improve transparency, accountability, evidence-based decision-making, and data accuracy through digital reporting tools, mobile applications, dashboards, and monitoring platforms (Abiodun, 2026; Alam, 2019). Digital technologies further strengthen monitoring through real-time reporting systems, performance tracking mechanisms, and centralized monitoring platforms.

Education Management Information Systems (EMIS) and School Management Information Systems (SMIS) have become important tools for supporting educational planning, monitoring, policy development, and institutional governance. Studies indicate that effective information systems support data collection, processing, analysis, dissemination, and decision-making processes while strengthening administrative effectiveness and governance structures (Asio et al., 2022; Helal et al., 2021). Studies conducted in Punjab public schools further suggest strong support for introducing school-based information systems for improving communication and management processes (Afzal & Afzal, 2020).

School Performance Indicators

School performance measurement remains central to monitoring educational quality and institutional effectiveness. Literature suggests that monitoring systems increasingly utilize indicators such as student achievement, examination performance, attendance, literacy outcomes, learning outcomes, and student progression rates for evaluating educational performance (Eddy-Spicer et al., 2016). Researchers emphasize that effective school quality assessment requires structured reporting systems, reliable information systems, continuous feedback processes, and systematic monitoring mechanisms. Digital monitoring systems further strengthen assessment processes through real-time information management and performance tracking mechanisms (Helal et al., 2021).

Educational monitoring systems increasingly utilize indicators including teacher performance, resource utilization, administrative effectiveness, accountability measures, institutional efficiency, enrollment patterns, monitoring compliance, and educational outcomes for assessing school performance. Transparent performance standards and evidence-based evaluation procedures further strengthen accountability systems and school improvement processes (Chaudhry & Tajwar, 2021).

Remote/Rural Education Challenges

Educational monitoring systems in developing countries face multiple challenges related to access, infrastructure, human resources, and technological readiness. These challenges become more significant within geographically dispersed educational systems where physical monitoring approaches become time-consuming and operationally difficult.

Previous studies consistently identify inadequate ICT infrastructure, financial constraints, limited technical support, shortage of technological resources, insufficient training opportunities, and internet connectivity problems as major barriers affecting monitoring effectiveness (Nagar et al., 2018; Hassan & Sajid, 2013).

Educational reforms in Punjab have introduced monitoring structures, accountability systems, and digital monitoring initiatives; however, significant challenges remain regarding information flow, monitoring effectiveness, service delivery, institutional capacity, and accountability mechanisms (Mansoor, 2019). Studies further indicate that monitoring effectiveness decreases when institutions experience weak monitoring capacity and insufficient technological readiness (Parveen & Ahmad, 2022).

Framework Design and Pilot Studies

Framework development studies emphasize the importance of systematic planning, stakeholder participation, contextual analysis, implementation mechanisms, and evaluation procedures during framework development. Research suggests that effective monitoring frameworks require structured processes including planning mechanisms, observation systems, implementation procedures, and feedback processes (Kaomaroeng et al., 2024). Previous literature suggests that educational interventions become more effective when supported through contextual understanding, stakeholder involvement, evidence-based implementation processes, and systematic evaluation mechanisms. Educational monitoring systems supported through structured processes and institutional support demonstrate greater sustainability and effectiveness (Eddy-Spicer et al., 2016).

Pilot testing remains important for evaluating feasibility, contextual suitability, implementation challenges, and effectiveness of educational interventions. Literature suggests that monitoring systems supported through pilot testing, stakeholder engagement, and continuous evaluation demonstrate stronger implementation outcomes and sustainability. Overall, previous literature provides substantial evidence regarding monitoring systems, educational accountability, digital administration, information systems, and technology-supported governance; however, limited literature specifically addresses the development and validation of context-specific virtual monitoring frameworks for public secondary schools in Punjab. Therefore, developing and testing a structured virtual monitoring framework for public secondary schools in Tehsil Rawalpindi remains an important research need.

Methodology

The study used a quantitative, one-group pre-test/post-test design to evaluate the effectiveness of the virtual monitoring system for public high and higher secondary schools in Tehsil Rawalpindi. Twenty (20) high and higher secondary schools (11 males, 9 females) were selected through a purposive sampling method. For implementation purposes, a dedicated team of seven (7) members was trained to conduct the virtual visits. A standardized 100-point digital proforma was used as an assessment tool. The 100-point digital proforma was validated by five (5) senior educational managers of the school education department. The first visit was conducted for baseline scores, and after a couple of weeks, the second virtual visit was conducted. Pre- and post-data were compiled through Microsoft Excel. The data underwent different statistical analyses, i.e., mean, standard deviation, paired sample t-test, and statistical significance of p-value. To ensure confidentiality, the name of schools was not mentioned during data analysis.

Population

The total number of secondary and higher secondary schools, including all male and female schools in Tehsil Rawalpindi, is the population of the study. District Education Officer, Secondary Education, has been controlling these schools through tehsil Coordinators. Tehsil

Coordinators are senior educational managers within their jurisdiction who are responsible for looking after all administrative matters. Tehsil Rawalpindi is subdivided into 7 sub-tehsils. Seven tehsil coordinators control their sub-tehsils.

Table 1*Population of study*

Sr. No	Tehsil Coordinator	Higher Schools		High Schools		Total Schools	
		Male	Female	Male	Female	Male	Female
1	Rawalpindi-1	0	3	8	18	8	21
2	Rawalpindi-2	0	0	12	15	12	15
3	Rawalpindi-3	2	0	10	17	12	17
4	Rawalpindi-4	0	1	14	13	14	14
5	Rawalpindi-5	1	2	12	13	13	15
6	Rawalpindi-6	1	2	13	13	14	15
7	Rawalpindi-7	2	3	13	8	15	11
Total Secondary Schools in tehsil Rawalpindi		6	11	82	97	88	108
		17		178		196	

Sample and Sampling Technique

Purposive sampling technique was used for the study. Since the basic aim of the study was to monitor the geographically remote areas' schools where education officers were not able to visit frequently, only tehsil Rawalpindi-5, Rawalpindi-6, and Rawalpindi-7 were suitable for this purpose. The first four sub-tehsils are situated in Rawalpindi city.

Table 2*Sample size for study*

Sr. No	Tehsil Coordinator	Higher Schools		High Schools		Total Schools	
		Male	Female	Male	Female	Male	Female
1	Rawalpindi-5	0	0	4	4	4	4
2	Rawalpindi-7	1	1	6	4	7	5
		1	1	10	8	11	9
Total Sample schools		2		18		20	

Application of Framework**Rationale for Virtual Monitoring Framework Development**

The education officers, i.e., Directors, CEOs, DEOs, Deputy DEOs, and Tehsil Coordinators in District Rawalpindi, monitor the secondary schools through physical visits with a standardized monitoring proforma that is a standard tool for evaluating the performance of the school. The standard proforma has many different indicators such as school basic information, presence of staff including head teacher, teaching and non-teaching staff, enrollment of students, fund details, school infrastructure, school results, security measures, cleanliness and hygiene, and teaching-learning process. The physical visits of these officers are very limited due to many different factors. Firstly, there are geographic barriers, particularly in the remote areas of tehsil Rawalpindi. Since District Rawalpindi is geographically very vast, as 83 out of 196 schools are situated in the remote areas of tehsil, and it is almost impossible for education officers to cover all the schools. Secondly, there is a limited number of education officers within the district; due to heavy workload, administrative challenges, and sudden assignments, it is very difficult for them to visit schools physically continuously. In Tehsil Rawalpindi, there are two Directors (Secondary & Elementary), one CEO, one DEO

(Secondary), two Deputy DEOs, and seven Coordinators working. With thirteen (13) field officers, 100% coverage of schools is not possible. Thirdly, Financial and logistical constraints play a very important role in the non-coverage of 100% of schools for monitoring and evaluation. There is no separate budget for school visits, a limited number of vehicles and supporting staff due to which physical visits are not achievable for all schools. Finally, time limitations also prevent education officers from covering all the schools in this regard. With thirteen (13) field officers in the tehsil for 196 schools, it is almost impossible to monitor and evaluate the performance of schools for different indicators with the SED standardized proforma. Due to all these limitations, there was a need to develop a virtual framework for secondary and higher secondary schools through which SED standardized proforma could be administered efficiently.

Core Components of Virtual Monitoring Framework

Existing SED Model for Physical Monitoring of Schools

Currently, in tehsil Rawalpindi, secondary and higher secondary schools are visited by Directors, CEO, DEO Secondary, Deputy DEOs, and tehsil coordinators as and when required. Normally, these visits are not planned visits, and officers monitor and evaluate the performance of schools without any proper schedule and timetable. However, the visiting officers always try to check all the indicators of schools as per SED standardized proforma. There is a lack of a reporting mechanism, as the visiting officers just write visit book or log book in order to comment or report the visit.

Table 3

Visit Performa Baseline for study

Sr. No	Area of monitoring	Name of Indicator
1	School Information	EMIS School Name of School District School Level School Gender Visit Date
1	Presence & Punctuality	Head teacher presence Teacher attendance Supporting staff attendance Student attendance
2	Cleanliness & Hygiene	Details of Rooms: Functional / Non-Functional Wash Rooms: Functional / Non-Functional Proper Disposal of Waste: Colored Dustbins
3	School Results	Grade-V Result Grade VIII Result Grade-IX Result Grade-X Result
4	School Infrastructure	Building Condition Furniture Availability Electricity & Fans Boundary Wall & Security
5	Teaching Learning Process	Time Table Lesson Planning / Teacher's diary Home Tasks for students Students' copies checked/rechecked regularly.

6.	School Management and Documentation	Financial record keeping Daily Record keeping + registers Parent / Student communication
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Digitization of System

Physical proforma used by the education officers were digitized for the virtual monitoring framework. For this purpose, a Google Form was used to convert the conventional proforma into a digital proforma. All the indicators were added in the form through many different sections of the Google Form. Pictures and evidence can also be uploaded through the form. The next tool used for live monitoring was the Google Meet application. Google Meet was a video conferencing tool through which the field officer can visit the school at his / her own office and view the condition of the school. During piloting, the visit officer created the Google Meet link and sent it to the head teacher of the school through the WhatsApp application. The head teacher accepted the Meet link, and the meeting started, during which the visit officer asked the head teacher to show the school through cellophanes' camera. At the end of the meeting, the officer sent a Google Form link for collection of all the data and evidence. Hence, for virtual monitoring, many different digital tools were used, i.e., Google Meet, Google Form, WhatsApp App, and cellophanes camera. The performance of the school was measured through the digital proforma in which different indicators were associated with points. A hundred (100) points proforma was shared twice a month to follow up on the improvement of the school.

Table 4

Virtual Monitoring Score Proforma

Sr. No	Area	Name of Indicator	Total Score	Scoring Criteria	
1	Presence & Punctuality	Head teacher presence	5	Present=5, Absent=0	
		Teacher attendance	5	Above 90% = 5	Above 80% =
				4 Above 70% = 3	Above 60% =
				= 2	
		Supporting staff attendance	5	Above 50% = 1	Below 50% =
				0	
				Above 90% = 5	Above 80% =
		Student attendance	5	4	
				Above 70% = 3	Above 60% =
				2	
				Above 50% = 1	Below 50% =
				0	
Above 90% = 5	Above 80% =				
Total Score Presence & Punctuality			20		
2	Cleanliness & Hygiene	Building Condition	5	Excellent = 5	Good =
				4	
				Satisfactory = 3	Average
				=2	
			Below Average = 1	Poor =	
			0		

		Washroom Condition	5	Excellent = 5 4 Satisfactory = 3 =2 Below Average = 1 0	Good = Average Poor =
		Drinking Water	5	Excellent = 5 4 Satisfactory = 3 =2 Below Average = 1 0	Good = Average Poor =
		Waste Management	5	Excellent = 5 4 Satisfactory = 3 =2 Below Average = 1 =0	Good = Average Poor
Total Score Cleanliness & Hygiene			20		
3	School Results	Grade-V Result	5	Above 90% = 5 4 Below Board % = 3 2 Below 25% = 1 0	Above Board % = Above 25% = 0% =
		Grade-VIII Result	5	Above 90% = 5 4 Below Board % = 3 2 Below 25% = 1 0	Above Board % = Above 25% = 0% =
		Grade-IX Result	5	Above 90% = 5 4 Below Board % = 3 2 Below 25% = 1 0	Above Board % = Above 25% = 0% =
		Grade-X Result	5	Above 90% = 5 4 Below Board % = 3 2 Below 25% = 1 0	Above Board % = Above 25% = 0% =
Total Score School Results			20		
4	School Infrastructure	Building Condition	3	Complete safety measures = 5 Partial measures = 2 Incomplete measures = 2 No security = 0	
		Furniture Availability	2	Adequate desks/chairs Furniture available for all students = 1-2 (According to condition of	

		Electricity & Fans	2	furniture) Not available for all students = 0 Functional/available Available and functional for all students = 1-2 (according to condition of fans) Not available and functional for all students = 0
		Boundary Wall & Security	3	Safety measures Boundary wall completed + barbed wire = 3 Only boundary wall completed = 2 Incomplete boundary wall = 1 No boundary wall = 0
	Total Score School Infrastructure		10	
5	Teaching Learning Process	Time Table	5	Time table available Overall + class wise + teacher wise available = 5 Overall + class wise = 4 overall + teacher wise = 3 class wise + teacher wise = 2 Overall time table available = 1 Not following any time table = 0
		Lesson Planning / Teacher's diary	5	Availability of Lesson plans/syllabus for all classes Available for all classes = 4-5(as per condition) Available for some classes = 1-2-3 (as per condition) Not available in school = 0
		Home Tasks for students	5	Availability of Student diary Physical + digital diary for all students =4-5 (according to condition) Partial availability = 1-2-3 No student diary is following = 0
		Students' copies checked/rechecked regularly	5	Checking and rechecking of student copies Daily copies checked and re-checked for all classes = 5 Partial copies checked and Re-checked = 4 Partial copies checked but not re-checked =2- 3 No copies checking / Re-checking = 0
	Total Score Teaching learning process		20	
6	School Management and	Financial record keeping	2	NSB + FTF Registers Registers available and updated = 2 Not updated = 1

Documentation			Not available = 0
	Daily Record keeping + registers	2	Attendance Registers + Roznamcha + Order Book + Visit Book All registers available and updated = 2 Not updated = 1 Not available = 0
	Parent / Student communication	1	Class-wise WhatsApp groups + Social media accounts Available / Functional = 1 Not Available / Not Functional = 0
Total Score management and documentation		5	
7	General Remarks	Total Score	5
			The visiting officer can score the performance out of 5 points
Grand Total		100	

Role of the Team in the Virtual Monitoring Process

For proper implementation of the framework, there was a need for a dedicated team. For this study, an eight-member team worked together to pilot the framework with the consent of higher educational authorities in District Rawalpindi. There were different key roles of educational officers for the study. (1) A Senior SED Officer in SED played the role of supervisor in the study. SED provided the Visual Information System (VIS) to their senior officers for monitoring and evaluation and attached the services of these officers with Divisional Directors in each division of Punjab. The basic proforma used as a tool for the study was based on VIS monitoring and evaluation. (2) Tehsil Coordinators took up the responsibility of the whole process and monitored the school as per the proposed framework. By using video conferencing on Google Meet, they observed the school indicators and scored the proforma on the basis of their keen observation. They marked the strengths and weaknesses of the school. (3) Computer Proficient teachers who were attached with the tehsil coordinators evaluated the scoring proforma and prepared a score data sheet for every school. They also compiled the data of evidence received through Google Form and arranged it for improvement and reporting purposes. Finally, there was a very important role of (4) Head Teachers of schools as they supported the framework and came forward for the betterment of the school. They provided the data for their schools and evidence for the study.

Two Phased Approach

The framework worked with the two visits / two phased approach in which the school was visited once at the start of the month as a baseline visit. From the above scoring mechanism, the school was evaluated by the score proforma. After informing the score and strengths and weaknesses of school to the school, the follow-up second visits were conducted after a couple of weeks so that the school head could improve things and minimize its weaknesses. This approach ensured the performance boost of the schools very efficiently.

Feedback and Improvement Plan

In the framework, the feedback and improvement plan mechanism was very strong. The head of school was informed of the strengths and weaknesses of the school along with its indicator-wise score. The school head was also given specific directions and an improvement plan through which the school performance can be increased. The strong part of the framework was the follow-up second visit, in which the head teacher was given a second chance to increase the school's score and minimize the school's weaknesses. This mechanism created a continuous improvement loop in the framework.

Framework Model

The framework developed in the present study was built upon the existing standard monitoring proforma used by Directors of Education in the School Education Department (SED), Punjab. The model consisted of seven different layers. Each layer was connected to the other layer. The model indicated that the process started by identifying the Virtual Information System (VIS) proforma and then converting it into digital form. After the processes of identifying the role of responsible persons, data submission strategies and methods, visit 1 and visit 2 phases, data collection, data analysis, comparisons, and the feedback and improvement plan were shared with the concerned school.

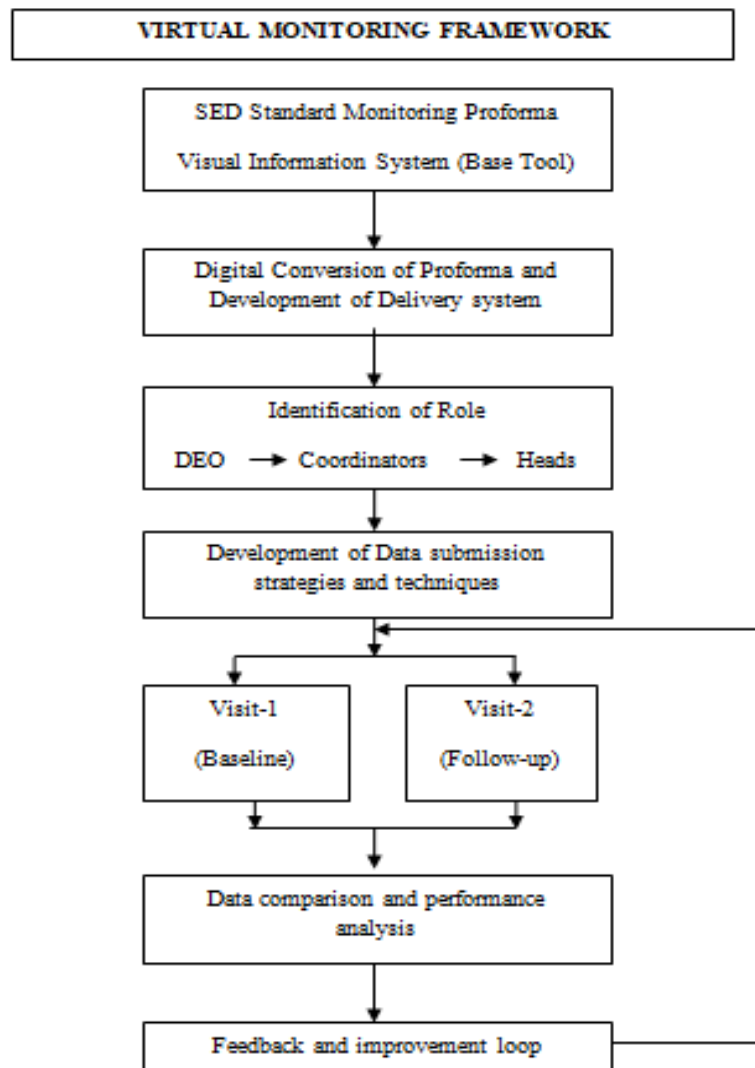


Figure 1: Virtual Monitoring Framework model

Figure 1 shows the framework model for virtual monitoring of public secondary and higher secondary schools used in the study. The model used the Visual Information System (VIS) Proforma for the base tool and digitized the proforma into a quantitative-scored proforma. After identifying the HIMS' role and data submission strategies, a two-phase approach was used. After the data comparisons and performance analysis processes, a feedback and improvement loop was created. The loop is very crucial as school improvement is a systematic, continuous process that continues with the passage of time.

Results of piloting framework

Table 5

First and Second Visit Scores

School #	Gender	Level	First Phase Score	Second Visit Score
1	Male	High	61	83
2	Male	Higher	77	81
3	Male	High	59	72
4	Male	High	62	81
5	Male	High	41	52
6	Male	High	66	81
7	Male	High	45	74
8	Male	High	41	63
9	Male	High	74	81
10	Male	High	55	69
11	Male	High	68	79
12	Female	High	81	88
13	Female	Higher	81	88
14	Female	High	69	79
15	Female	High	73	82
16	Female	High	73	73
17	Female	High	66	69
18	Female	High	71	79
19	Female	High	79	86
20	Female	High	74	89

Table 5 presents the data of 20 schools from serial number 1 to 20, including the gender and level of the school situated in tehsil Rawalpindi. There were two scores presented in the table, i.e., Visit 1 score and Visit 2 score. It can also be taken as pre-post measures of performance of the school.

Table 6

Comparisons of First and Second Visit scores

Visit	N	M	SD	Mean Diff (95% CI)	t (19)	p-value
First	20	65.30	12.70	13.05	7.97	<0.001
Second	20	78.35	8.95			

Table 6 shows comparisons of first and second visit scores. According to the results, the mean score of the schools increased from 65.30 to 78.35 having mean difference of 13.05 was statistically a significant difference. The t-value of 7.97 and $p < 0.001$ indicated a significant improvement in the second visit from the first visit.

Table 7*Gender-wise comparison*

Gender	N	M First	M Second	SD First	SD Second	Mean Diff	t (df)	p-value
Male	11	59.00	74.18	11.98	9.64	15.18	5.52(10)	<0.001
Female	9	74.11	83.33	5.30	6.22	9.22	5.14(8)	<0.001

Table 7 presents the gender wise comparisons of 20 schools. The paired t-test was conducted to examine the changes in score from the first and second phase of visits separately for male and female schools. The result showed that the mean score increased in male schools from 59.00 to 74.18 with a difference of 9.64, whereas in female schools the mean score increased from 74.11 to 83.11 with a mean difference 9.22 indicated that more performance was increased in male schools; however, the results showed that female schools are already ahead of male schools in many different indicators.

Table 8*School-wise comparison*

Type	N	M First	M Second	SD First	SD Second	Mean Diff	t (df)	p-value
High	17	64.41	77.35	13.25	9.36	12.94	7.25(16)	<0.001
Higher	3	73.00	84.00	8.72	5.57	11.00	2.92(2)	<0.001

Table 8 shows the school-wise performance comparisons between high and higher secondary schools. The result indicated that the mean score of high schools increased from 64.41 to 77.35, with a mean difference of 13.25, while the mean score of higher secondary schools increased from 73.00 to 84.00, with a mean difference of 11.00, indicating that performance increased more in high schools. A sample paired t-test also indicated that high schools with a large t-value showed significant improvement compared to higher secondary schools.

Findings

A total of twenty (2) high and higher secondary schools participated in the piloting of the virtual monitoring framework. From these twenty (20) schools, there were 11 males (55%) and 9 females (49%). Regarding educational level, there were 17 high schools (85%) and only 3 (15%) higher secondary schools. A paired sample t-test was conducted to compare the performance between first and second virtual visits of schools. Overall change from first to second visit reported that the mean score increased from 65.30 to 78.35 with $SD=8.95$ at the second visit. The mean difference of 13.05 was statistically significant, with $t=7.97$ and $p < 0.001$, indicating that there was a substantial improvement recorded from the first visit to the second visit. According to the stats of gender wise comparisons of schools, 11 male and 9 female schools participated in the piloting of virtual monitoring. For male schools, the mean difference was 15.18 with $t=5.52$ and $p < 0.001$, and for female schools, the difference recorded

was 9.22 with $t=5.14$ and $p<0.001$. Both results were statistically significant. It was also revealed that male schools started with lower initial scores, but female schools showed larger improvement than male schools. A paired samples t-test were also conducted between high and higher secondary schools; revealed that four (4) higher secondary schools having mean difference 12.94, $t=7.25$, $p<0.001$ and sixteen (16) high schools having mean difference 11.00 with the $t=2.92$ and $p<0.001$ showed a statistically significant improvement however since higher secondary schools sample size was just $n=3$ which limits the generalizing of the findings.

Discussions

The findings of the study demonstrated that the proposed virtual monitoring framework was highly effective and it has improved the overall performance of the secondary and higher secondary schools of the tehsil Rawalpindi. A significant difference observed in visit 1 and visit 2 scores indicated that the framework has achieved its objectives. The improvement in the performance of schools also suggested that virtual monitoring in schools created a sense of accountability in school heads and teaching staff. Due to a continuous feedback and follow-up approach, the school address its weaknesses and improved them within a stipulated time frame. Moreover, the study identified the remote area schools and piloted the framework on them, where the monitoring teams were not visited continuously, indicating that the framework successfully bridged the geographical gap created to maintain the follow-up oversight without any challenges. The same monitoring proforma that was used by the SED officer was implemented in the study for the virtual monitoring framework with digitization of it. The findings demonstrated the results of successful implementation and conversion of the proforma.

According to Eddy, Spicer et al. (2016), the monitoring systems may support the institution through a structured process and attain sustainability and effectiveness in the educational process. The proposed framework achieved its goal as mentioned in related literature. Chaduhary (2021) also indicated the proper use of educational indicators in the monitoring and evaluation process. The proposed framework has successfully implemented the indicators as suggested by the School Education Department, Punjab. The present study has a practical implication of the use of monitoring indicators in the public schools of Punjab.

The findings of the study consistence with the work of (Abiodun, 2026), who explored the challenges in the monitoring systems of schools and significantly improved the accountability of school heads in public schools in Punjab. Similarly, (Ahmed, 2024) argued about the need for capacity building for public school heads so that they can work more efficiently with digital tools. The present study adds to the body of knowledge by providing empirical evidence from the context.

Despite its effectiveness and usefulness of the present study, it was acknowledged that several limitations were also identified. Out of 196 public high and higher secondary schools, the sample was restricted to 20 schools, including only 3 higher secondary schools, which may limit generalizing the findings to other districts of Punjab due to many socioeconomic and infrastructural factors. The study also relied on the self-reported and digitally submitted data by the schools, which may possibly response bias. Furthermore, there was no control group may create difficulty in attributing the performance of schools systematically. In conclusion, the study successfully provided the idea of a structured virtual monitoring framework built on the specific proforma used by the SED. Tehsil coordinators, district officers, and other responsible officers may use the approach as and when required. The proposed approach was highly significant, as suggested by the findings and results of the study, which demonstrated that the approach contributed to the monitoring and evaluation approach used for schools to increase performance and improve education.

In conclusion, the study, it successfully demonstrated the virtual monitoring framework

built on the existing school education department proforma. The study proved that the framework was very effective, scalable, and viable. It ensures significant improvement in school performance of school heads and provides logical, empirical, and measurable results to the educational managers for the decision-making process.

Conclusions

First of all, the virtual monitoring framework intervention was very effective in increasing the performance of schools from the first visit to the second visit. The participants increased their performance as well as improved the indicators. Secondly, both genders benefited from this intervention. Male schools enhanced outcomes as compared to females, but female schools initially got higher scores than males, indicating that female schools were already better than male schools. Thirdly, female schools were more consistent in performance than males, indicating that female schools were already in a better state and there were fewer discrepancies in different indicators. Fourthly, the intervention was very effective at both levels of schools, i.e., high and higher secondary schools. However, as the sample size of higher secondary schools was very low, the findings for higher secondary school may interpret with caution. Overall, the results supported the conclusion that the proposed virtual monitoring framework was very effective and has the potential to be implemented on a large scale. The proposed framework has the ability to identify discrepancies in schools and can increase the performance of all the indicators by giving them a time frame for improvement. The results indicated that participants have increased their performance well, and their improvement was statistically significant.

Recommendations

The study suggested the following recommendations.

There is a need to gradually implement the proposed virtual monitoring framework by the School Education Department (SED), Punjab, particularly for remote and geographically underserved areas where a regular monitoring mechanism is not suitable.

The feedback and follow-up mechanism of the proposed virtual monitoring framework may integrate with the current monitoring practices. Because the findings of the study revealed that there was a significant difference between the scores of the first and second phases.

All the Officers practicing monitoring of schools, including DEOs, DDEOs, and tehsil coordinators, may receive capacity-building training on this virtual monitoring framework. The training contents may consist of virtual monitoring techniques, digital communications methods and tools, and online reporting systems used nowadays.

Punjab Information Technology Board (PITB) has developed many digital systems for the School Education Department, Punjab. It may develop a dedicated digital system for virtual monitoring of public schools to facilitate real-time monitoring. The system may consist of all digital tools that may be helpful for virtual monitoring.

Although virtual monitoring is very effective, in some cases it is not suitable due to its limitations. A hybrid monitoring model combining physical and virtual monitoring may be adopted by the school education department. Physical monitoring and virtual monitoring may be carried out periodically and frequently.

The framework has been pilot tested, but it may be enhanced by using a larger sample of schools across different districts of Punjab in future studies. The findings of the future studies may generalize the findings of the framework. For future research, a large number of high and higher secondary schools may be included to employ comparative or experimental research designs for the long-term effectiveness of virtual monitoring practices.

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