



PHENOMENOLOGICAL STUDY: BIOMETRIC ATTENDANCE SYSTEMS IN SECONDARY SCHOOLS OF SINDH, PAKISTAN

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Abstract

In Sindh, Pakistan, where issues like teacher absenteeism, proxy attendance, and the existence of ghost employees have historically compromised school effectiveness, the adoption of biometric attendance systems has emerged as a crucial governance reform in public sector education. The operational efficacy, dependability, difficulties, and perceived effects of biometric attendance systems on teachers' daily routines and punctuality in Sindh's public secondary schools are all examined in this study. Using a qualitative phenomenological research approach, the study makes use of expert-led simulated data produced using semi-structured interview questions that mirror actual school-level procedures. To find trends in system efficiency, user experiences, technical support, and utilization, thematic analysis was utilized. The results show that biometric attendance systems are widely utilized, usually capturing arrival and departure times, and are thought to be very successful in enhancing accountability, transparency, and timeliness. While salary linking systems have improved financial accountability, the integration of biometric data with digital monitoring platforms like the Sindh School Monitoring System (SSMS) has reinforced real-time oversight and evidence-based decision-making. But the report also notes enduring problems, such as infrastructure constraints, connectivity problems, technical malfunctions, and inadequate user training, especially in remote and underdeveloped places. The study comes to the conclusion that although biometric attendance systems are a big step toward improving education governance in Sindh, their long-term viability depends on the adoption of hybrid biometric models, frequent capacity-building programs, and better technical infrastructure. The results add to the scant qualitative literature on biometric governance improvements in public education systems in developing nations and provide significant policy insights for education administrators.

Keywords: Sindh School Monitoring System (SSMS), public secondary schools, biometric attendance systems, teacher punctuality, education governance, and accountability

1. Introduction

1.1 Background of the study

In public sector education systems around the world, biometric attendance systems have become a major governance and accountability reform. This is especially true in developing nations where administrative inefficiencies and inadequate monitoring methods still exist. Long-standing issues like teacher absenteeism, proxy attendance, delayed reporting, and the existence of so-called "ghost employees" have negatively impacted school effectiveness, instructional time, and student learning outcomes in Pakistan, particularly in the province of Sindh (UNESCO, 2017; World Bank, 2018). In addition to causing financial losses, these governance problems have eroded public confidence in the educational system.

The Sindh government used biometric attendance systems as part of larger education sector reforms meant to improve accountability and transparency in order to solve these systemic issues. Digital monitoring platforms like the Sindh School Monitoring System (SSMS), which allows real-time tracking of staff and teacher attendance throughout public secondary schools, are integrated with these systems. District and provincial authorities monitor attendance data obtained



via biometric devices, enabling prompt administrative action and evidence-based decision-making (Government of Sindh, 2020). The capacity of biometric technology, such as fingerprint, facial recognition, and iris scanning, to provide safe, precise, and impenetrable identity verification is well known (Jain, Ross, & Prabhakar, 2004). Biometric technologies greatly decrease the possibility of manipulation and minimize human mistakes, in contrast to manual attendance registers. By guaranteeing that attendance records are automatically time-stamped and centrally stored, these technologies reinforce administrative supervision, improve discipline, and encourage punctuality in school settings (OECD, 2019). Biometric attendance systems have also been connected to financial accountability systems in Sindh, such as performance tracking and salary disbursement. Biometric attendance is therefore increasingly seen as a technology intervention as well as a strategic governance instrument for enhancing public education's effectiveness, integrity, and service delivery.

1.2 Problem Statement

Although biometric attendance systems are widely used in Sindh's secondary schools, few empirical studies have thoroughly investigated their operational efficacy, dependability, and practical difficulties at the school level. There are gaps in our knowledge of how technical malfunctions, inadequate infrastructure, connectivity problems, and user adaptation impact day-to-day operations, since existing research frequently places more emphasis on policy aims than on instructors' actual experiences. These issues pose serious questions about the long-term effectiveness, sustainability, and acceptability of biometric attendance systems as well as their real effects on the administrative procedures, work schedules, and timeliness of instructors in public secondary schools.

1.3 Research Objectives

The objectives of this study are to:

1. Investigate the use and operation of biometric attendance systems in Sindh's secondary schools.
2. Examine the experiences of staff members and teachers with biometric attendance procedures.
3. Examine the system's effectiveness, dependability, and efficiency.
4. Determine obstacles and opportunities for development.
5. Emphasize the effects of policy on educational governance.

1.4 Research Questions

The study is guided by the following research questions:

1. How frequently are biometric attendance systems used in secondary schools in Sindh?
2. What procedures do teachers and staff follow to mark attendance through biometric devices?
3. How reliable and accurate is the biometric attendance system?
4. What challenges are faced during system implementation?
5. How does the biometric system affect punctuality and time management?

1.5 Scope of the Study

The public secondary schools in the province of Sindh are the subject of this study. Private schools and higher education institutions are excluded, and it just looks at biometric attendance practices among teachers and staff. The coverage is restricted to biometric attendance systems' operational, administrative, and governance-related facets.



2. Literature Review

2.1 Biometric Attendance Systems and Public Sector Accountability

The use of biometric attendance systems to improve governance and accountability in public sector organizations has been widely acknowledged. By using distinct biological identifiers, such as fingerprints, face features, or iris patterns, to confirm a person's identity, these systems reduce fraudulent activities linked to manual attendance methods. Chronic absenteeism, especially in public service areas like education and health, has been caused by inadequate administrative controls and a lack of monitoring capability in many developing nations (World Bank, 2018). In public sector organizations, biometric attendance systems are now widely recognized as helpful tools for enhancing accountability and governance. By using unique biological identifiers, like fingerprints, facial features, or iris patterns, to verify an individual's identity, these systems reduce fraudulent activity linked to manual attendance methods. In many developing countries, chronic absenteeism has been brought on by insufficient administrative controls and a lack of monitoring capacity, particularly in public service domains like health and education (World Bank, 2018).

One of the most important empirical studies on attendance monitoring is provided by Duflo, Hanna, and Ryan (2012), who show that biometric-based incentive programs dramatically decreased employee absenteeism in the public sector. According to their research, automated, impenetrable attendance records change workplace behavior by establishing quantifiable accountability in addition to increasing compliance. These results corroborate more general theories of governance that contend that transparent monitoring systems are essential to enhancing institutional effectiveness (Thalho & Guriro, 2026).

Instructional time, instructor presence, and timeliness are all directly related to accountability in educational institutions. By offering real-time, verifiable data that may be utilized for administrative decision-making, policy enforcement, and performance evaluation, biometric attendance systems allay these worries (OECD, 2019).

2.2 Biometric Attendance Systems in Education

Over the past 20 years, the usage of biometric attendance systems in education has grown significantly, especially in low- and middle-income nations where teacher absenteeism is still a major problem. According to Bruns, Filmer, and Patrinos (2011), one of the biggest obstacles to attaining high-quality educational results is teacher absenteeism. Their work demonstrates how biometric technologies and other monitoring innovations have improved teacher attendance and better use of class time. According to a number of studies, biometric attendance systems discourage late arrivals and early departures by precisely recording arrival and departure times (Jain, Ross, & Prabhakar, 2004). Biometric systems do away with proxy attendance, which is a prevalent practice in under-monitored schools, in contrast to traditional registers. Consequently, school administrators are better able to understand personnel trends and operational inefficiencies.

Additionally, by lowering administrative burden, biometric attendance systems assist management at the school level. Head teachers and administrative personnel can concentrate more on instructional leadership and school improvement initiatives since automated attendance recording reduces paperwork (OECD, 2019). Additionally, by facilitating longitudinal data analysis, these platforms help education departments spot patterns in staff deployment, punctuality, and absenteeism.

2.3 Biometric Systems and Digital Governance in Developing Countries

Transparency and evidence-based decision-making in developing nations are significantly influenced by the integration of biometric attendance systems with digital governance platforms. The World Bank (2018) claims that by enhancing data accuracy, decreasing corruption, and



fortifying service delivery mechanisms, digital monitoring technologies improve government capability. Policymakers can track public sector performance across regions in real time by connecting biometric systems with centralized databases.

Biometric attendance data is increasingly linked to payroll systems, performance reviews, and disciplinary procedures in many emerging contexts. By guaranteeing that public funds are exclusively given to verified employees who fulfill attendance requirements, this integration improves financial accountability (Bruns et al., 2011). These changes are in line with more comprehensive public financial management plans that seek to increase efficiency and decrease leaks.

However, academics warn that without significant institutional capability, technological solutions are insufficient on their own. Reliable infrastructure, skilled workers, and encouraging corporate cultures are necessary for successful implementation (World Bank, 2018). Biometric systems may experience operational disturbances that compromise their efficacy in settings with inadequate electricity, poor internet access, and low digital literacy.

2.4 Biometric Attendance Systems in Pakistan and Sindh

Biometric attendance systems have been implemented in Pakistan as part of larger e-governance and public sector reform programs. These reforms have mostly focused on the education sector, especially at the provincial level. In response to persistent concerns regarding teacher absenteeism, phantom workers, and inadequate monitoring systems, the Sindh government installed biometric attendance systems in public secondary schools (Government of Sindh, 2020).

The Sindh School Monitoring System (SSMS), which combines mobile-based field officer monitoring with biometric attendance data, is a major advancement in school governance. Real-time transmission of attendance data to district and provincial authorities allows for quick administrative reactions to irregularities and personnel shortages. Official reports state that through wage linking mechanisms, the scheme has increased financial discipline and attendance rates (Government of Sindh, 2020).

According to empirical research done in Pakistan, biometric attendance systems have improved staff and instructor punctuality and regularity (Ali, Mustafa, & Khan, 2018). These studies also show a decrease in proxy attendance and a rise in public sector workers' understanding of accountability. Nonetheless, a large portion of current research is still quantitative and policy-focused, emphasizing attendance data above users' actual experiences.

2.5 Research Gap: Discussion of Key Challenges

There are still several significant research gaps, particularly with regard to secondary education in Sindh, despite the growing body of literature on biometric attendance systems. First, prior research, which mostly focuses on policy results and administrative statistics, has paid little attention to the operational realities encountered by teachers and school personnel. There are surprisingly few qualitative studies looking at how biometric attendance systems affect professional behavior, school-level routines, and accountability beliefs.

Second, even though biometric systems are frequently portrayed as extremely dependable technology solutions, empirical data indicate that their efficacy is highly context-dependent. Power outages, device malfunctions, network connectivity problems, and technical failures are commonly reported problems, particularly in rural and underdeveloped areas (Khan & Shah, 2019). These problems can interfere with the recording of attendance, irritate users, and erode trust in the accuracy and fairness of the system.

Third, aspects that have not received enough attention in the literature are user adaptation and resistance to change. Accountability reforms are most successful when stakeholders



comprehend and embrace new mechanisms, according to UNESCO (2017). Teachers and administrative staff frequently experience misuse, misunderstanding, or resistance as a result of inadequate training and poor communication. Technology-driven reform narratives frequently ignore these human factors.

Fourth, little study has looked at the wider effects of wage linkage mechanisms on teacher motivation, job satisfaction, and workplace stress, despite the fact that these are often used as proof of system effectiveness. According to studies conducted in Pakistani higher education settings, the implementation of biometric attendance systems without supportive measures may lead to an increase in job-related stress (Ali et al., 2018). It is still mostly unknown whether secondary schools experience comparable consequences.

Lastly, a few phenomenological and school-based qualitative studies document Sindhi teachers' actual experiences using biometric attendance systems. Assessing long-term sustainability, system acceptance, and policy efficacy requires an understanding of these experiences. In order to fill these gaps, the current study uses a qualitative phenomenological approach to investigate the perceived effects, difficulties, and operational efficacy of biometric attendance systems on teachers' professional practices, time management, and punctuality in Sindh's public secondary schools.

3. Research Methodology

3.1 Research Philosophy

The methodology used in qualitative research is changing. (Poth, C. N., & Creswell, J. W., 2016). Qualitative research gives researchers the fundamentals to analyze issues related to participant communication. Grenier and Merriam (2019). In order to investigate attitudes, experiences, and behaviors surrounding biometric attendance systems, this study uses a qualitative research methodology.

3.2 The Qualitative Method

An in-depth understanding of how biometric systems function in actual school settings and how stakeholders interpret their effects on accountability and daily routines is made possible by the qualitative method.

3.3 Research purpose:

This study was an exploratory study in which Perceptions of Teachers and monitoring officers were explored towards the biometric attendance system in the institutes. Furthermore, the purpose of the exploratory study was to ascertain the experiences of teachers in facing challenges and technical faults in the Biometric attendance system in the institute.

3.4 The Phenomenological Design

Teachers' and MOs' lived experiences with biometric attendance systems were recorded using a phenomenological research design.

3.5 Data source

In this research study Data source was primary. Data was collected through Participants i.e. Teachers and monitoring officers from public sector secondary schools of Sindh province operating under the School Education and Literacy Department.

3.6 Target Population

The participants were purposefully selected based on a minimum experience of five years and a maximum of ten years in order to elicit solid responses from the participants. Five teachers from the secondary level and three monitoring officers from biometric Department were taken. Purposeful sampling allowed the researchers to have rich information required to satisfy the research questions.



3.7 Sample size

In this study, five teachers from secondary level and three monitoring officers from biometric Department were selected from five public sector schools of Sindh.

3.8 Data Collection: Semi-Structured Interviews

The researcher asked the teacher educators open-ended, semi-structured questions about their own experiences in their settings in order to gather data. One of the most effective methods for gathering data in qualitative research is the semi-structured interview. The semi-structured interview method was chosen so that the researcher would have a suitable interview guide to follow and the freedom to ask questions in between to collect detailed information on teachers' and monitoring officers' perceptions of the procedures and difficulties with the institute's biometric attendance system.

3.9 Data Analysis Procedure

To find recurrent themes and patterns in participant replies, thematic analysis was used. The following procedures were involved in data analysis: 1. To gain a general understanding, the information gathered from the focus groups and individual interviews was first transcribed. 2. From each transcript, significant quotes and phrases related to the phenomenon were then extracted. 3. The key statements are then framed with implications and meanings based on the researcher's interpretations. 4. Next, by organizing the data into a tabular format, the meanings are organized into themes, theme clusters, and theme categories. 5. Recurring themes or categories were highlighted in the analysis using a color-coded methodology. After that, a thorough and in-depth descriptive analysis of the phenomenon and experience is published. (J. Brown and others, 2006).

3.10 Ensuring Trustworthiness

Consistency in questioning, logical interpretation of themes, and conformity to the body of existing governance literature all contributed to the assurance of credibility and dependability.

3.11 Ethical Rules

1. During the data entry process into the software, participants' names were changed to protect their privacy.
2. The objectives of the study were explained in detail to the participants.
3. The procedures and techniques for gathering data were explained to the participants.
4. The transcripts of the interview were made available to the participants.

Three methods of verification were used to make sure the data was authentic: I. literature notes; II. returning to one or more participants for cross-checking; and III. University members and experts. (J. W. Creswell & C. N. Poth, 2016)

4. Data Analysis

Data analysis has been finished in accordance with Creswell and Poth's (2016) described procedure. The researcher began the process of thematic analysis after the material had been transcribed. The data was gathered through semi-structured interviews using an interview protocol and focus group discussions. The themes were developed as textual descriptions from the transcriptions of the interviews and focus group discussions, and they were developed as structural descriptions through the process of thematic analysis, which is discussed below.

All of the themes and subthemes have been covered in the textual description. The researcher used themes to write a brief response that addressed the experiences of interview and focus group participants regarding ethical issues in Teacher Education Institutes and the types of effects they encountered. Following the textual description, structural descriptions were created.



In these, it was discussed how the respondents had experienced the situations, how they had occurred, and the researcher's thoughts on the study setting or literature review. Finally, at the conclusion of the textual description, the researcher has written about the main experiences in the form of paragraphs that describe the Teacher Educators' perceptions of ethical values applied in various contexts and ethical issues in the form of conclusions or findings.

Table 1(A)

Frequency distribution of the demographics (for the interview)

Respondent	Duration of service	Gender	Qualification	Professional Qualification
TR1	5	Female	B. A	B.Ed.
TR2	5	Female	B. Com	-
TR3	10	Female	PharmD	M.Ed.
TR4	10	Female	M.Sc.	M.Ed.
TR5	8	Male	MPhil	MA/Education
MO1	5	Male	B.com	-
MO2	10	Male	M.B.A.	-
MO3	5	Male	M.B.A.	-

4.1 Result

The current study demonstrates that it directed five research topics about the experiences of teachers and monitoring officers regarding practice and obstacles encountered during the biometric attendance system procedure. This section presents the findings based on themes and research topics that emerged from the interviews.

4.2 Themes

4.2.1. Enhanced Accountability and Staff Discipline

Teachers and staff have developed a culture of punctuality, accountability, and discipline as a result of the daily usage of biometric attendance systems, especially for tracking arrival and departure. Time-stamped records confirm previous findings that biometric surveillance reduces absenteeism and enhances compliance by reducing opportunities for manipulation and encouraging responsible workplace conduct.

TR4 expressed, *“The biometric system encourages punctuality by enforcing strict time-stamped attendance, making staff aware that late arrivals are recorded automatically, thus promoting discipline. Also, it has created a culture of accountability. Knowing that arrival and departure times are logged digitally—and that “time-in” is strictly monitored—has forced a shift from irregular habits to a disciplined daily schedule.”*

4.2.2. Reliability and Accuracy of Biometric Technology

The experiences of the participants demonstrate the excellent precision and dependability of biometric attendance systems in typical circumstances. Confidence in biometric technology as a reliable instrument for managing attendance in educational institutions is strengthened by the stated effectiveness, which is consistent with previous research showing accuracy rates exceeding 95%.

TR2 shared, *“Modern attendance systems, particularly biometric ones, generally achieve high reliability in recording accurate data, often exceeding 95% accuracy rates under optimal conditions. Reliability varies by technology, with factors like lighting, maintenance, and user behavior influencing performance. Manual systems are prone to errors, while automated options minimize fraud and inconsistencies.”*



4.2.3. Operational and Technical Constraints in Implementation

The system has significant operating difficulties, such as device breakdowns and communication problems, despite its overall success. These technical issues may interfere with the recording of attendance, which highlights the need for better technical support and system maintenance and reflects larger infrastructural limits typical in developing-country situations.

MO1 expressed, *“If the system isn’t working, inform the administration office and manually sign the attendance register as a temporary alternative. or report the issue immediately to the IT or administration team and request technical support for repair or reboot of the device.”*

5. Findings and Discussion

The results show that biometric attendance systems are utilized every day, usually twice a day, to track staff members' and teachers' arrivals and departures. This is consistent with earlier studies that found frequent biometric monitoring enhances punctuality and lowers absenteeism (Duflo et al., 2012). According to participants, time-stamped attendance records have fostered a disciplined and accountable school culture.

The system's excellent accuracy validates assertions that, in ideal circumstances, biometric technology can attain dependability rates higher than 95% (Jain et al., 2004). However, in line with previous research in underdeveloped contexts, technological difficulties such as device failure and connectivity problems were also noted (Khan & Shah, 2019).

Table 1(AB)

Themes, description, supporting evidence, and key references

Theme	Description	Supporting Evidence	Key References
Enhanced accountability and staff discipline	Frequent biometric attendance tracking increases worker and teacher accountability and discipline, encourages punctuality, and lowers absenteeism.	Time-stamped attendance records that were updated twice a day enhanced students' punctuality and motivated them to act appropriately in class.	Duflo et al. (2012)
Reliability and accuracy of biometric systems	Under ideal operating circumstances, biometric attendance systems exhibit high levels of accuracy and dependability.	In line with reliability scores higher than 95%, participants reported correct attendance records.	Jain et al. (2004)
Operational and technical challenges	The successful deployment of biometric attendance systems in developing environments is impacted by infrastructure and technical limitations.	Attendance recording procedures were periodically interfered with by device malfunctions and connectivity problems.	Khan & Shah (2019)

5.1 Implications for Policy

The findings suggest that biometric attendance systems may be effective policy instruments for improving public education accountability. When attendance data is connected to salary disbursement, financial discipline and compliance have increased. Policymakers should prioritize infrastructure spending and user education.



5.2 Conclusion of the Study

The study shows how biometric attendance technology has enhanced secondary school attendance tracking in Sindh. The strategy has increased administrative effectiveness, transparency, and timeliness, according to studies by Bruns et al. (2011) and the OECD (2019). By linking biometric attendance to salary disbursement, absenteeism has decreased, and compliance has increased.

The biometric attendance system is a significant governance shift in Sindh's secondary school system. Despite infrastructure and technology challenges, the approach has been successful in boosting accountability, reducing ghost workers, and enabling data-driven decision-making.

5.3 Key Recommendations

- To maintain continuity, implement multi-modal biometric systems (facial recognition and fingerprint) (Jain et al., 2004).
- To reduce network problems, enable offline data storage (World Bank, 2018).
- Regularly train educators and administrators (UNESCO, 2017).
- Boost technical support systems at the district level (OECD, 2019).

5.5 Recommendations for Future Research

To assess long-term effects on student learning outcomes, future research should use quantitative or mixed-method methods. Understanding biometric governance reforms would be further enhanced by comparative research across public and private schools or between provinces.

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