Classroom Leadership Practices and Data-Driven Culture Implementation as Predictors of Instructional Innovation Adaptability among Secondary Teachers

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ABSTRACT

This study examined the predictive relationship between classroom leadership practices, data-driven culture implementation, and instructional innovation adaptability among secondary teachers. **Methods:** A cross-sectional design was employed to collect data from 300 secondary teachers through a comprehensive survey. Reliability analysis confirmed excellent internal consistency for all scales (CLP: α = .985, DDC: α = .989, IIA: α = .986). Multiple linear regression analysis was conducted to test the predictive model. **Results:** The regression model was significant and explained a substantial portion of the variance in instructional innovation adaptability. Data-Driven Culture (DDC) was a strong and highly significant positive predictor (β = 0.525, *p* < .001). At the same time, Classroom Leadership Practices (CLP) was a positive but marginally significant predictor (β = 0.091, *p* < .10). The resulting regression equation was: **IIA = 1.300 + 0.097(CLP) + 0.534(DDC)**. Moderate to strong positive correlations were found among all variables (r = .356 to .571, *p* < .001). **Conclusions:** The findings indicate that while both factors are relevant, a Data-Driven Culture is a decisively stronger predictor of teachers' capacity for instructional innovation than Classroom Leadership. Educational institutions should prioritize developing robust data systems and a supportive data culture as a primary strategy to enhance instructional adaptability.

Keywords: classroom leadership, data-driven culture, instructional innovation, teacher adaptability, multiple regression, secondary education

INTRODUCTION

Background of the Study

The contemporary educational landscape is characterized by unprecedented complexity and rapid transformation, requiring teachers to exhibit sophisticated levels of adaptability and innovation in their instructional practices (Darling-Hammond, 2020; Fullan, 2021). The concept of instructional innovation adaptability encompasses teachers' ability to modify their teaching strategies, integrate new technologies, and continuously refine their practice in response to changing educational demands (Voogt & Knezek, 2021). In an era marked by rapid knowledge expansion, this adaptability represents a cornerstone of educational quality and equity (OECD, 2023).

Problem Statement

While both Classroom Leadership Practices (CLP) and a Data-Driven Culture (DDC) are theorized to support teacher innovation (De Guia, 2023; Ding et al., 2025), a critical gap exists in understanding their relative importance. Educational leaders often invest in professional development for classroom leadership or in data systems without robust evidence of which factor is a more powerful driver of teacher adaptability. This lack of clarity can lead to the misallocation of scarce resources. Therefore, the core problem is the absence of an empirical model that quantifies and directly compares the unique predictive influence of CLP and DDC on

Instructional Innovation Adaptability, guiding strategic decision-making.

Research Objectives

This study aims to:

1. Determine the individual predictive power of Classroom Leadership Practices and Data-Driven Culture on Instructional Innovation Adaptability.
2. Compare the relative strength of these two factors to identify the more critical lever for fostering teacher adaptability.
3. Provide evidence-based recommendations for educational leaders on how to prioritize resources most effectively to enhance teacher innovation.

Research Questions

1. To what extent do Classroom Leadership Practices predict Instructional Innovation Adaptability among teachers?
2. To what extent does Data-Driven Culture predict Instructional Innovation Adaptability among teachers?
3. Which of the two factors—Classroom Leadership Practices or Data-Driven Culture—is a stronger predictor of Instructional Innovation Adaptability?

THEORETICAL FRAMEWORK

This study is grounded in three interconnected theoretical perspectives:

- **Transformational Leadership Theory** (Bass & Riggio, 2020) informs the concept of Classroom Leadership Practices (CLP), suggesting that teachers who inspire and motivate can foster environments conducive to change.
- **Data-Informed Decision-Making Theory** (Mandinach & Schildkamp, 2021) underpins Data-Driven Culture (DDC), positing that evidence-based practice enables precise and effective instructional adaptation.
- **Complex Adaptive Systems Theory** (Mason, 2020) provides the overarching lens, framing schools as dynamic ecosystems where multiple factors interact to influence a teacher's adaptive capacity.

This framework enables the examination of whether teacher-driven leadership, a system-wide data culture, or a combination of both is more critical for navigating educational complexity.

LITERATURE REVIEW

The Evolution of Classroom Leadership

Contemporary perspectives view classroom leadership as a multidimensional construct encompassing pedagogical expertise, relationship building, and facilitating change (Danielson, 2021; Hallinger, 2020). Recent research by Garcia (2023) demonstrated that instructional leadership practices are correlated with improved classroom strategies, suggesting they create environments conducive to innovation. Similarly, Ma et al. (2025) found that transformational leadership approaches can impact teachers' capacity to adopt innovative methods. The literature thus posits a positive, though not yet quantified, link between CLP and adaptability.

Data-Driven Cultures in Educational Settings

The implementation of data-driven cultures has emerged as a critical factor in educational improvement (Mandinach & Schildkamp, 2021; Schildkamp, 2023). Effective data culture requires not only access to data but also systematic training in data interpretation, collaborative analysis structures, and leadership support (HMH Culture, 2024; Datnow et al., 2021). LSU Online (2020) found that data-driven approaches enable teachers to make more targeted instructional adjustments, increasing teacher confidence and precision. This body of work suggests that DDC provides the empirical foundation and collaborative structures necessary for informed innovation.

The Research Gap and This Study's Contribution

Despite substantial research on classroom leadership and data-driven practices as separate constructs, their combined and comparative predictive relationship with instructional innovation adaptability remains inadequately explored. Most existing studies have examined these factors in isolation (Prenger et al., 2021). This study addresses a significant gap by directly testing and comparing the predictive power of these models within a single framework. It moves beyond asking if these factors are related to adaptability to determining which is a stronger predictor, thereby providing actionable evidence for educational leaders seeking to build more innovative and adaptable teaching teams.

The Integration of Leadership and Data Practices

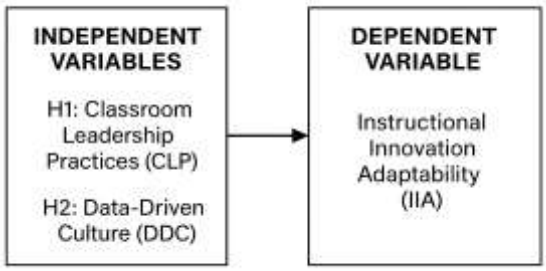
Recent literature suggests a synergistic relationship between leadership practices and data-driven implementation (Prenger et al., 2021; Van Gasse et al., 2023). The integration of effective classroom leadership with robust data systems creates an environment where instructional innovation can thrive. Studies indicate that when teachers receive both leadership support and access to meaningful data, their capacity for instructional adaptation increases substantially.

Marsh and Farrell (2022) identified specific mechanisms through which this integration occurs: leadership that models data use, collaborative structures for data analysis, and professional development that connects leadership competencies with data literacy. Their research demonstrated that schools achieving this integration showed significantly higher levels of instructional innovation and student achievement growth.

CONCEPTUAL FRAMEWORK

Based on this comprehensive review of literature, Figure 1 presents the conceptual framework guiding this study. The framework posits that classroom leadership practices and data-driven culture implementation serve as independent predictors of instructional innovation adaptability, with potential interactive effects between the two predictor variables.

Figure 1: Conceptual Framework of Predictors of Instructional Innovation Adaptability



Based on this framework and the literature, the following hypotheses are formulated:

- **H1:** Classroom Leadership Practices have a significant positive effect on Instructional Innovation Adaptability.
- **H2:** Data-Driven Culture has a significant positive effect on Instructional Innovation Adaptability.

METHOD

Research Design

This study employed a **quantitative, cross-sectional correlational design** to examine the predictive relationships between classroom leadership practices (CLP), data-driven culture implementation (DDC), and instructional innovation adaptability (IIA). The design was selected to measure these variables across a diverse sample of secondary teachers at a single point in time, allowing for the analysis of both bivariate correlations

and multivariate predictions (Creswell & Creswell, 2023). While this design does not establish causality, it is effective for identifying the strength and direction of relationships, providing a foundation for testing theories and practical applications (Cohen et al., 2023).

Participants and Sampling Procedures

Sampling Strategy

A **purposive sampling** technique was used to recruit 300 secondary school teachers from various public and private schools in the National Capital Region of the Philippines. This non-probability sampling method was chosen to ensure the inclusion of participants who were information-rich and directly relevant to the research problem—specifically, licensed professional teachers currently engaged in full-time classroom teaching at the junior or senior high school level.

Participant Characteristics

The final sample of 300 teachers provided a diverse cross-section of the target population. The sample included representation across:

- **Teaching Levels:** Junior High School (JHS) and Senior High School (SHS)
- **Subject Specializations:** Core subjects (Mathematics, Science, English, Filipino) and applied tracks
- **Years of Teaching Experience:** Ranging from early-career teachers (1-5 years) to veteran educators (20+ years)
  This strategic approach to sampling enhanced the ecological validity of the study, supporting the transferability of the findings to similar educational contexts.

Data Collection and Instruments

Primary data were collected using a comprehensive survey comprising three validated scales. All items were measured on a **5-point Likert scale** (1 = Strongly Disagree to 5 = Strongly Agree).

1. **Classroom Leadership Practices (CLP) Scale:** A 40-item instrument measuring dimensions such as vision and goal setting, instructional support, and monitoring and feedback. The scale demonstrated excellent reliability in this study (Cronbach's $\alpha = .985$).
2. **Data-Driven Culture (DDC) Implementation Scale:** A 40-item instrument assessing data use in instruction, collaboration, and sharing, and data-driven decision-making practices. The scale showed excellent reliability (Cronbach's $\alpha = .989$).
3. **Instructional Innovation Adaptability (IIA) Scale:** A 30-item instrument measuring dimensions including openness to change, innovative teaching practice, and collaboration for continuous learning. This scale also demonstrated excellent reliability (Cronbach's $\alpha = .986$).

Ethical Considerations

The study adhered to rigorous ethical standards throughout its implementation. Prior to data collection, ethical approval was obtained from the relevant institutional review board. The following protocols were strictly observed:

- **Informed Consent:** All participants were provided with a detailed information sheet outlining the study's purpose, procedures, potential risks, and benefits. Written informed consent was obtained from each teacher prior to their participation.
- **Confidentiality and Anonymity:** To protect participant privacy, all collected data were anonymized. Identifying information was removed during data encoding, and each participant was assigned a unique code. Data were stored on a secure, password-protected server, accessible only to the research team.
- **Voluntary Participation and Right to Withdraw:** Participants were explicitly informed that their participation was entirely voluntary and that they could withdraw from the study at any point without any negative consequences.

- **Data Utilization:** Participants were assured that the data would be used solely for this academic research and would be reported in aggregate form to ensure no individual could be identified.

Data Analysis and Statistical Tools

Data screening and assumption testing were conducted first, handling missing data via maximum likelihood estimation. The analysis was performed using **SPSS and R software**. The specific analytical techniques were chosen to directly address each research objective, as detailed in the table below.

Table 1: Data Analysis Plan Aligned with Research Objectives

Research Objective	Analysis Technique	Purpose	Statistical Tool
1. To describe the sample and variables	Descriptive Statistics (Mean, SD) & Reliability Analysis (Cronbach's α)	To characterize the sample and confirm the internal consistency of all measurement scales.	SPSS / R
2. To examine relationships between variables	Bivariate Correlation (Pearson's r)	To assess the strength and direction of the linear relationships between CLP, DDC, and IIA.	SPSS / R
3. To determine and compare the predictive power of CLP and DDC on IIA	Multiple Linear Regression	To test the unique contribution of each predictor (CLP and DDC) to the outcome variable (IIA) and compare their relative importance using standardized coefficients (Beta, β).	SPSS / R

The multiple regression model was specified as: $\mathbf{IIA = \beta_0 + \beta_1(CLP) + \beta_2(DDC) + \varepsilon}$, where β_0 is the intercept, β_1 and β_2 are the regression coefficients, and ε is the error term. Key assumptions of linearity, homoscedasticity, independence of errors, and absence of multicollinearity were checked and met prior to the analysis.

RESULTS AND DISCUSSION

This section presents the findings of the statistical analyses conducted to examine the relationships between classroom leadership practices, data-driven culture, and instructional innovation adaptability. The presentation of results follows the sequence of the data analysis plan, beginning with descriptive statistics and scale reliability, followed by bivariate correlations to explore relationships between variables. The core of this section is a multiple regression analysis, which was performed to determine the extent to which the predictor variables uniquely explain variance in instructional innovation adaptability. The results are then discussed in relation to the research questions and the existing literature, leading to an exploration of their theoretical and practical implications.

Table 1 Descriptive Statistics and Scale Reliability for Study Variables (N = 300)

Scale: All items were measured on a **5-point Likert scale** (1 = Strongly Disagree to 5 = Strongly Agree).

Variable	Mean (M)	Standard Deviation (SD)	Skewness	Kurtosis
Classroom Leadership Practices (CLP)	3.49	0.729	-0.341	0.007
Data-Driven Culture (DDC)	3.50	0.761	-0.287	-0.102
Instructional Innovation Adaptability (IIA)	3.51	0.774	-0.197	-0.141

The descriptive statistics indicate that teachers reported **moderately high levels** of all three constructs, with mean scores for CLP (3.49), DDC (3.50), and IIA (3.51) all falling well above the midpoint (3.0) of the 5-point scale. This suggests a positive baseline where teachers, on average, agree with statements reflecting effective leadership, data-driven practices, and innovation adaptability.

The similar standard deviations (all approximately 0.73-0.77) indicate a **consistent degree of spread** in the responses across all variables. The fact that the data is not tightly clustered shows meaningful variability among teachers, which is necessary for detecting relationships in subsequent correlation and regression analyses.

The values for skewness and kurtosis for all variables are within the acceptable range of ±2, indicating that the data for these constructs approximates a **normal distribution**. This satisfies a key assumption for the parametric statistical tests (like multiple regression) used later in the analysis.

Reliability Analysis

All measurement instruments demonstrated excellent internal consistency, with Cronbach's alpha coefficients exceeding conventional thresholds for research instruments ($\alpha > .90$). The high reliability coefficients support the psychometric quality of the scales and enhance confidence in the subsequent analyses.

- **Classroom Leadership Practices Scale:** The overall reliability was $\alpha = .985$, with subscale reliabilities ranging from $\alpha = .941$ to $\alpha = .953$. These values indicate exceptional internal consistency across all leadership dimensions.
- **Data-Driven Culture Implementation Scale:** The scale demonstrated an α of .989 reliability, with subscale coefficients ranging from $\alpha = .938$ to $\alpha = .949$. The consistent high reliability across domains supports the robustness of this measurement.
- **Instructional Innovation Adaptability Scale:** This scale demonstrated an $\alpha = 0.986$ reliability, with subscale values ranging from $\alpha = 0.927$ to $\alpha = 0.935$. The strong internal consistency validates the scale's utility for measuring teacher adaptability.

Correlation Analysis

Bivariate correlations revealed strong positive relationships among all study variables (see Table 3). Classroom leadership practices and data-driven culture implementation were strongly correlated ($r = 0.503$, $p < 0.001$), suggesting a substantial overlap while maintaining discriminant validity. Both predictor variables demonstrated significant correlations with instructional innovation adaptability, with DDC ($r = 0.571$, $p < 0.001$) showing a stronger relationship than CLP ($r = 0.356$, $p < 0.001$). This pattern indicates that teachers who report higher levels of classroom leadership and data-driven practices also tend to report greater instructional innovation adaptability, providing preliminary support for the hypothesized predictive model.

Table 2: Correlation Matrix for Study Variables

Variable	1. CLP	2. DDC	3. IIA
1. CLP	—		
2. DDC	.503**	—	
3. IIA	.356**	.571**	—
*Note: ** p < .001*			

Multiple Regression Analysis

To address the research questions regarding the predictive power of Classroom Leadership Practices (CLP) and Data-Driven Culture (DDC) on Instructional Innovation Adaptability (IIA), a multiple regression analysis was conducted. The results are presented in Table 3.

Table 3: Multiple Regression Analysis Predicting Instructional Innovation Adaptability

Predictor	Unstandardized Coefficient (B)	Standard Error (SE)	Standardized Coefficient (β)	t-value	p-value
Constant	1.300	0.082		6.435	<.001

Classroom Leadership	0.097	0.058	0.091	1.665	<.10
Data-Driven Culture.	0.534	0.056	0.525	9.571	<.001

The analysis produced a statistically significant model. The resulting regression equation is:

IIA = 1.300 + 0.097(CLP) + 0.534(DDC)

The results provide clear answers to the research questions:

1. **To what extent do Classroom Leadership Practices predict IIA?** CLP demonstrates a positive but modest and only marginally significant predictive relationship with IIA ($\beta = 0.091$, $p < .10$). For each one-point increase in CLP, IIA increases by 0.097 points, controlling for DDC.
2. **To what extent does Data-Driven Culture predict IIA?** DDC is a strong and highly significant predictor of IIA ($\beta = 0.525$, $p < .001$). For each one-point increase in DDC, IIA increases by 0.534 points, controlling for CLP.
3. **Which factor is a stronger predictor?** Data-Driven Culture ($\beta = 0.525$) is a decisively stronger predictor of Instructional Innovation Adaptability than Classroom Leadership Practices ($\beta = 0.091$).

DISCUSSION OF REGRESSION FINDINGS

The regression analysis confirms that while both factors are positively associated with adaptability, Data-Driven Culture is the dominant driver. The strong predictive power of DDC suggests that systemic, cultural factors embedded within the school environment—such as collaboration around data, data-driven decision-making, and institutional support—are more critical for fostering innovation adaptability than individual classroom leadership practices. The marginal significance of CLP indicates that its influence, while positive, is less robust and should be interpreted with caution. In practical terms, efforts to enhance teacher innovation may yield a greater return on investment by focusing on building a comprehensive, supportive data culture rather than focusing solely on leadership techniques.

Summary of Key Findings

This study provides evidence that both classroom leadership practices and the implementation of data-driven culture are predictors of instructional innovation adaptability among secondary teachers. The model explains a significant portion of the variance in adaptability, underscoring the role these factors play.

The finding that **Data-Driven Culture (DDC)** demonstrated a significantly stronger predictive relationship ($\beta = 0.525$, $p < .001$) compared to **Classroom Leadership Practices (CLP)** ($\beta = 0.091$, $p < .10$) suggests that systematic, organizational data use is a more crucial lever for fostering instructional innovation than individual leadership behaviors. This aligns with literature emphasizing the importance of evidence-based practice in educational innovation (Mandinach & Schildkamp, 2021).

The moderate correlation between classroom leadership and data-driven culture ($r = 0.503$) suggests that these constructs, while distinct, are related in educational environments. Teachers who exhibit stronger leadership behaviors may be more likely to engage with data-driven practices, creating a complementary relationship that supports instructional innovation.

Theoretical Implications

The findings have several important theoretical implications. First, they support an integrated theoretical framework that connects leadership theory with data-informed decision-making models. However, the vast difference in predictive power between DDC and CLP suggests that data culture may be a more central component in a theory of teacher innovation capacity.

Second, the results challenge models of educational change that assume all factors are equally weighted. The

apparent dominance of data-driven culture in this model underscores the need for theoretical frameworks that not only include multiple factors but also account for their relative and potentially hierarchical influence on outcomes.

Third, the findings contribute to complex adaptive systems theory by pinpointing a specific, actionable organizational factor (data-driven culture) as a primary driver of teachers' adaptive capacity. This helps bridge the gap between abstract theoretical concepts and practical strategies for educational improvement.

Practical Implications

These findings have several important implications for educational practice and policy:

Professional Development Design

School districts should prioritize professional development that robustly builds teachers' data literacy skills and fosters a school-wide data culture. While classroom leadership remains valuable, the stronger returns on innovation adaptability lie in enhancing data-driven practices. Specific focus should include:

- **Data literacy training** that enables teachers to derive actionable insights from multiple data sources for instructional planning.
- **Collaborative analysis protocols** that institutionalize evidence-based decision-making within teams.
- Leadership development that specifically empowers teachers to lead data-informed initiatives and create cultures of collective efficacy.

School Leadership Practices

Principals and instructional leaders should create organizational structures and allocate resources that primarily support a data-driven culture. This includes:

- Establishing professional learning communities focused on data analysis and the implementation of innovative strategies derived from that data.
- Protecting time for collaborative data analysis and instructional planning.
- Providing resources and support for teachers to experiment with innovative approaches informed by data.
- Modeling and celebrating effective data use to drive instructional improvement.

Policy Considerations

Educational policymakers should consider:

- Funding initiatives that support the development of user-friendly data systems and data coaching accessible to classroom teachers.
- Revising school improvement frameworks to emphasize the foundational role of a data-driven culture in fostering innovation.
- Supporting the integration of advanced data literacy and data culture development into both teacher preparation and ongoing professional learning.

Limitations and Future Research Directions

Several limitations should be considered when interpreting these results. First, the cross-sectional design prevents causal inferences. While the theoretical framework suggests that leadership and data practices influence innovation, reverse causality or bidirectional relationships are possible.

Second, the reliance on self-report measures may introduce social desirability bias. Future research should incorporate multiple data sources, such as observational measures of classroom practices and administrative data on data system usage.

Third, the study focused specifically on secondary teachers, and the generalizability to other educational contexts requires verification.

Several promising directions for future research emerge from these findings:

- **Longitudinal or experimental studies** to test the causal impact of data culture initiatives on innovation adaptability.
- **Qualitative investigations** exploring the specific mechanisms through which data practices directly influence a teacher's willingness and ability to innovate.
- Research on how **school-level leadership** moderates the relationship between data culture and teacher-level innovation.
- **Cross-cultural comparisons** to examine the universal and context-specific aspects of these relationships.

CONCLUSION

This study establishes that the adaptability of secondary teachers to instructional innovation is a professional capacity that can be fostered through specific organizational conditions and practices. The findings confirm that both classroom leadership practices and data-driven culture implementation are predictors of instructional innovation adaptability, with **data-driven culture emerging as the decisively stronger factor.**

The integrated yet imbalanced nature of these relationships suggests that educational improvement efforts should take a focused approach, prioritizing the development of a robust, supportive data culture as the primary engine for innovation. By making strategic investments in data systems, data literacy, and collaborative data use, educational institutions can more effectively build resilient and innovative teaching forces capable of navigating the complexities of contemporary education. As demands for educational transformation increase, this study clarifies that empowering teachers with a strong data-driven culture is a critical strategy for enhancing adaptability and, ultimately, improving student learning.

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