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Data-Based Curriculum Evaluation and Teacher Performance: Quantitative Evidence of Strengthening Digital Systems in Learning Management

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ABSTRACT

Purpose of the study: This study investigates the influence of curriculum management practices on teacher performance in primary and secondary schools across Bengkulu Province, Indonesia. With the nationwide implementation of the Independent Curriculum (Kurikulum Merdeka) demanding stronger instructional quality, empirical evidence on how curriculum management contributes to teacher performance in local contexts remains limited.

Methodology: A quantitative survey design was employed, involving 327 teachers selected through proportional stratified random sampling. Curriculum management was measured through three dimensions: planning, implementation, and evaluation. Teacher performance was assessed using indicators of pedagogical competence, instructional delivery, and classroom assessment practices. Data were analyzed using structural equation modeling (SEM).

Main Findings: The findings reveal that curriculum management practices have a significant positive effect on teacher performance, with curriculum evaluation emerging as the strongest predictor.

Novelty/Originality of this study: The study highlights the need for strengthening data-driven curriculum monitoring and professional development. These findings contribute to the literature on curriculum governance in developing regions by providing empirical evidence from a non-metropolitan Indonesian context. They also offer evidence-based recommendations for policymakers and school leaders in optimizing curriculum implementation within decentralized education systems.

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1. INTRODUCTION

In recent decades, curriculum management has become a critical foundation in global education reform, especially in countries undergoing rapid transformation in teaching systems and accountability. The successful implementation of national curricula depends heavily on schools' capacity to manage three cycles: planning, implementation, and evaluation [1]-[3]. In Indonesia, the launch of the Merdeka curriculum marks a paradigm shift towards school autonomy, which also requires strengthening curriculum management at the educational unit level to ensure successful learning [4]-[6].

However, this policy transition poses complex operational challenges, particularly in aligning planning with classroom implementation and systematically evaluating its impact [5]. A study by Rachmanto & Akande [8]

shows that although ICT increases student engagement, limitations in devices and internet connectivity remain a major obstacle, especially in schools with limited resources. In the modern context, the integration of digital technology has become increasingly vital. Curriculum management platforms and data-based evaluation systems can improve precision in planning, monitor implementation in real time, and transform the evaluation cycle into a more objective and sustainable process through learning analytics and digital supervision systems. As shown in the research by Syamiluddin et al. [9], the use of Android-based Augmented Reality technology has been proven to improve student learning outcomes through interactive visualization, which supports the importance of technology integration in the learning process.

In this transformation, teacher performance emerges as a key variable that determines the ultimate success of any curriculum [10]-[12]. Teacher performance, which includes pedagogical competence, teaching quality, and evaluation practices, is widely recognized as a direct determinant of student learning outcomes [13]-[15]. The literature shows that this performance does not only depend on individual competence, but is also greatly influenced by the school ecosystem, particularly the effectiveness of curriculum management. Therefore, understanding the relationship between curriculum management and teacher performance is an important prerequisite for improving the quality of education [16]-[18].

Theoretically, the relationship between curriculum management and teacher performance can be traced from the perspective of School-Based Management (SBM) and School Effectiveness theory [19]-[21]. The MBS theory asserts that improving the quality of education begins with empowering schools to manage their resources, with curriculum management at the core of the learning process [22]-[24]. The operational model of curriculum management by Soviany et al. [25] articulate three interdependent main functions: planning as a guiding foundation, implementation as a transformation process, and evaluation as a feedback and quality assurance mechanism [26], [27]. These three functions form a cycle which, when implemented coherently, creates a structured and supportive work environment.

It is this structured environment that, according to the Teacher Capability theory in the Dynamic Model of Educational Effectiveness [28], directly improve teachers' instructional abilities. This theory argues that teacher performance is determined not only by individual performance competencies, but also by organizational conditions that facilitate the application of these competencies [29], [30]. Therefore, it can be hypothesized that each dimension of curriculum management, such as planning, implementation, and evaluation, can have a positive and significant effect on teacher performance [31]. Good planning provides clarity of purpose, integrated implementation provides procedural support, while systematic evaluation provides critical information for reflection and improvement of teaching practices. This theoretical framework forms the basis for empirical testing in this study.

Although the conceptual relationship between the curriculum and teacher performance has been recognized, specific and strong empirical evidence from various contexts, particularly in Indonesia, is still very limited. There are several notable research gaps. First, there is a contextual gap, with the majority of empirical studies in Indonesia concentrated in urban centers such as Java, while regions with different geographical and socio-cultural characteristics, such as Bengkulu Province, are still rarely explored. This aspect poses a particular challenge in testing how curriculum management principles are translated in conditions of limited resources [32]-[34].

Next is the methodological gap. In terms of analytical approach, previous studies in this area tend to use descriptive-qualitative approaches or simple regression analysis, which have limited ability to test multivariate causal relationships and validate measurement constructs simultaneously [35]. In fact, advanced statistical models such as Structural Equation Modeling (SEM) have been proven to provide stronger and more comprehensive empirical evidence in international education management research [36]. Third, substantive gaps: the role of digital technology and data utilization in supporting the curriculum evaluation cycle and academic supervision to improve teacher performance has not been empirically investigated, especially in rural areas [37]-[39].

Based on these gaps, this research is urgently needed to provide a solid empirical basis for policy makers. The objectives of this study are, first, to analyze the influence of each dimension of curriculum management (planning, implementation, and evaluation) on teacher performance in public schools in Bengkulu Province. Second, to examine the mediating role or contribution of digital technology utilization in the relationship between curriculum evaluation and teacher performance, and to validate this relationship through a Structural Equation Modeling (SEM) approach to produce strong and comprehensive empirical evidence. The research questions asked are, first, how much influence do the dimensions of curriculum planning, implementation, and evaluation have on teacher performance? How does digital technology moderate or strengthen the relationship between curriculum evaluation and teacher performance? What structural model best describes the relationship between curriculum management and teacher performance in the Bengkulu context?

This study is expected to make a meaningful contribution in three areas. First, theoretically, these findings will enrich the body of educational management literature by presenting empirical evidence from a non-metropolitan context in Indonesia, while also testing the theoretical proposition that places curriculum evaluation as the most critical dimension. Second, methodologically, this study is expected to demonstrate the application of

SEM analysis (through CFA and path analysis) in the context of educational research in Indonesia, which can serve as a reference model for similar studies in the future. Finally, in practical and policy terms, the results of this study are expected to provide an empirical basis for stakeholders in the Bengkulu Provincial Education Office and school leaders to design more focused interventions, particularly in strengthening the curriculum evaluation system that has the most significant impact on improving teacher performance, including through the integration of digital tools.

2. RESEARCH METHOD

This study uses a quantitative design with a cross-sectional survey approach [40]. This design was chosen to measure and analyze the relationship between variables at a single point in time (one-shot study), enabling the testing of the effect of curriculum management practices on teacher performance through statistical inference techniques that produce measurable generalizations [41]-[43]. The population of this study was all teachers in public elementary schools (SD), junior high schools (SMP), and senior high schools (SMA) in Bengkulu Province. The sampling technique used was stratified random sampling proportional to ensure representativeness. The steps are as follows:

1. The population was divided into strata based on district/city and school level (SD, SMP, SMA).
2. From each stratum, a number of teachers were selected using simple random sampling in proportion to the size of the stratum.
3. This technique produced a sample of 327 teachers, which was adequate for multivariate analysis such as SEM.

2.1. Research Variables and Measurement Instruments

This study used a closed questionnaire with a 1-5 Likert scale. The instrument was developed based on a theoretical study of the curriculum management model by Soviany et al. [25] sand teacher performance theory. As in the research by Mawardani et al. [44], the development of learning media through expert validation and field testing can be a model for ensuring the quality of educational instruments and interventions [32]. Although self-developed, the items were designed with reference to constructs and indicators that had been validated in previous literature.

1. Independent Variables (Curriculum Management): Consists of three dimensions:
   a. Curriculum Planning (5 items): Example: “I develop teaching modules that are aligned with Learning Outcomes (CP).”
   b. Curriculum Implementation (6 items): Example: “I implement differentiated learning strategies in the classroom.”
   c. Curriculum Evaluation (5 items): The instruments in this dimension are specifically designed to capture technology-enabled evaluation practices, such as the use of digital platforms for reporting assessment results, the use of data dashboards to monitor learning progress, and participation in evidence-based academic supervision (e.g., through video recordings of teaching or digital portfolios).
2. Dependent Variable (Teacher Performance): Measured through 7 statements covering pedagogical competence, quality of the learning process, and quality of assessment.

The instrument was validated by two experts in the field of education management. Furthermore, the reliability test using Cronbach's Alpha showed excellent values for all constructs. The results of the Confirmatory Factor Analysis (CFA) showed that all indicators had factor loadings above 0.60 (range 0.72 - 0.88), which met the convergent validity requirements.

Table 1. Results of Reliability and Convergent Validity Tests of Constructs

Construction/Dimensions	Number of Indicators	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Curriculum Management				
Curriculum Planning	5	0.85	0.87	0.52
Curriculum Implementation	6	0.87	0.89	0.54
Curriculum Evaluation	5	0.89	0.91	0.58
Teacher Performance	7	0.88	0.90	0.56

1. Cronbach's Alpha (α) > 0.80 and Composite Reliability (CR) > 0.85 indicate that all constructs have excellent internal consistency and reliability.
2. Average Variance Extracted (AVE) > 0.50 indicates that each construct has adequate convergent validity, meaning that the indicators strongly represent the construct being measured.

Construct validity and composite reliability tests were also conducted empirically using Confirmatory Factor Analysis (CFA) [45].

2.2. Data Collection Techniques

Data was collected using a hybrid method from March to June 2025. Printed questionnaires were used for schools in areas with limited internet access, while online questionnaires (Google Forms) were distributed via WhatsApp groups and email. Prior to data collection, official permission was obtained from the Bengkulu Provincial Education Office. Respondent participation was voluntary and confidentiality was guaranteed (informed consent).

2.3. Data Analysis Techniques

The data were analyzed using Structural Equation Modeling (SEM) with IBM SPSS AMOS 26 software. This model was used because of its ability to test causal relationships between latent variables with several indicators simultaneously, as well as to validate measurement and structural models in a single integrated analytical framework [46]-[48]. The use of Structural Equation Modeling (SEM) in this study serves not only to test hypotheses but also to support the paradigm of evidence-based decision-making in education. By generating robust statistical evidence on the magnitude of the influence of each dimension of curriculum management, the findings provide a solid empirical foundation for policy formulation and interventions aimed at improving educational quality. The data analysis process begins with Descriptive Statistical Analysis to summarize respondent characteristics and variable profiles, followed by Exploratory Data Analysis, which includes tests for normality and identification of outliers. Subsequently, the Measurement Model Evaluation, conducted through Confirmatory Factor Analysis (CFA), assesses convergent validity (factor loadings > 0.5; Average Variance Extracted (AVE) > 0.5), discriminant validity using the Fornell-Larcker criterion, and reliability (Composite Reliability (CR) > 0.7; Cronbach's Alpha > 0.70). Finally, the Structural Model Evaluation tests the model's goodness-of-fit using indices such as Chi-Square/df < 3, CFI & TLI > 0.90, and RMSEA < 0.08, while also examining the significance of path hypotheses based on a critical ratio (CR) > 1.96 and p-value < 0.05.

3. RESULTS AND DISCUSSION

The novelty of this study lies in the identification of curriculum evaluation as the most critical dimension ($\beta = 0.39$) affecting teacher performance in the non-metropolitan context of Bengkulu, while also revealing the role of digital facilities in strengthening this relationship. These findings not only reinforce the theoretical proposition of the Dynamic Model of Educational Effectiveness that a structured school environment, particularly through a data-based evaluation cycle, directly improves teachers' instructional capabilities, but also address the previous empirical gap that was still limited to studies in urban areas. Furthermore, the results of the group analysis show that schools with integrated digital reporting systems tend to have a stronger influence of curriculum evaluation on teacher performance.

This confirms that within the framework of School-Based Management, the use of technology such as curriculum dashboards and learning analytics can serve as a catalyst that accelerates the formation of a culture of professional reflection and evidence-based instructional leadership. Thus, this study provides robust quantitative evidence regarding the hierarchy of influence of curriculum management dimensions, but also offers a contextual perspective on how technology integration supports the effectiveness of the curriculum cycle in a decentralized education system.

3.1. Data Preparation and Characteristics

Of the 350 questionnaires distributed, 327 complete and valid responses were obtained (response rate 93.4%). The data were then coded, entered, and cleaned. Multivariate normality testing using Mardia's Coefficient showed that the data tended to be multivariate normal. No significant multivariate outliers were found based on Mahalanobis Distance values.

3.2. Descriptive Statistics of Respondents and Variables (Preliminary Descriptive Processing Results)

Research participants were evenly distributed based on school level and region. In general, teachers' perception scores regarding curriculum management practices and their own performance were in the high category. Descriptive details of the research variables are as follows:

Table 2. Descriptive details of the research variables

Variable/Dimension	Mean (M)	Standard Deviation (SD)	Category
Curriculum Management	4.12	0.51	High
-Curriculum Planning (X1)	4.10	0.55	High
- Curriculum Implementation (X2)	4.07	0.58	High

- Curriculum Evaluation (X3)	4.18	0.49	High
Teacher Performance (Y)	4.08	0.54	High

This description shows that the curriculum evaluation dimension received the highest perception score, while curriculum implementation received a relatively lower score.

3.3. Measurement Model Testing Results (CFA) (Processing Results for Validity & Reliability)

Before testing the structural model, the measurement model was tested. The results of Confirmatory Factor Analysis (CFA) showed that all indicators had factor loadings above 0.60 (range 0.72 - 0.88), which met the convergent validity requirements. All constructs also met the composite reliability requirements (CR > 0.85) and internal consistency (Cronbach's Alpha > 0.80). The AVE value of each construct was greater than 0.50. The results of the discriminant validity test using the Fornell-Larcker method were also met, where the square root of the AVE of each construct (value on the diagonal) was greater than the correlation with other constructs.

3.4. Structural Model Goodness-of-Fit Test Results

Table 3. Structural Model Goodness-of-Fit Test Results

Goodness-of-Fit Index	Value Obtained	Threshold Value	Interpretation
Chi-Square/df (CMIN/df)	2.14	< 3.00	Good fit
Comparative Fit Index (CFI)	0.956	> 0.95	Good fit
Tucker-Lewis Index (TLI)	0.947	> 0.95	Good fit
Root Mean Square Error of Approximation (RMSEA)	0.059	< 0.08	Good fit

The goodness-of-fit test results show that the structural model proposed in this study fits the empirical data collected very well. The Chi-Square/df value of 2.14 is well below the maximum threshold of 3.00, indicating that there is no significant difference between the sample covariance matrix and the covariance matrix estimated by the model, so the model is statistically acceptable. Furthermore, two incremental comparison-based indices, namely CFI (0.956) and TLI (0.947), both exceed the criterion value of >0.95.

This confirms that the proposed model has a substantial improvement in fit compared to the baseline (independent) model, while also reflecting high explanatory power after correcting for model complexity. The most critical indicator of model fit, RMSEA, is 0.059, which falls within the “good fit” category (RMSEA < 0.08) and even approaches the threshold for “excellent fit” (RMSEA < 0.05). This RMSEA value not only indicates a low level of approximation error, but also suggests that the model has accurate predictive power in the population. Collectively, the convergence of these four main fit indices provides strong and coherent evidence that the theoretical model of the relationship between curriculum management and teacher performance has been empirically verified, making it feasible to proceed to the parameter interpretation and hypothesis testing stages.

3.5. Hypothesis Testing and Structural Model Results (Core Results of SEM Processing)

After the model was declared fit, hypothesis testing was conducted by assessing the estimate value and p-value of each pathway. The following is a summary of the results:

Table 4. Hypothesis Testing and Structural Model Results

Hypothesis	Path Relationship	Path Coefficient (β)	C.R.	p-value	Decision
H1	Curriculum Planning → Teacher Performance	0.21	2.512	0.012	Accepted
H2	Curriculum Implementation → Teacher Performance	0.18	2.156	0.031	Accepted
H3	Curriculum Evaluation → Teacher Performance	0.39	4.832	<0.001	Accepted
Hypothesis	Path Relationship	Path Coefficient (β)	C.R.	p-value	Decision

The path analysis results reveal that the three dimensions of curriculum management, namely planning, implementation, and evaluation, significantly affect teacher performance, with curriculum evaluation emerging as the strongest indicator ($\beta = 0.39$; $p < 0.001$). This dominant finding reflects a paradigm shift towards data-driven education management, in which assessment literacy and the systematic use of feedback serve as the most critical levers for improving learning quality and fostering a culture of continuous professional reflection. Meanwhile, curriculum planning also made a significant contribution ($\beta = 0.21$; $p = 0.012$), confirming its role as an instructional roadmap that reduces ambiguity and provides clarity of direction for teachers in translating curriculum goals into effective classroom practices. On the other hand, although significant, the influence of curriculum implementation was relatively lower ($\beta = 0.18$; $p = 0.031$).

This indicates that the stage of translating plans into action is the most vulnerable to contextual constraints, and its success is highly dependent on the supporting ecosystem, such as the availability of resources, school leadership, and continuous professional development. Collectively, these findings provide strong empirical support for a cyclical and dynamic curriculum management model. The significant contributions of these three dimensions validate the continuous improvement framework, in which each stage informs and reinforces the next, creating a structured environment that directly encourages improvements in teacher performance. The proposed model successfully explains 57.4% of the variance in teacher performance ($R^2 = 0.574$), indicating substantial explanatory power.

Additional findings from a more in-depth analysis enrich contextual understanding. First, there are significant differences in curriculum implementation scores between schools in urban and rural areas, highlighting a gap in resources or capacity. Second, and most importantly, in schools that already have an integrated digital reporting system, the influence of curriculum evaluation on teacher performance tends to be stronger. These findings not only confirm the role of technological facilities and infrastructure as supporting factors, but also suggest that digital-based instructional leadership can serve as a catalyst that strengthens the entire curriculum management cycle. Thus, the integration of technology into evaluation and monitoring systems is not merely complementary, but rather a strategic lever for improving the accountability and effectiveness of the learning process in the era of educational decentralization.

This study confirms that curriculum management practices, particularly in planning, implementation, and evaluation, play a significant role in shaping teacher performance in Bengkulu Province. The strongest predictor, namely curriculum evaluation, shows that systematic monitoring and assessment of the learning process contributes directly to improving pedagogical competence. These findings are in line with international studies that emphasize the importance of data-driven decision making in education reform [49]-[51].

In addition, a quality evaluation process not only serves as a monitoring tool, but also as a source of formative feedback that allows teachers to engage in critical reflection and adjust their teaching practices in a timely manner [52]. The dominance of curriculum evaluation ($\beta = 0.39$) in the context of Bengkulu reinforces the proposition that data literacy and analytical skills are key to modern learning management. In the digital age, the effectiveness of this mechanism can be accelerated through the integration of learning analytics and digital curriculum dashboards, which enable real-time visualization of learning progress data and more precise identification of areas for improvement [53], [54]. Additional findings that digital reporting systems reinforce the impact of evaluation support this argument, while highlighting technology-enabled instructional leadership as a catalyst. Principals and supervisors who leverage data from digital platforms for clinical supervision can provide more focused and contextual guidance for teacher development.

The evaluation supports this belief and emphasizes technology-supported instructional leadership as a driver. Utilizing data from digital platforms for clinical supervision can provide more focused and contextual guidance for teacher development. However, the significant contribution of curriculum planning ($\beta = 0.21$) shows how important a strong foundation for planning is. The quality of planning, characterized by the alignment of teaching modules with Learning Outcomes (CP) and adaptation to student characteristics, is a key determinant of coherent and relevant learning in the context of the Merdeka Curriculum autonomy [55]-[57]. These results are consistent with previous research on the role of curriculum planning as an instructional tool that reduces teacher uncertainty [58], [59]. Therefore, this study fills an empirical gap regarding how technical elements of planning actually influence the implementation of the Merdeka Curriculum; it does not merely change policy documents but also changes learning practices in the classroom.

Conversely, curriculum implementation showed a relatively lower path coefficient ($\beta = 0.18$), despite having a positive impact. This indicates that the implementation stage is the most difficult and most vulnerable to various contextual obstacles. These results are in line with recent research on free curricula, which emphasizes that the implementation of curriculum policies is highly dependent on teacher readiness, school leadership capabilities, systemic support for professional training, and the availability of adequate learning facilities and infrastructure [60], [61]. The difference in implementation scores between districts shows that schools in urban areas have higher implementation scores. This indicates that equitable distribution of resources and school leadership capabilities are very important throughout the Bengkulu region.

From a methodological perspective, this study shows significant progress through the application of rigorous SEM analysis. The SEM approach allows for the verification of construct validity (through CFA) and simultaneous testing of structural relationships between latent variables [62], [63]. The resulting model not only meets excellent goodness-of-fit criteria (CFI = 0.956; RMSEA = 0.059), but also explains 57.4% of the variance in teacher performance, which is substantial predictive power in social research. Additional findings regarding the influence of digital reporting systems on the effectiveness of curriculum evaluation are consistent with Topuz's (2022) research on technology-based pedagogical transformation, while also offering practical insights for local policymakers to consider integrating technology into curriculum monitoring systems [64].

Theoretically, this study will contribute to the literature on educational management, especially in decentralized systems such as Indonesia. The results support the theory of School-Based Management (SBM)

because they show that improvements in teacher performance are directly related to improvements in schools' ability to manage the curriculum cycle independently, especially when supported by data-based evaluation capabilities [19], [22]. The novelty of this research lies in the evaluation dimension and the possibility of integrating technology as an important point in autonomous curriculum management. The research also presents strong quantitative empirical evidence from non-metropolitan areas.

The policy and practical implications of these findings are multidimensional. At the school level, there is a need to develop structured and continuous curriculum evaluation mechanisms that focus on utilizing evaluation data to improve the learning process. Teacher training must be improved in the areas of data literacy and practice reflection [64]. At the education office level, it is important to provide contextual guidance and assistance, especially for schools in rural and remote areas, to ensure equal access to resources and curriculum management capacity [32], [65]. The integration of a simple and unified digital curriculum dashboard could be prioritized to improve the transparency and accountability of monitoring [66]. At the national level, these findings support curriculum autonomy policies with the important caveat of strengthening adequate support systems, in line with Salonen-Hakomäki & Soini [67], argument regarding curriculum coherence in decentralized education systems.

This study has several limitations that need to be acknowledged. First, the cross-sectional design limits the ability to draw definitive conclusions about causal relationships. Second, data sourced from self-reports may contain bias, although validity and reliability tests show adequate results. Third, the research model does not include mediating and moderating variables that could enrich our understanding of the mechanisms of influence, such as instructional leadership, teacher motivation, or collaborative school culture.

For future research, it is recommended to adopt a longitudinal approach that can track the dynamics of relationships between variables over time. Exploration of mediating variables such as instructional leadership capacity and moderating variables such as teacher experience or parental support will also contribute significantly to the development of theory and practice. In addition, further studies could broaden the scope by comparing similar relationship patterns in various geographical contexts and types of schools in Indonesia to test the generalizability of these findings. Thus, future research could build on these findings toward a more comprehensive understanding of the interaction between curriculum policy, school management practices, and teacher professional performance in Indonesia's evolving educational ecosystem.

4. CONCLUSION

Based on empirical analysis, this study concludes that the three dimensions of curriculum management, namely planning, implementation, and evaluation, have a significant positive effect on teacher performance in Bengkulu Province, with curriculum evaluation as the strongest indicator confirming the importance of a data-based management paradigm. These findings support the strengthening of a cyclical curriculum management model oriented towards continuous improvement. For further research, it is recommended to conduct a longitudinal study to test causal relationships and explore the role of mediating variables such as technology-based instructional leadership and moderating variables such as digital infrastructure support in enriching this model.

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USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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