

Applying plan-do-check-act indicators to assess school culture development in Vietnam

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ABSTRACT

This study aims to develop and validate a plan-do-check-act (PDCA)-based measurement model for assessing school culture development (SCD) in Vietnamese high schools. Using a cross-sectional survey of 616 high-school educators (teachers and administrators), data were analyzed through confirmatory factor analysis (CFA) and structural equation modeling (SEM) to test a five-factor model comprising four PDCA stages—planning, implementation, monitoring, and improvement—and SCD as the outcome. The model demonstrated excellent validity and reliability, with all indicators meeting the recommended criteria and cutoffs. All PDCA components significantly predicted SCD, explaining 47.1% of its variance. Among them, the “improvement” (act) phase was the strongest driver ($\beta=0.375$), followed by monitoring ($\beta=0.236$), implementation ($\beta=0.214$), and planning ($\beta=0.151$). These findings highlight PDCA as a robust framework for systematic cultural change, enabling school leaders to move from fragmented initiatives toward closed-loop quality management. Practically, the study provides an evidence-based tool for principals to embed shared values, foster collaboration, and sustain cultural development amid educational reforms. This research fills a critical gap in Vietnam’s education context by offering a validated approach to managing school culture through continuous improvement.

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1. INTRODUCTION

School culture has long been recognized as a foundational element that profoundly shapes educational quality, student performance, and the sustainable development of educational institutions [1]–[3]. A positive culture, where shared values, beliefs, and norms are reinforced, creates a safe and supportive environment for students [4] and acts as a powerful driver of continuous improvement [5], [6]. In Vietnam, the ongoing comprehensive reform of general education places high schools at the center of cultural transformation, since they play a decisive role in shaping the character and competencies of future generations [7].

Yet, the construction and development of school culture is not a spontaneous process. It demands purposeful, systematic management and insightful leadership from principals, who act as cultural “architects” guiding teachers and students toward shared values and collaborative practices [1]. While research in Vietnam has highlighted certain achievements, it also shows that many school leaders still lack structured approaches, leading to fragmented and unsustainable culture-building practices [8], [9]. This gap calls for

robust and validated management frameworks that can help principals move beyond ad-hoc efforts toward sustained cultural development.

One promising framework is the plan-do-check-act (PDCA) cycle, also known as the Deming cycle. As a cornerstone of quality management, PDCA provides an iterative, four-step method for continuous improvement [10]. Widely applied in education, it has been used to enhance teacher professional development [11], improve school competitiveness [12]–[14], and assure academic quality in pre-school [15] and higher education [13], [16], [17]. Beyond its operational applications, PDCA embodies a management philosophy of data-informed decision-making and systematic problem-solving [18]. Its cyclical nature makes it particularly suitable for school culture, which is not a one-time initiative but a continuous process of shaping shared meanings and behaviors. Although the potential of PDCA has been conceptually recognized in educational management in Vietnam [18], [19], empirical evidence remains limited regarding its use as a validated measurement framework for school culture development (SCD) in high schools. This gap is particularly important in education systems undergoing rapid reforms toward competency-based curricula and strengthened quality assurance, where fragmented or ad hoc culture-building initiatives may hinder sustainable improvement [20], [21]. Accordingly, this study addresses this gap by operationalizing the four PDCA stages—plan, do, check, and act—as distinct but related dimensions, developing and validating a multidimensional instrument, and examining their direct relationships with SCD. In doing so, the study provides an evidence-based framework for understanding how systematic quality-management practices are associated with school culture development in a transitional education context.

This study makes three contributions to the literature on school culture and educational leadership. First, it develops and validates a measurement instrument that operationalizes the PDCA cycle into four distinct dimensions tailored to the context of school culture development. Second, it provides empirical evidence, based on confirmatory factor analysis (CFA) and structural equation modeling (SEM), regarding the direct relationships between the four PDCA dimensions and SCD. Third, it integrates continuous-improvement principles into the study of cultural leadership, thereby offering both a practical assessment tool for school leaders and a conceptual framework for examining systematic school culture development.

Addressing this gap, the present study proposes and tests a PDCA-based model for assessing SCD in Vietnamese high schools. The primary objective is to develop and validate a reliable measurement instrument grounded in the four PDCA stages—plan, do, check, and act—and to examine the direct relationships between each PDCA dimension and SCD. Using CFA and SEM, the study evaluates the measurement properties of the proposed five-factor model and tests the direct effects of planning, implementation, monitoring, and improvement on SCD, as illustrated in Figure 1. Accordingly, the study addresses the following research questions: i) to what extent is the proposed five-factor measurement model comprising the four PDCA dimensions and SCD valid and reliable in the context of Vietnamese high schools? and ii) what are the directions, magnitudes, and statistical significance of the relationships between planning, implementation, monitoring, and improvement and SCD?

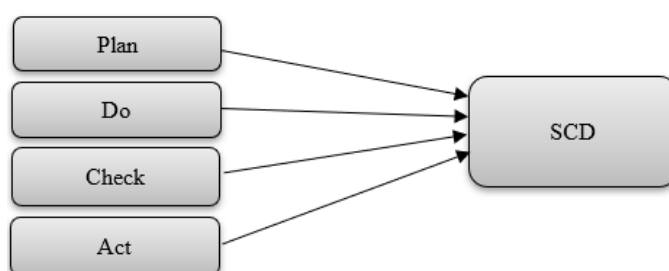


Figure 1. Theoretical framework

On this basis, the study proposes a set of hypotheses to examine the relationships between PDCA components and SCD. Specifically, it is hypothesized that planning (plan) has a significant positive direct effect on SCD. Similarly, implementation (do), monitoring (check), and continuous improvement (act) are each expected to exert significant positive direct effects on SCD. These hypotheses reflect the assumption that all phases of the PDCA cycle contribute meaningfully to cultural development within schools.

This study is expected to generate both theoretical and practical contributions to the field of educational leadership. From a theoretical perspective, it advances the literature by operationalizing the PDCA cycle into a validated multi-dimensional construct applicable to school culture research. From a practical perspective, it equips school leaders and policymakers with a systematic, evidence-based tool to

guide cultural development. This contribution is particularly relevant in contexts of educational transition, where schools face increasing demands for quality improvement and organizational adaptability.

2. METHOD

2.1. Research design

This study adopted a quantitative, cross-sectional survey design to examine the relationships between PDCA components and SCD. While this design is efficient for capturing perceptions from a large population at a single point in time, it inherently limits causal inference. Therefore, findings should be interpreted as correlational rather than causal. Future research should employ longitudinal or experimental designs to track cultural changes over time and strengthen the reliability of causal interpretations.

2.2. Population and sampling

The target population comprised teachers and administrators working at public high schools in Vietnam. A multi-stage sampling strategy was employed to ensure representativeness and diversity. First, Vietnam was stratified into three major regions—North, Central, and South—to capture cultural and administrative variations across the country. This regional stratification reflects differences in educational governance, resource allocation, and socio-cultural contexts, which could influence SCD.

Within each region, provinces were randomly selected, and schools within those provinces were invited to participate. To further enhance representativeness, the sample balanced urban and rural schools, acknowledging that school culture dynamics often differ by location due to disparities in infrastructure, community engagement, and leadership practices. This approach ensures that the findings are generalizable across diverse educational settings.

An online survey was distributed to 850 potential respondents. From this initial pool, 616 valid responses were retained for analysis, yielding a final response rate of 72.50%. A total of 234 responses were excluded based on a multi-step data screening process to ensure data quality and validity. The exclusion criteria were as follows: i) incomplete responses, defined as surveys with more than 10% of data missing; ii) invalid response patterns, such as straight-lining (e.g., selecting ‘strongly agree’ for all items) which indicates a lack of respondent engagement; iii) ineligible respondents, for responses identified as not being from current high school teachers; and iv) multivariate outliers, which were identified and removed to ensure the statistical assumptions of CFA and SEM were met. The final sample (N=616) provided a clean and robust dataset for analysis. The detailed demographic profile of the respondents is presented in Table 1.

Table 1. Demographic profile of respondents

Characteristic	Category	Frequency (n)	Percent (%)
Position	Administrators	148	24
	Teacher	468	76
Education level	Bachelor's degree	426	69.2
	Master's degree	190	30.8
Work experience	<15 years	147	23.9
	15-20 years	130	21.1
	21-25 years	129	20.9
	26-30 years	113	18.3
	>30 years	97	15.7
School status	National standard compliant	255	41.4
	Non-compliant with national standards	361	58.6
Location	Urban	272	44.2
	Rural	344	55.8

The majority of respondents were teachers (76.0%), while 24.0% held administrator positions. Most participants held a bachelor's degree (69.2%). Work experience levels were well-distributed across the five assessed categories. Furthermore, 58.6% of respondents worked in schools currently non-compliant with national standards, and 55.8% were located in rural areas.

2.3. Instrument

A structured survey instrument was developed specifically for this study. The items for the four PDCA indicators were synthesized based on the theoretical framework of continuous quality improvement and its application in education [10], [12], [13], [16], [18]. The items for the SCD construct were derived from established literature on school culture and organizational effectiveness [1], [2], [6]. All items were

measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). To mitigate response bias, five items (P6, D6, C6, A6, and S6) were reverse-phrased and were reverse-coded (R) before analysis. The constructs, their corresponding items, and their theoretical sources are detailed in Table 2.

Table 2. Measurement items for PDCA and SCD constructs

Construct	Code	Item content	Source
Plan	P1	The principal defines specific goals for SCD.	[18]
	P2	The principal aligns cultural goals with the school's vision and mission.	[10], [16]
	P3	The principal analyzes the current state of culture before planning.	[10], [16]
	P4	The principal clearly allocates resources for the cultural plan.	[10], [16]
	P5	The principal communicates the cultural plan to all staff and teachers.	[10], [16]
	P6(R)	The principal often creates cultural plans without relying on data or evidence.	[10], [16]
Do	D1	The principal organizes activities that reflect the school's core values.	[18]
	D2	The principal assigns clear tasks and responsibilities to individuals/ departments.	[12], [13]
	D3	The principal ensures resources are used appropriately during cultural activities.	[12], [13]
	D4	The principal encourages the participation of teachers, students, and parents.	[12], [13]
	D5	The principal monitors compliance with procedures and the progress of cultural activities.	[12], [13]
	D6(R)	Cultural activities often occur spontaneously without specific guidance from the principal.	[12], [13]
Check	C1	The principal monitors progress against established milestones.	[18]
	C2	The principal collects specific evidence to evaluate the effectiveness of cultural activities.	[10]
	C3	The principal periodically gathers feedback from teachers, students, and parents.	[10]
	C4	The principal compares achieved results with set goals or benchmarks.	[10]
	C5	The principal reports evaluation results and discusses lessons learned with the faculty.	[10]
	C6(R)	After an activity concludes, the principal rarely conducts a systematic evaluation.	[10]
Act	A1	The principal proposes improvement measures based on evaluation results.	[18]
	A2	The principal adjusts goals, activities, or resources when they are found to be inappropriate.	[10]
	A3	The principal standardizes and scales up effective cultural practices.	[10]
	A4	The principal updates solutions to adapt to the changing educational context.	[10]
	A5	The principal maintains a continuous improvement cycle for school culture work.	[10]
	A6(R)	The principal maintains the original cultural plan despite identified shortcomings.	[10]
SCD	S1	Shared values and norms are clearly stated and widely practiced.	[2], [20]
	S2	Collaboration and professional support among teachers occur frequently.	[6]
	S3	Student behavior reflects the agreed-upon cultural values.	[1]
	S4	School-parent relationships reinforce shared cultural expectations.	[1]
	S5	Rituals, symbols, and recognition of achievements enhance the school's positive identity.	[1]
	S6(R)	The school climate/culture shows little positive change following cultural initiatives.	[1]

2.4. Data collection and data analysis

The data gathering was conducted via an online platform between February and May 2025. The process began with securing official permissions from relevant educational bodies and the principals of the selected high schools. Informed consent was obtained from every participant via a clear statement at the beginning of the survey, which detailed the study's objectives, procedures, and the voluntary nature of participation. Respondents were explicitly informed that they could withdraw at any time without consequence. To ensure confidentiality and anonymity, no personally identifiable information was collected, and the aggregated data was stored securely and used solely for research purposes. A survey link was then distributed to the target respondents.

Data analysis was conducted using SPSS version 20. First, the reliability of the measurement scales was assessed using Cronbach's alpha (α) and composite reliability (CR) to ensure internal consistency. CFA was then conducted to test the validity of the constructs, including convergent validity (via factor loadings and average variance extracted (AVE)) and discriminant validity (via the heterotrait-monotrait (HTMT) ratio).

After validating the measurement model, SEM was performed using AMOS version 29 to test the hypothesized relationships between the PDCA indicators and SCD. Model fit was evaluated using multiple indices, including chi-square/degrees of freedom (χ^2/df), goodness-of-fit index (GFI), comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA), in accordance with established SEM guidelines [22].

3. RESULTS AND DISCUSSION

3.1. Confirmatory factor analysis

The data analysis was conducted in a stepwise and methodologically rigorous manner. It began with assessments of internal consistency reliability and convergent validity to ensure the adequacy of the measurement model. The analysis then proceeded to evaluate overall model fit, followed by tests of

discriminant validity. This sequencing ensured that the PDCA-SCD instrument satisfied key psychometric prerequisites before advancing to the examination of hypothesized structural relationships.

First, the measurement model demonstrated strong reliability and convergent validity across all constructs. As summarized in Table 3, all standardized item loadings exceeded recommended threshold values, indicating that each observed variable contributed meaningfully to its intended latent construct. These results suggest that the items were appropriately specified and theoretically aligned with their respective dimensions.

Table 3. Measurement model

Factor	Item	Loadings	α	CR	AVE
SCD	S1	0.842	0.892	0.894	0.586
	S2	0.738			
	S3	0.822			
	S4	0.860			
	S5	0.767			
	S6 (R)	0.767			
Plan	P1	0.838	0.912	0.913	0.635
	P2	0.792			
	P3	0.846			
	P4	0.853			
	P5	0.809			
	P6 (R)	0.860			
Do	D1	0.813	0.886	0.887	0.569
	D2	0.770			
	D3	0.797			
	D4	0.781			
	D5	0.825			
	D6 (R)	0.797			
Check	C1	0.859	0.916	0.918	0.653
	C2	0.859			
	C3	0.827			
	C4	0.815			
	C5	0.826			
	C6 (R)	0.846			
Act	A1	0.854	0.904	0.905	0.614
	A2	0.812			
	A3	0.815			
	A4	0.810			
	A5	0.807			
	A6 (R)	0.825			

In addition, CR values consistently surpassed the accepted criterion for construct reliability. The AVE for each construct also met established standards for convergent validity. Taken together, these findings indicate that the instrument effectively captures coherent latent dimensions of planning, implementation, monitoring, continuous improvement, and SCD.

Second, the global fit of the five-factor measurement model was excellent. The fit indices reported in Table 4 collectively indicate that the hypothesized factor structure aligns closely with the observed covariance structure, supporting the adequacy of the operationalization of PDCA into four leadership constructs alongside the outcome construct of SCD. This evidence is critical because it shows that the PDCA cycle can be modeled not only as a managerial logic but also as a measurable leadership capability in school settings.

Third, discriminant validity was confirmed using the heterotrait-monotrait (HTMT) criterion. As shown in Table 5, all HTMT ratios were well below the conservative threshold, with the largest value observed between act and SCD. This pattern indicates that the constructs are empirically distinguishable rather than redundant, supporting the interpretation that PDCA components represent related yet distinct leadership practices.

Table 4. Multiple fit indices

Index	Result	Acceptable level
χ^2/df	1.26	<3
GFI	0.995	>0.95
CFI	0.991	>0.95
TLI	0.990	>0.95
RMSEA	0.020	<0.08

Table 5. Heterotrait-monotrait (HTMT) ratio of correlations

Construct	SCD	Plan	Do	Check	Act
SCD					
Plan	0.407				
Do	0.389	0.163			
Check	0.486	0.306	0.296		
Act	0.569	0.375	0.213	0.359	

Overall, the CFA results confirm that the PDCA-SCD instrument possesses robust psychometric properties. The satisfactory reliability and validity indices provide confidence in the measurement quality of the model. Consequently, the instrument offers a sound empirical foundation for advancing to SEM to test the proposed hypotheses.

3.2. SEM

Building on the satisfactory psychometric evidence from the CFA, SEM was conducted to test the hypothesized direct effects of the four PDCA leadership constructs—plan, do, check, and act-on SCD. Model adequacy was evaluated using the same family of goodness-of-fit indicators applied to the measurement model. As reported in Table 4, the structural model demonstrates an excellent fit to the data, supporting the plausibility of the proposed causal structure. The final standardized model is displayed in Figure 2.

The hypothesis-testing results are summarized in Table 6, which reports standardized path coefficients and significance tests for the four direct effects. The pattern is unambiguous: all hypothesized paths are positive and statistically significant, thereby supporting H1-H4. Rather than interpreting these coefficients as isolated effects, the results collectively indicate that SCD is best understood as an intentional, closed-loop leadership process in which planning and enactment are strengthened by evidence-based monitoring and, most critically, by responsive improvement actions.

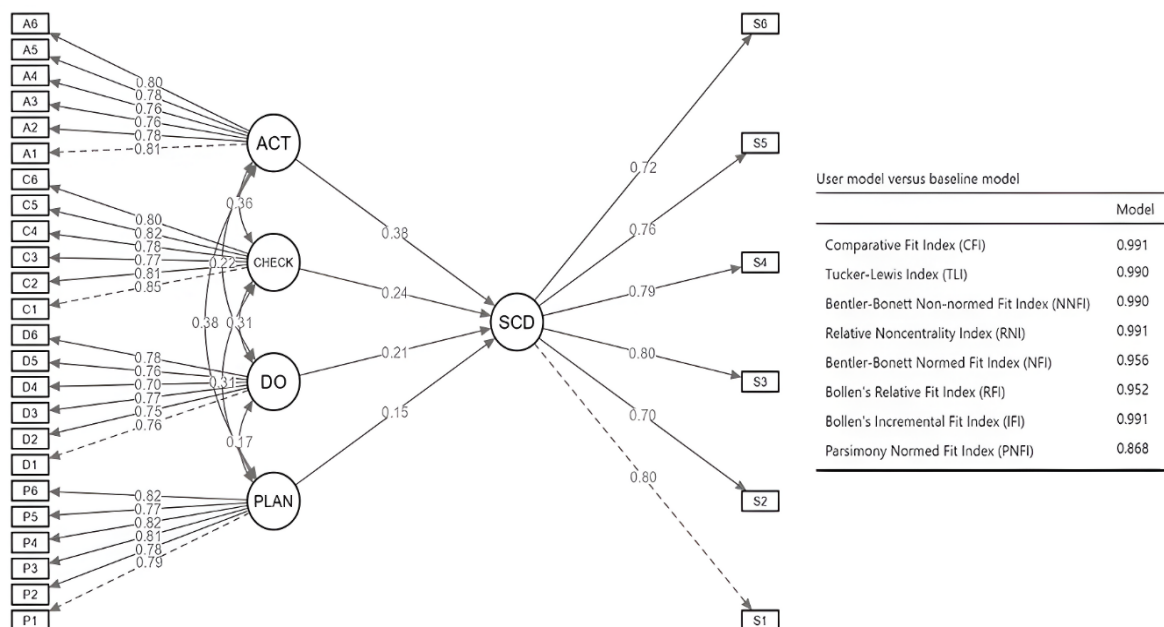


Figure 2. Structural model fit indices

Table 6. Standardized path coefficients for the structural model

Path	β	Standard error	z	p
Plan→SCD	0.151	0.043	3.84	<0.001
Do→SCD	0.214	0.045	5.50	<0.001
Check→SCD	0.236	0.037	5.58	<0.001
Act→SCD	0.375	0.044	8.75	<0.001

Interpreting the relative contributions, plan shows a significant yet comparatively smaller effect on SCD, indicating that strategic intent and clarity of direction are necessary foundations but insufficient on their own to substantially transform culture. Planning contributes by aligning cultural goals with the school's mission and communicating priorities consistently, which reduces ambiguity and establishes shared meaning. However, the modest magnitude suggests that culture does not consolidate through vision statements alone; it requires enactment and reinforcement through subsequent PDCA stages.

Do exerts a stronger influence than planning, indicating that culture is materially shaped through visible implementation—structured activities, participation routines, and leadership follow-through that translate stated values into daily practices. This supports the view that shared experiences and recurring

institutional routines are the primary carriers of cultural norms. In practical terms, implementation is the stage at which culture becomes observable: staff can recognize what the school “really values” based on what leaders consistently support, resource, and prioritize.

Check further strengthens culture development beyond mere implementation, highlighting the role of institutionalized reflection. Monitoring practices—systematic evidence collection, progress review, and stakeholder feedback—appear to function as a governance mechanism that reinforces transparency and shared accountability. This result is theoretically important because it frames school culture not simply as cohesion around activities, but as a learning-oriented environment where routines of inquiry shape professional expectations and collective responsibility.

Most importantly, act is the strongest predictor of SCD as shown in Table 6, establishing improvement as the decisive driver of cultural development. Substantively, this indicates that what most shapes culture is not the presence of plans, activities, or even evaluation itself, but the credibility of the feedback-to-action loop. When school members observe that evaluation results lead to meaningful adjustments—refining strategies, scaling effective practices, discontinuing ineffective routines, and updating implementation standards—continuous improvement becomes culturally consequential. This reinforces a resilient, future-oriented culture by signaling that the organization learns, adapts, and values professional input. Conversely, if action does not follow evaluation, PDCA risks being perceived as procedural compliance, which can erode trust and reduce engagement. In this sense, “act” functions as the integrative mechanism that converts the entire cycle into an organizational learning system rather than a sequence of disconnected managerial tasks.

The structural model results reveal that the PDCA leadership constructs account for a substantial proportion of variance in SCD ($R^2=0.471$). This finding indicates that quality-oriented leadership—conceptualized as cyclical planning, enactment, monitoring, and improvement—constitutes a major determinant of perceived cultural development in Vietnamese high schools. Such a level of explanatory power is meaningful within organizational and educational research and underscores the practical relevance of embedding PDCA routines in cultural leadership practices.

To examine whether these relationships differ across contextual conditions, a multi-group SEM analysis was conducted. The analysis compared structural paths across subgroups defined by position, education level, work experience, school status, and geographic location. The resulting subgroup patterns are summarized in Figures 3(a)-(e), which present comparative regression estimates and highlights areas of stability and variation across groups.

The subgroup results reinforce the overall model while revealing actionable nuance. First, act remains the dominant predictor across nearly all subgroups, strengthening the central claim that adaptive, responsive leadership is the most reliable engine of cultural change. This finding aligns with literature connecting PDCA-based routines with broader total quality management (TQM) approaches to sustainable improvement [23]–[25], and it is also consistent with implementation challenges noted in resource-constrained settings, where staff may judge leadership primarily by whether evaluation produces tangible improvements [26].

Second, experience-based variation provides a theoretically meaningful insight. For staff with less than 15 years of experience, the non-significant do effect alongside a strong check pathway suggests that early- to mid-career educators may derive cultural value from structured monitoring and feedback processes that clarify expectations, provide validation, and reduce uncertainty. This pattern resonates with discussions of internal quality assurance systems (IQAS), where the “check” phase supplies procedural legitimacy and supports learning-oriented governance [27]. In contrast, for over 30 years of experience, the stronger emphasis on do (and reduced salience of plan/check) suggests that veteran staff may prioritize tangible enactment and outcomes over formal planning and monitoring routines, potentially reflecting higher autonomy, established professional schemas, and lower dependence on procedural structure. Practically, these findings imply that PDCA implementation should be differentiated: schools may need stronger monitoring-and-feedback scaffolds for newer staff, while ensuring that improvement actions remain visible and meaningful for experienced staff who respond more strongly to concrete practice change.

Third, differences by school status further clarify how PDCA operates across maturity levels. In schools not yet meeting standards, the balanced relevance of all PDCA phases indicates that foundational improvement requires the full cycle: planning to establish direction, implementation to build routines, monitoring to generate evidence, and improvement to consolidate gains. In high-performing (compliant) schools, the dominance of act suggests that once baseline quality is achieved, cultural development depends more on refinement, innovation, and continuous optimization than on establishing basic routines. This interpretation is coherent with arguments linking curriculum quality management and TQM to sustained excellence rather than mere compliance [2], [28].

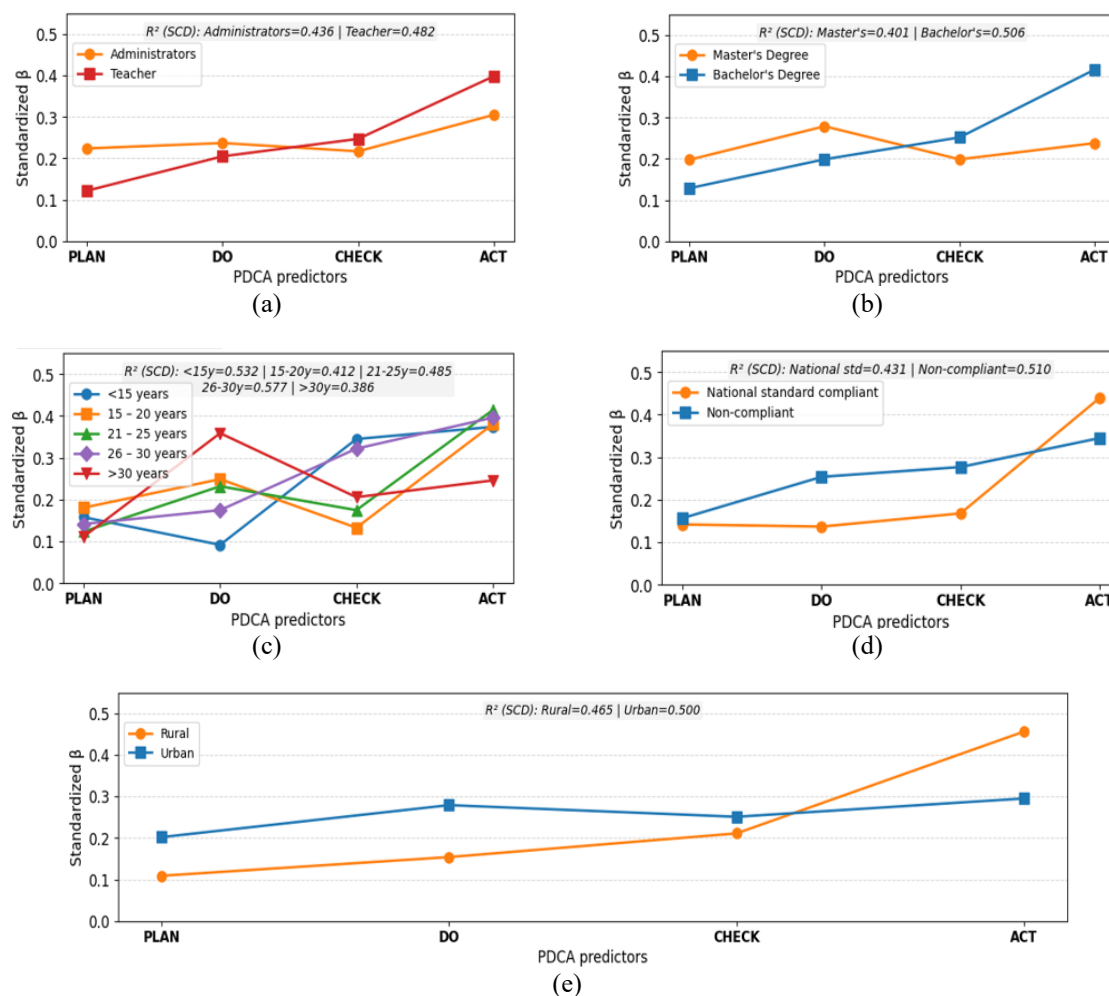


Figure 3. Comprehensive regression analysis by sub-groups: (a) position, (b) level of education, (c) work experience, (d) school status, and (e) location

Finally, the analysis reveals modest differences by position, with teachers demonstrating slightly higher explained variance in SCD than administrators. This pattern suggests that teachers may experience the cultural effects of PDCA more directly, as they are the primary agents of instructional enactment and the immediate recipients of improvement-related decisions. These findings underscore an important practical implication for improvement leadership: the “act” phase must be operationalized in ways that meaningfully transform classroom-facing routines and professional collaboration, rather than remaining confined to administrative procedures.

From a comparative international perspective, the dominance of “act” is also instructive. In systems influenced by Japan’s continuous improvement traditions, the cultural legitimacy of quality governance often depends on visible standardization and iterative refinement—an “act-centric” logic that mirrors the present findings. In China, monitoring and accountability structures are frequently emphasized, but their cultural impact depends on whether data are translated into concrete institutional adjustments, again reinforcing the centrality of “act”. In Indonesia, IQAS-related cycles similarly hinge on follow-up improvements after evaluation, highlighting that improvement capacity—not evaluation alone—is what sustains organizational change. Viewed through this lens, the Vietnamese results contribute to a broader global lesson: quality management strengthens school culture most effectively when evidence is consistently converted into action and institutionalized learning.

3.3. Discussion

The primary aim of this study was to develop and empirically validate a model for assessing SCD in Vietnamese high schools grounded in the PDCA quality management cycle. The results provide strong support for the proposed model, demonstrating that PDCA is not merely a relevant theoretical framework but

can also be operationalized as a valid and reliable measurement instrument for evaluating leadership practices associated with SCD. The excellent fit of both the measurement and structural models substantiates the conceptualization of the PDCA cycle as four distinct yet tightly interrelated constructs—planning, implementation, monitoring, and improvement—thereby addressing a critical gap in the literature concerning the scarcity of empirically tested instruments that can systematically guide and evaluate cultural development initiatives in educational settings [2], [18].

Beyond establishing psychometric adequacy, the structural analysis yielded several substantive insights. All four PDCA components were significant and positive predictors of SCD, supporting hypotheses H1 through H4 and indicating that effective cultural leadership requires a holistic approach spanning strategic intent, enactment, evidence-based review, and adaptive refinement. This holistic pattern is broadly consistent with international experiences in which comparable quality governance frameworks have been institutionalized. In Japan, continuous improvement philosophies (e.g., Kaizen) have long emphasized iterative learning and standardization after improvement, mirroring PDCA's cyclical logic. In China, quality-oriented governance in public institutions—including education—has often underscored disciplined implementation and data-informed accountability mechanisms, highlighting the importance of systematic “check” processes. In Indonesia, the development of internal quality assurance arrangements in education similarly reflects recurring cycles of evaluation and improvement that resemble PDCA logics. Against this international backdrop, the Vietnamese evidence strengthens the argument that quality management principles have cross-context relevance for school governance, while also underscoring the necessity of contextual adaptation to local administrative capacity and resource constraints.

When examining the relative contributions of each PDCA phase, planning had a statistically significant but comparatively modest effect on SCD ($\beta=0.151$). This suggests that strategic intent and vision-setting are foundational conditions rather than the most proximal drivers of cultural change. Planning clarifies goals, communicates expectations, and provides coherence; however, cultural norms are unlikely to become embedded without enactment and reinforcement through daily practices. Consistent with this reasoning, implementation exerted a stronger influence ($\beta=0.214$), reinforcing the proposition that school culture is ultimately built through concrete actions, shared routines, and lived experiences. Through implementation, espoused values are translated into observable norms and practices, thereby signaling leadership commitment and strengthening community engagement [1].

Notably, monitoring ($\beta=0.236$) emerged as a stronger predictor than implementation, which is theoretically consequential. This finding implies that a culture of inquiry, reflection, and evidence use may function as a particularly powerful mechanism for enhancing cultural health. Systematic feedback collection and progress evaluation can strengthen transparency, accountability, and collective ownership, reinforcing the school's capacity to operate as a learning organization [6]. In practical terms, monitoring does not merely verify compliance with plans; it can also reshape meaning-making processes by establishing shared interpretive frameworks about what counts as improvement and how success is assessed.

The most salient contribution of the present study, however, lies in the preeminent role of the act phase as the strongest predictor of SCD ($\beta=0.375$). This pattern suggests that school culture is shaped most decisively by an institution's demonstrated capacity to learn, adapt, and institutionalize better practices over time. When teachers and staff perceive that feedback results in tangible adjustments, followed by the consolidation and standardization of effective practices the entire improvement cycle gains legitimacy, and the organizational environment becomes more dynamic, resilient, and future-oriented. This interpretation aligns closely with continuous improvement principles in which the “act” stage closes the loop, converts learning into action, and initiates the next cycle of growth [10]. Conceptually, the act phase may also serve an integrative function: it absorbs inputs from planning, reflects the realities of implementation, and operationalizes evidence from monitoring into institutional decisions. If “act” is weak or symbolic, PDCA risks degenerating into fragmented activities rather than a coherent learning system; conversely, when “act” is robust, it can amplify the effectiveness of the preceding phases by making the cycle consequential.

Given the dominance of the improvement phase, action recommendations for school leaders should prioritize building an operationally feasible “improvement infrastructure” rather than merely expanding programs or intensifying supervision. First, leadership teams should institutionalize improvement rhythms (e.g., monthly or semester-based cycles) with explicit deliverables—such as documented process adjustments in teaching coordination, student support, professional learning routines, and behavioral norms—communicated internally as feedback-to-action commitments. Second, improvement priorities should be selected through evidence-informed mechanisms (e.g., learning outcomes, attendance patterns, discipline indicators, and school climate surveys) to avoid ad hoc or trend-driven interventions. Third, successful improvements should be standardized through clear procedures, exemplars of good practice, and internal capacity-building so that gains are not lost due to staff turnover or the end of an academic year. Fourth, leaders should cultivate psychologically safe feedback environments, where constructive critique is

encouraged and contributions are recognized, because an “act-oriented” culture depends on organizational trust; when feedback is ignored or penalized, improvement capacity deteriorates, and the entire PDCA cycle becomes less credible.

Although the present study focuses on managerial drivers of school culture, the ultimate significance of culture development lies in its implications for student outcomes. A strong culture shaped by systematic PDCA practices—characterized by shared values, collaboration, and continuous improvement—is consistently linked in the literature to higher student engagement, improved academic achievement, and enhanced socio-emotional well-being. Evidence also suggests that well-managed school culture, including its digital dimensions [29] and character education components [26], provides the structured and supportive environment in which students can flourish. Accordingly, the PDCA framework validated in this study should be understood not simply as an administrative mechanism but as a pathway through which leaders can create cultural conditions that enable student thriving.

Collectively, the model’s ability to explain 47.1% of the variance in SCD indicates substantial explanatory power. The findings provide robust empirical support for the proposition that systematic PDCA capability constitutes a major determinant of positive cultural outcomes in school environments. This result further aligns with research emphasizing TQM principles in schools [23]. More broadly, structured improvement approaches have been applied in other organizational settings [20], [31] and in long-term educational programs [30], illustrating the wider cross-context use of systematic improvement frameworks.

From a comparative international perspective, Vietnam’s PDCA application aligns with established uses in Japan, China, and Indonesia, reinforcing its cross-context utility for school culture and quality management. In Japan, the PDCA cycle forms a core part of national education policy, supporting continuous improvement (Kaizen) through systematic planning, evaluation, and refinement in schools [32]. China integrates PDCA into higher education and vocational training for teaching quality monitoring, emphasizing data-driven cycles to enhance institutional outcomes [33]. Similarly, Indonesian vocational schools employ PDCA (deming cycle) within quality assurance systems to institutionalize iterative improvements, addressing challenges akin to Vietnam’s resource constraints [34]. These parallels position Vietnam’s validated model as a contribution to Asian educational governance, adaptable to transitional contexts where PDCA bridges local reforms with proven quality frameworks.

Nevertheless, systematic PDCA implementation is not without challenges, which may also account for differential effects observed in the multi-group analysis. In Vietnam, as in other contexts, school leaders may face structural barriers such as excessive administrative workload that constrains time for reflective “check” and especially action-oriented “act” processes; limited formal training in quality management; and insufficient resources—such as outdated information and communication technology (ICT) infrastructure or limited personnel—to support robust implementation and monitoring activities [26]. The effectiveness of IQAS often depends on resolving these operational constraints and securing sustained institutional support [27]. Therefore, future adoption of the model should explicitly incorporate feasibility considerations, including time allocation, role clarity, streamlined documentation, minimum viable data infrastructure, and targeted professional development in evidence-based improvement cycles, to ensure that the “act” phase functions as the central engine of SCD rather than a procedural afterthought.

4. CONCLUSION

This study positions the PDCA cycle as a scalable, evidence-based framework for strengthening and assessing school culture in Vietnamese high schools, while also opening a forward-looking agenda for system-wide quality governance in education. Rather than treating school culture as a by-product of day-to-day activities, the validated model supports a view of culture as a manageable organizational capability—one that can be deliberately cultivated through iterative cycles of planning, implementation, monitoring, and improvement. The prominence of the “improvement” (act) phase, in particular, signals that the long-term vitality of school culture depends less on isolated initiatives and more on an institution’s capacity to convert evaluative evidence into sustained refinements of practice.

Looking ahead, the most consequential implication is the model’s potential for national-scale adoption. Because the PDCA constructs have been operationalized into a coherent measurement tool with robust psychometric performance, the instrument can be integrated into broader internal quality assurance processes across provinces and school systems. With appropriate policy alignment, the tool can support national benchmarking of cultural development, enable data-informed leadership development, and provide a common language for continuous improvement across diverse school contexts. In this sense, the model is not only diagnostically useful for individual schools but can function as an infrastructure for scaling cultural leadership capacity—supporting consistency, comparability, and targeted support at the system level.

At the same time, the PDCA-based instrument demonstrates strong prospects for international transferability. PDCA is widely recognized as a universal quality management logic, and the four-construct

operationalization validated here provides a structured template that can be adapted to other educational systems while retaining conceptual equivalence. Future cross-national studies could test measurement invariance and contextual calibration in settings such as Japan, China, or Indonesia, where comparable quality management and internal assurance traditions have been institutionalized. Such comparative work would clarify which elements of cultural leadership are context-general and which require localized indicators, thereby strengthening the tool's utility as a shared research and policy instrument for international scholarship on school culture and quality governance.

Practically, the study offers school leaders and policymakers a pathway to move beyond fragmented culture-building efforts toward closed-loop improvement systems. As educational demands continue to evolve—through curricular reform, digital transformation, and shifting student needs—the PDCA cycle provides an actionable architecture for sustaining shared values under conditions of change. The centrality of the act phase implies that the credibility of cultural leadership will increasingly depend on whether schools can demonstrate that feedback leads to meaningful adjustments and the institutionalization of effective practices.

Several limitations remain, including the cross-sectional design and reliance on self-reported measures, which constrain causal inference and may introduce response bias. However, these limitations should be viewed as a starting point for a program of future research rather than as a boundary on the model's usefulness. Next steps should prioritize longitudinal and mixed-method designs, incorporate multi-stakeholder perspectives (leaders, teachers, students, and parents), and examine downstream outcomes such as school sustainability, student engagement, academic achievement, and socio-emotional well-being. With continued validation and contextual refinement, the PDCA-based model and instrument can evolve into a national and internationally adaptable toolkit—supporting both scholarly accumulation and practical governance aimed at strengthening school culture through continuous improvement.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : **O** Writing - **O**riginal Draft

E : **E** Writing - Review & **E**editing

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

All individuals involved in this study provided informed consent. Participating teachers were thoroughly informed about the research objectives and made aware of their right to withdraw from the study at any time.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author, [NHT], upon reasonable request. The dataset is not publicly accessible due to participant confidentiality and privacy considerations.

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