International Journal of Evaluation and Research in Education (IJERE)
Vol. 15, No. 6, December 2026, pp. 5257~5272
ISSN: 2252-8822, DOI: 10.11591/ijere.v15i6.40133

Beyond leadership and policy: how total quality management drives educational quality for SDG 4

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Article Info

Article history:

Received Apr 26, 2026
Revised Sep 30, 2026
Accepted Oct 14, 2026

Keywords:

Conservation education
Educational quality
Inclusive education
Knowledge management
SDG 4
Total quality management

ABSTRACT

This study examines how total quality management (TQM) mediates the relationship between organizational inputs principal leadership, knowledge management, inclusive education, and conservation education and educational quality, within the input–process–outcome (IPO) framework aligned with sustainable development goal 4 (SDG 4). A quantitative cross-sectional design was employed, analyzing data from 396 respondents across 99 public junior high schools in Banyuasin Regency, Indonesia, using partial least squares structural equation modeling (PLS-SEM). TQM emerged as the strongest predictor of educational quality (β=0.491, $p<0.001$) and significantly mediated the effects of principal leadership (indirect-only), knowledge management (partial mediation), and inclusive education (indirect-only). Conservation education exerted a direct but non-mediated influence. The model explains 71.5% of variance in educational quality (R^2=0.715). These findings re-conceptualize TQM as a core organizational capability rather than a peripheral administrative tool, offering practical guidance for policymakers and school leaders seeking sustainable quality improvement in resource-constrained contexts.

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1. INTRODUCTION

Quality education is vital to inclusive growth, social fairness, and long-term development, according to sustainable development goal 4 (SDG 4) [1]. Beyond expanding access to schooling, SDG 4 emphasizes equitable learning outcomes, institutional accountability, and continuous improvement of education systems [2]. In this setting, the ability of schools to convert resources, policies, and leadership into quantifiable learning outcomes and long-term institutional success is now used to assess educational quality rather than just enrollment rates or infrastructure availability [3], [4].

However, in many developing contexts, including Indonesia, progress in educational access has not been matched by equivalent gains in quality [5], [6]. This challenge is particularly evident in geographically dispersed and resource-constrained regions such as Banyuasin Regency, where schools have implemented various initiatives such as leadership reforms, inclusive education policies, and sustainability-oriented programs yet continue to exhibit uneven and fragmented outcomes [7], [8]. These conditions suggest that the problem is not solely the absence of policies or programs, but the limited capacity of schools to systematically integrate these initiatives into coherent and sustainable improvement processes.

Previous research has identified several organizational factors associated with educational quality [9], [10]. Principal leadership plays a role in shaping school vision, coordination, and organizational climate, while knowledge management supports collaboration, innovation, and evidence-based decision-making [11]. Inclusive education contributes to equity and access, and conservation education promotes sustainability awareness and environmental responsibility [12]. In parallel, total quality management (TQM) has been introduced in educational settings as a framework for continuous improvement, stakeholder satisfaction, and process standardization [13], [14]. Collectively, these factors are recognized as important drivers of school performance.

Despite this growing body of literature, three critical limitations remain. First, most studies examine leadership, knowledge management, inclusion, and sustainability initiatives as independent predictors of educational quality, rather than as interrelated components within a broader organizational system [15]. This fragmented approach limits the ability to explain how multiple initiatives interact in practice. Second, limited empirical attention has been given to the role of TQM as a mediating mechanism that translates organizational inputs into measurable educational outcomes [16]. While TQM is often acknowledged as beneficial, it is frequently treated as a technical or administrative tool rather than as a core process capability that integrates and sustains improvement efforts. Third, there is a lack of context-specific empirical evidence from resource-constrained and geographically dispersed regions, where schools face greater challenges in coordination, monitoring, and implementation, and where effective governance mechanisms are most urgently needed [17], [18].

Accordingly, the objectives of this study are fourfold: i) to examine the direct effects of principal leadership, knowledge management, inclusive education, and conservation education on educational quality; ii) to analyze their influence on the implementation of TQM; iii) to test the mediating role of TQM in linking organizational inputs to educational quality; and iv) to identify the most influential drivers of educational quality in a resource-constrained context. To address these gaps, this study adopts the input–process–outcome (IPO) framework, positioning principal leadership, knowledge management, inclusive education, and conservation education as organizational inputs; TQM as the core process mechanism; and educational quality as the SDG 4-aligned outcome [19]. Using partial least squares structural equation modeling (PLS-SEM) with data from 396 respondents across 99 public junior high schools in Banyuasin Regency, the study examines direct and indirect pathways through which TQM mediates the translation of organizational inputs into educational outcomes. Theoretically, this advances the IPO framework by repositioning TQM as a central organizational capability. Empirically, it provides context-specific evidence from an underrepresented developing-region setting. Practically, the findings offer actionable guidance for policymakers seeking scalable pathways to SDG 4 progress through strengthened internal governance systems [20], [21].

By clarifying the organizational mechanisms that enable schools to achieve quality outcomes, this study contributes to both theory and practice. Theoretically, this study advances understanding of process-based educational governance. Practically, it provides evidence for policymakers and school leaders seeking cost-effective strategies to improve educational quality through stronger internal management systems rather than fragmented program expansion. The conceptual framework of the study is presented in Figure 1.

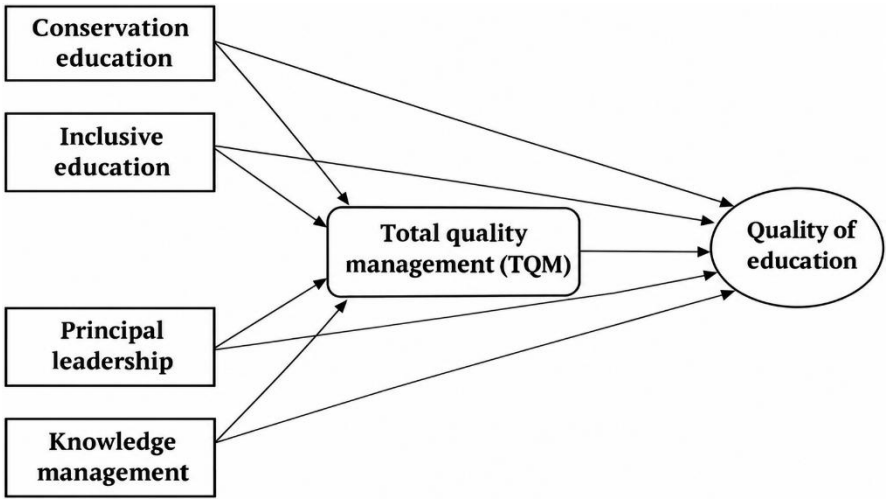


Figure 1. Research framework (Source: processed from various sources, 2025)

Grounded in the IPO framework, this study examines how organizational inputs namely principal leadership, knowledge management, inclusive education, and conservation education contribute to educational quality, both directly and indirectly through TQM. The proposed model assumes that TQM functions as a central organizational process that transforms educational initiatives into sustainable quality outcomes. Accordingly, this study seeks to answer the following research questions:

- To what extent do principal leadership, knowledge management, inclusive education, and conservation education directly influence educational quality?
- How do principal leadership, knowledge management, inclusive education, and conservation education influence the implementation of TQM in schools?
- Does TQM mediate the relationships between organizational inputs and educational quality?

Based on the theoretical foundations and prior empirical evidence, the following hypotheses are proposed:

- H1: principal leadership has a positive effect on educational quality.
- H2: principal leadership has a positive effect on TQM.
- H3: knowledge management has a positive effect on educational quality.
- H4: knowledge management has a positive effect on TQM.
- H5: inclusive education has a positive effect on educational quality.
- H6: inclusive education has a positive effect on TQM.
- H7: conservation education has a positive effect on educational quality.
- H8: conservation education has a positive effect on TQM.
- H9: TQM has a positive effect on educational quality.
- H10: TQM mediates the relationship between principal leadership and educational quality.
- H11: TQM mediates the relationship between knowledge management and educational quality.
- H12: TQM mediates the relationship between inclusive education and educational quality.
- H13: TQM mediates the relationship between conservation education and educational quality.

2. METHOD

2.1. Approach and research design

This study employed a quantitative, cross-sectional, explanatory survey design to test the structural relationships among principal leadership, knowledge management, inclusive education, conservation education, TQM, and educational quality. The study is therefore not conceptual or purely qualitative; rather, it is designed to generate empirical evidence regarding both direct and indirect causal pathways within an integrated organizational model [22]. The explanatory design was selected because the study aims to examine how multiple antecedent variables influence educational quality and whether TQM functions as a mediating mechanism [23]. The proposed model was grounded in the IPO framework, in which leadership, knowledge management, inclusive education, and conservation education represent organizational inputs; TQM represents the internal process; and educational quality represents the outcome aligned with SDG 4.

2.2. Research setting and data sources

The study was conducted in Banyuasin Regency, South Sumatra, Indonesia, an area characterized by geographic dispersion and unequal educational infrastructure. This context was selected because it reflects the practical challenges of improving educational quality in resource-constrained settings. Primary data were collected directly from respondents through a structured questionnaire [24]. The target population consisted of 136 public junior high schools officially registered under the Banyuasin Regency Education Office. The unit of analysis was the school organization, while respondents were individuals occupying managerial and instructional roles with adequate knowledge of school operations. These included principals, vice principals, and senior teachers [25].

2.3. Sampling and bias control

A minimum sample size was determined using Slovin's formula with a 5% margin of error, resulting in 99 schools. To ensure representativeness, a multistage proportional sampling technique was employed. First, schools were stratified based on accreditation categories (A, B, and C) [26]. Second, schools were selected proportionally from each stratum using random sampling procedures. Each selected school contributed approximately four respondents, generating a total of 396 valid respondents. This sample size exceeded the minimum requirement for PLS-SEM, ensuring adequate statistical power for multivariate analysis.

Given the reliance on self-reported questionnaire data, potential common method bias (CMB) was addressed through both procedural and statistical approaches [27]. Procedurally, anonymity and confidentiality were assured, item wording was carefully designed to minimize ambiguity, and predictor and

criterion variables were psychologically separated within the questionnaire. Statistically, Harman's single-factor test was conducted, confirming that no single factor accounted for the majority of variance, thereby indicating that CMB was not a serious concern [28]. Although Harman's single-factor test indicated that CMB was unlikely to be a major concern, recent methodological studies have noted that this technique has limited diagnostic power and should not be interpreted as definitive evidence of the absence of method bias. Accordingly, the test results were considered alongside the procedural remedies implemented during questionnaire design and data collection.

2.4. Instrumentation and measurement

Data were gathered using a structured self-administered questionnaire developed from established literature in educational management and quality assurance [20]. All items were measured on a 5-point Likert scale (1=strongly disagree to 5=strongly agree) [29]. The instrument measured six latent constructs: i) principal leadership (vision-setting, supervision, and coordination); ii) knowledge management (knowledge sharing, documentation, and collaborative learning); iii) inclusive education (equity practices, accessibility, and differentiated instruction); iv) conservation education (integration of sustainability into curriculum and school culture); v) TQM (continuous improvement, planning, monitoring, and stakeholder involvement); and vi) educational quality (learning outcomes, stakeholder satisfaction, and institutional effectiveness).

The measurement instrument was developed by adapting items from established and validated scales in the educational management and quality assurance literature [30]. For example, principal leadership items captured vision-setting and supervision practices; knowledge management items reflected knowledge sharing and collaborative learning; inclusive education items addressed accessibility and differentiated instruction; and TQM items measured continuous improvement and process monitoring. Sample items include: "School leadership provides clear direction for quality improvement" (adapted from leadership studies); "Teachers regularly share knowledge and best practices" (knowledge management literature); "The school implements structured quality evaluation processes" (TQM literature). A complete list of measurement items and their sources is provided in the Appendix to enhance transparency and replicability.

Prior to full data collection, the instrument was pilot-tested with 30 respondents from similar school contexts. The pilot results indicated acceptable reliability (Cronbach's alpha>0.70 across constructs) and led to minor revisions in wording to improve clarity, reduce ambiguity, and ensure contextual relevance. These refinements enhanced both the reliability and validity of the final instrument [31].

2.5. Validity and reliability procedures

To ensure methodological rigor, instrument quality was assessed in two stages. First, content validity was established through expert review by specialists in educational management and quality assurance. Items were refined based on clarity, relevance, and contextual appropriateness. Second, construct validity and reliability were evaluated statistically using PLS-SEM criteria: outer loadings>0.70, average variance extracted (AVE)>0.50, Cronbach's alpha>0.70, and composite reliability>0.70. Discriminant validity was further examined using the Fornell–Larcker criterion and cross-loading analysis [32], [33].

2.6. Data collection procedures

Data were collected between January and March 2025 through an online survey platform (Google Forms), following official approval from the local education authority. The procedures included: obtaining formal approval from the regional education authority, conducting pilot testing of the questionnaire, distributing survey links to selected schools, providing informed consent information, and monitoring responses and screening incomplete submissions. Only complete and internally consistent responses were retained for final analysis [34], [35]. Responses were screened for completeness and consistency; incomplete or patterned responses were excluded. Missing data were minimal and handled using listwise deletion, as the proportion was below acceptable thresholds and did not affect overall model estimation.

2.7. Data analysis techniques

Data were analyzed using PLS-SEM with SmartPLS 4.0. PLS-SEM was chosen over covariance-based SEM (CB-SEM) for three main reasons: i) its suitability for predictive and exploratory modeling involving complex relationships and multiple mediators; ii) its robustness to non-normal data distributions; and iii) its effectiveness with relatively moderate sample sizes [36]. This makes PLS-SEM particularly appropriate for the present study, which focuses on explaining variance in educational quality rather than confirming a well-established theory [37].

The analysis followed a two-stage procedure. First, the measurement model (outer model) was evaluated to ensure indicator reliability (outer loadings>0.70), convergent validity (AVE>0.50), and internal consistency (Cronbach's alpha and composite reliability>0.70), as well as discriminant validity through the

Fornell–Larcker criterion. Second, the structural model (inner model) was assessed using path coefficients (β), significance testing through bootstrapping with 5,000 resamples, coefficients of determination (R^2), effect sizes (f^2), and predictive relevance (Q^2) [38]. Mediation effects were examined using indirect effect analysis to determine the nature of mediation (full, partial, or indirect-only) [39].

To enhance interpretability, statistical results were not limited to significance testing but were also interpreted in terms of practical and substantive meaning. For instance, the strong coefficient of TQM (β=0.491) indicates that structured management processes contribute more substantially to improvements in educational quality than isolated leadership or programmatic interventions. This approach ensures that findings are both statistically robust and practically meaningful for educational management and policy contexts. The use of a quantitative explanatory design combined with PLS-SEM is appropriate because the study seeks to test a complex predictive model involving multiple latent constructs and mediation effects in a context where theory development and practical relevance are equally important. This approach enhances transparency, analytical rigor, and replicability [37].

2.8. Ethical considerations

Participation was voluntary and anonymous. Respondents were informed of the study's purpose, confidentiality protections, and their right to withdraw at any time. No personal identifiers were collected, and all data were used solely for academic research purposes [40].

3. RESULTS

This section presents the empirical findings of the study in accordance with the research objectives, focusing on: i) measurement model evaluation; ii) structural model results; iii) explanatory power; iv) effect size; and v) mediation analysis.

3.1. Measurement model evaluation

The results of the measurement model evaluation (outer model) are presented in Table 1. Before testing the structural relationships, the measurement model was assessed to ensure the validity and reliability of the constructs. Convergent validity, internal consistency reliability, and AVE were examined. All constructs demonstrated strong internal consistency, with Cronbach's alpha and composite reliability values exceeding the recommended threshold of 0.70. Furthermore, all AVE values were above 0.50, indicating adequate convergent validity. These results confirm that the indicators reliably measure their respective latent constructs, thereby justifying further analysis of the structural model.

Table 1. Convergent validity and reliability results

Variable	Cronbach's alpha	Composite reliability	AVE
Principal leadership	0.970	0.972	0.702
Knowledge management	0.939	0.948	0.624
Inclusive education	0.884	0.906	0.520
Conservation education	0.834	0.875	0.501
TQM	0.943	0.950	0.616
Educational quality	0.945	0.951	0.532

3.2. Structural model results (direct effects)

The structural model was evaluated by analyzing path coefficients (β), t-values, and p-values obtained via bootstrapping. The findings reveal several important patterns as presented in Table 2. The table presents the key findings in direct alignment with the research objectives, focusing on: i) the effects of organizational inputs on educational quality; ii) their influence on TQM; iii) the mediating role of TQM; and iv) the identification of the most influential driver of educational quality.

First, regarding the direct effects on educational quality, the results show that TQM is the most influential predictor (β=0.491, $p<0.001$), indicating that educational quality is primarily determined by internal management processes rather than isolated organizational inputs. Among the input variables, knowledge management (β=0.128, $p<0.05$) and conservation education (β=0.244, $p<0.001$) demonstrate significant direct effects, whereas principal leadership and inclusive education do not exhibit statistically significant direct relationships with educational quality. Second, in relation to the determinants of TQM, knowledge management (β=0.413, $p<0.001$) and inclusive education (β=0.369, $p<0.001$) emerge as strong predictors, while principal leadership shows a smaller but significant effect (β=0.121, $p<0.05$). In contrast, conservation education does not significantly influence TQM, suggesting limited integration of sustainability initiatives into formal quality management systems.

Third, mediation analysis reveals distinct patterns across variables. TQM fully mediates the effects of principal leadership and inclusive education on educational quality (indirect-only mediation), indicating that these factors contribute to outcomes only when translated into structured management processes. Knowledge management exhibits partial (complementary) mediation, reflecting its dual role as both a direct contributor and a process enabler. Meanwhile, conservation education shows no significant mediation effect, operating independently of TQM.

Table 2. Direct effects and hypothesis testing results

Relationship	β	t-value	p-value	Result
Principal leadership→educational quality	0.118	1.552	0.060	Not significant
Principal leadership→TQM	0.121	1.747	0.040	Significant
Knowledge management→educational quality	0.128	1.825	0.034	Significant
Knowledge management→TQM	0.413	8.094	0.001	Significant
Inclusive education→educational quality	–0.028	0.474	0.318	Not significant
Inclusive education→TQM	0.369	6.105	0.001	Significant
Conservation education→educational quality	0.244	4.864	0.001	Significant
Conservation education→TQM	0.020	0.430	0.334	Not significant
TQM→educational quality	0.491	7.066	0.001	Significant

3.3. Coefficient of determination (R^2)

The results of the determination coefficient analysis from the SEM-PLS test are presented in Table 3. The model demonstrates strong explanatory power, accounting for 71.5% of the variance in educational quality (R^2=0.715). Collectively, these findings indicate a clear hierarchical structure in which TQM functions as the central mechanism linking organizational inputs to educational outcomes, thereby addressing the core research question regarding how educational initiatives are translated into measurable quality improvements. This suggests that the selected organizational variables collectively provide substantial predictive capability for understanding educational quality within the studied context.

Table 3. Coefficient of determination

Endogenous variable	R^2	Adjusted R^2	Interpretation
TQM	0.666	0.663	Strong
Educational quality	0.715	0.711	Strong

3.4. Effect size (f^2)

Effect size analysis was conducted to evaluate the relative contribution of each predictor presented in Table 4. The table shows the influence of TQM on the quality of education, with a large effect size (f^2=0.491). The influence of knowledge management on TQM (f^2=0.413) and the influence of inclusive education on TQM (f^2=0.369) also show a large influence, which indicates their strong contribution to the formation of the process. Knowledge management influences the quality of education (f^2=0.331) and conservation education influences the quality of education (f^2=0.254) indicating a moderate influence. Principal leadership also influences TQM (f^2=0.121) and the influence of conservation education on TQM (f^2=0.020) shows a small influence. These findings reinforce the central role of TQM as the primary mechanism driving educational quality, while also highlighting the strategic importance of knowledge management and inclusive education in strengthening institutional processes.

Table 4. Effect size result

Relationship	f^2	Effect size
Principal leadership→educational quality	0.177	Moderate
Principal leadership→TQM	0.121	Small
Knowledge management→educational quality	0.331	Moderate
Knowledge management→TQM	0.413	Large
Inclusive education→educational quality	0.153	Moderate
Inclusive education→TQM	0.369	Large
Conservation education→educational quality	0.254	Moderate
Conservation education→TQM	0.020	Small
TQM→educational quality	0.491	Large

From a practical perspective, the large effect size of TQM indicates that schools with stronger quality management systems are more likely to demonstrate consistent instructional planning, systematic performance monitoring, data-informed decision-making, effective stakeholder engagement, and continuous improvement practices. These organizational capabilities may contribute to better coordination of school activities, improved responsiveness to educational challenges, and more sustainable quality outcomes. In contrast, the smaller effect sizes of the input variables suggest that their contribution to educational quality becomes more substantial when supported by structured quality management processes.

3.5. Mediation analysis

To address the core research objective, mediation analysis was conducted using bootstrapping to examine indirect effects through TQM. The results reveal three distinct mediation patterns which are presented in Table 5. The results of the indirect effect analysis confirm that TQM plays a significant mediating role in linking several organizational variables to educational quality. Principal leadership has a significant indirect effect on educational quality through TQM (β=0.059, $p<0.05$), as does inclusive education (β=0.181, $p<0.001$), indicating full mediation in both relationships. Knowledge management also demonstrates a significant indirect effect (β=0.203, $p<0.001$), alongside its direct effect, reflecting a complementary partial mediation pattern. In contrast, the indirect effect of conservation education through TQM is not statistically significant (β=0.047, $p>0.05$), suggesting that its influence on educational quality operates independently of TQM. These findings underscore the central role of TQM as an integrative mechanism that translates organizational inputs into improved educational outcomes.

Table 5. Indirect effects (mediation results)

Mediation path	Indirect Effect	t-value	p-value	Mediation type
Principal leadership→TQM→educational quality	0.059	1.702	0.044	Indirect-only
Knowledge management→TQM→educational quality	0.203	5.572	0.001	Partial (complementary)
Inclusive education→TQM→educational quality	0.181	4.386	0.001	Indirect-only
Conservation education→TQM→educational quality	0.010	0.430	0.334	Not significant

4. DISCUSSION

This study examined whether TQM functions as the organizational mechanism through which leadership, knowledge management, inclusive education, and conservation education are translated into educational quality outcomes. The findings move beyond a simple description of significant relationships by demonstrating that educational quality is primarily process-dependent rather than input-dependent. In other words, schools do not improve merely because they possess leadership programs, inclusion policies, or sustainability initiatives; they improve when such inputs are embedded within coherent management systems characterized by planning, monitoring, coordination, and continuous improvement.

The findings collectively demonstrate that educational quality is primarily process-dependent rather than input-dependent. Among all variables, TQM exhibited the strongest direct effect (β=0.491, $p<0.001$), confirming that systematic planning, monitoring, stakeholder involvement, and continuous improvement are more decisive determinants of school performance than any single organizational input [13], [14]. This supports the IPO framework: inputs alone are insufficient without an effective process mechanism to coordinate and sustain them. TQM emerged as a significant mediator for three of four input variables. Principal leadership and inclusive education operated through indirect-only pathways, indicating that their contribution to educational quality depends on institutionalization within quality management systems rather than direct influence [41], [42]. Knowledge management demonstrated partial (complementary) mediation, reflecting its dual role as both a direct contributor and process enabler suggesting that knowledge resources are amplified when embedded within formal quality assurance mechanisms [43], [44]. Conservation education, by contrast, exerted a direct effect without significant mediation, indicating that sustainability programs contribute positively to school culture yet often remain administratively disconnected from formal quality cycles [45], [46].

These patterns can be understood through three complementary theoretical lenses. Organizational learning theory suggests that TQM functions as a learning infrastructure, enabling schools to convert individual experiences into collective improvement routines. Systems theory explains why inputs produce stronger outcomes when coordinated through integrated quality processes rather than operating in isolation. Institutional theory further positions TQM as a legitimacy mechanism, translating external accountability expectations (SDG 4) into embedded organizational practices [47], [48]. Together, these perspectives confirm that the central contribution of this study lies in explaining how organizational processes facilitate the conversion of educational resources into quality outcomes.

For policy and practice, the findings carry clear implications. Schools in resource-constrained environments can operationalize TQM through relatively low-cost practices regular teacher collaboration, stakeholder feedback systems, school self-evaluation, and data-based monitoring without requiring extensive additional resources. Leadership training should encompass quality assurance competencies; inclusive practices should be tied to measurable operational standards; and sustainability programs should be embedded in institutional review cycles. The core message is that educational quality is determined not only by what schools implement, but by how effectively they manage and sustain those implementations through structured organizational processes [3], [4].

4.1. Implications for the IPO framework

The findings provide strong support for the IPO model. Leadership, knowledge management, inclusion, and conservation education function as inputs, but their effectiveness depends on the process variable represented by TQM. This confirms that outcomes cannot be inferred directly from inputs. Schools with similar resources or policies may perform differently because their internal processes differ in quality and consistency. This has broader implications for educational research. Many studies overestimate the importance of inputs while under examining the organizational processes that transform them. By demonstrating the centrality of TQM, the present study helps rebalance the literature toward process-based explanations of school performance. Importantly, the findings suggest that schools in resource-constrained environments can operationalize TQM through relatively low-cost organizational practices, including regular teacher collaboration, stakeholder feedback systems, school self-evaluation, and data-based monitoring of learning outcomes. By embedding these activities into routine planning and evaluation processes, schools may strengthen organizational learning and coordination without requiring extensive additional resources, thereby enhancing the practical feasibility of quality improvement initiatives.

4.2. Policy and strategic implications

For policymakers, the results suggest that investments in new programs should be accompanied by investments in implementation systems. Leadership training should include quality assurance, data governance, and process management competencies. Inclusion policies should be tied to measurable operational standards. Sustainability programs should be embedded in institutional review cycles. For schools in resource-constrained environments, strengthening internal processes may be more feasible and cost-effective than expanding fragmented initiatives. TQM does not necessarily require large financial inputs; it requires disciplined routines, feedback systems, shared accountability, and organizational learning. This makes it particularly relevant for districts seeking scalable pathways to SDG 4 progress.

The study demonstrates that TQM is not peripheral to educational reform—it is the mechanism through which reform becomes effective. The core contribution of these findings is to show that quality education is produced not only by what schools have, but by how schools are managed. This insight strengthens the theoretical connection between management systems and SDG 4 outcomes, while offering a practical roadmap for sustainable educational improvement.

The findings of this study reinforce and extend a growing body of international research demonstrating that organizational process quality is a decisive determinant of educational outcomes. The strong direct effect of TQM on educational quality is consistent with studies showing that quality management systems improve institutional effectiveness, teacher performance, and student satisfaction. For example, Berkat *et al*. [47] reported that TQM implementation significantly improved vocational school quality through stronger coordination and continuous improvement practices. Similarly, Shehada and Supriyanto [49] concluded that TQM supports teaching effectiveness by strengthening evaluation systems and service quality in crisis-affected educational contexts. These studies align with the present findings that TQM functions as a core mechanism for school improvement rather than as a peripheral administrative tool.

The results also correspond with broader management literature outside education. Research by Aichouni *et al*. [50] found that the integration of TQM with dynamic capabilities enhances sustainability performance through organizational learning and adaptive processes. This supports the present study's argument that TQM is best understood as an organizational capability that enables schools to respond systematically to quality challenges. Likewise, Ibrahim *et al*. [51] emphasized that valid performance systems depend on reliable measurement and evaluation structures, which parallels the importance of evidence-based management found in this research.

Regarding leadership, the non-significant direct effect and the significant indirect effect through TQM provide a more nuanced interpretation than many previous leadership studies. Alzouebi *et al*. [41] found that school leadership contributes to innovation when leaders build collaborative cultures and stakeholder engagement systems. Similarly, it showed that principal visionary leadership influences teacher innovation through mediating variables such as workplace well-being and collaboration [42]. These findings

are compatible with the present study, which suggests that leadership becomes effective not automatically, but when translated into institutional processes such as quality planning, monitoring, and organizational learning.

The dual role of knowledge management found in this study is also supported by prior evidence. Previous study demonstrated that knowledge management practices improve organizational sustainability and leadership capability through stronger information systems and learning routines [43]. Further, knowledge-sharing mechanisms strengthen collective problem-solving in learning communities [44]. However, the current study advances this literature by showing that the stronger pathway operates indirectly through TQM, indicating that knowledge becomes most valuable when embedded in formal quality improvement systems.

The mediated effect of inclusive education also resonates with previous research. Oswal *et al.* [52] argued that inclusive education requires coherent institutional frameworks, teacher preparedness, and monitoring systems to be effective. Similarly, Wasila *et al*. [53] identified implementation barriers such as weak coordination and limited organizational readiness. The present findings empirically confirm these arguments by showing that inclusive education does not directly improve educational quality unless supported by TQM processes. This implies that inclusion is not only a pedagogical principle, but also a management challenge.

The direct effect of conservation education, but the lack of mediation through TQM, can be compared with sustainability-focused studies. Husban [45] found that integrating SDGs into learning improves student awareness and pro-environmental behavior. Velempini [46] also reported that environmental education contributes positively to holistic competencies linked to sustainable development. However, unlike those studies, the present research highlights that sustainability programs often remain pedagogically beneficial yet administratively disconnected. This distinction is important because it suggests that long-term impact depends on embedding environmental goals into institutional quality systems.

More broadly, the findings support SDG 4 scholarship emphasizing that quality education depends on governance capacity, not merely access expansion. The study from Berkat *et al*. [47] showed that educational quality in developing countries requires valid institutional systems that support student-centered learning. Further, Tafese and Kopp [48] argued that sustainable education depends on embedding social sustainability into organizational pathways. The present study complements these perspectives by demonstrating that TQM can serve as the operational bridge between policy aspirations and measurable educational outcomes.

4.3. Practical/empirical contributions

This study offers several practical and empirical contributions. First, it provides evidence that schools seeking to improve educational quality should prioritize internal management systems continuous improvement cycles, stakeholder feedback, monitoring, and data-based decision-making rather than relying solely on new programs or leadership rhetoric. Second, for resource-constrained regions, the findings suggest that strengthening organizational processes may be more feasible and cost-effective than expanding fragmented interventions. Third, the study identifies knowledge management and inclusive education as factors that become more effective when integrated into quality systems, thereby guiding policy sequencing and implementation priorities.

Theoretically, this research advances the IPO framework by empirically demonstrating that process variables can exert a stronger influence than input variables. While many educational studies focus on leadership, curriculum, or resources as direct determinants, the study shows that these inputs are contingent upon organizational mechanisms represented by TQM. In doing so, the research repositions TQM from a peripheral management concept to a central mediating construct in educational effectiveness literature.

Methodologically, this study contributes by using PLS-SEM to test a complex multivariate model involving simultaneous direct, indirect, and mediated relationships among six latent constructs. This approach provides a more comprehensive explanation than conventional regression models, which examine variables separately. In addition, by using data from geographically dispersed public junior high schools in a developing regional context, the study adds context-sensitive evidence that is often underrepresented in international educational management research.

Taken together, comparison with previous studies indicates broad consistency regarding the value of leadership, knowledge management, inclusion, and sustainability. However, the distinctive contribution of this study is to show that these factors do not automatically generate quality outcomes. Their impact depends largely on whether schools possess structured quality management systems capable of integrating and sustaining them. Thus, the present findings extend prior research by demonstrating that TQM is the mechanism through which diverse educational reforms become effective, scalable, and aligned with SDG 4 objectives.

5. CONCLUSION

This study demonstrates that educational quality is determined primarily by the effectiveness of organizational processes rather than by the mere presence of leadership, policies, or programs. TQM functions as the critical mechanism that translates fragmented educational initiatives into coherent, sustainable quality outcomes. The proposed IPO-based model, empirically validated across 99 public junior high schools in Banyuasin Regency, Indonesia, repositions TQM from a peripheral management tool to a central organizational capability aligned with SDG 4 objectives. For policymakers, this underscores the priority of investing in quality management infrastructure continuous improvement cycles, data-driven monitoring, and collaborative learning systems alongside program expansion. Future research should employ longitudinal and mixed-method designs to examine TQM implementation dynamics across diverse educational contexts and to investigate additional mediating factors such as digital transformation, teacher commitment, and organizational culture.

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design captures relationships among variables at a single point in time and therefore does not permit definitive causal inference. Although the structural model identifies significant associations and predictive pathways among principal leadership, knowledge management, inclusive education, conservation education, TQM, and educational quality, the findings should not be interpreted as evidence that these factors directly cause changes in educational quality. Longitudinal or experimental designs would be required to establish temporal ordering and causality more rigorously. Second, the study relied on self-reported perceptions from school stakeholders, which may be subject to response bias and social desirability effects despite efforts to minimize CMB. Third, the research was conducted exclusively in public junior high schools within Banyuasin Regency, Indonesia; therefore, the generalizability of the findings to other educational levels, institutional settings, or national contexts may be limited. Finally, while the model incorporated several important organizational factors, other potentially relevant variables such as school culture, teacher motivation, digital readiness, policy support, and socioeconomic conditions were not included and may also be associated with educational quality. Accordingly, the results should be interpreted as evidence of statistically significant relationships within the studied context rather than as conclusive proof of causal effects. Future research employing longitudinal, mixed-method, or experimental approaches is needed to further examine the directionality and stability of these relationships over time.

Future studies are encouraged to: i) use longitudinal designs to assess how TQM influences school quality over time; ii) apply mixed-method approaches to explore how TQM practices are implemented in daily school operations; iii) compare public and private schools, urban and rural schools, or different countries to test contextual differences; iv) examine additional mediators or moderators such as digital transformation, teacher commitment, organizational culture, or policy support; and v) investigate specific TQM dimensions (leadership commitment, customer focus, continuous improvement, and data systems) to identify which components produce the strongest educational gains.

FUNDING INFORMATION

The authors state no funding is involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Mukhlisin	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓
Rusdarti		✓				✓		✓	✓	✓	✓	✓		
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Hadromi	✓		✓	✓			✓			✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of the research are available from the corresponding author, [M], upon reasonable request. Explain the reason why the readers must request the data.

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APPENDIX

The questionnaire instrument was developed by adapting measurement items from established educational leadership, knowledge management, inclusive education, sustainability education, total quality management (TQM), and educational quality literature. All items were measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument was pilot-tested prior to full-scale data collection to ensure clarity, reliability, and contextual relevance.

Title of research

Beyond leadership and policy: how total quality management drives educational quality for SDG

Respondent information

Please place a check mark (✓) in the appropriate column.

1. Gender
   - ☐ Male
   - ☐ Female
2. Position
   - ☐ Principal
   - ☐ Vice Principal
   - ☐ Senior Teacher
3. Highest Educational Qualification
   - ☐ Bachelor's Degree
   - ☐ Master's Degree
   - ☐ Doctoral Degree
4. Length of Service
   - ☐<5 years
   - ☐ 5–10 years
   - ☐ 11–15 years
   - ☐>15 years
5. School Accreditation Status
   - ☐ A
   - ☐ B
   - ☐ C

Instructions for respondents

Please indicate the extent to which you agree with each statement by selecting one answer according to your actual experience in your school.

Scale	Description
1	Strongly disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly agree

Research instrument outline

S/N	Variable	Indicator	Statement	1	2	3	4	5
1	Conservation education	Conservation knowledge	I know the definition of environmental conservation					
			I understand the impact of human behavior on environmental damage					
			I can explain the principles of sustainable development					
		Environmental attitudes	I have a responsibility to protect the environment					
			Every individual has an important role in environmental preservation.					
			I believe that education can change human behavior towards the environment.					
		Integrating conservation values in learning	Teachers link subject matter to environmental issues					
			The school provides learning materials about environmental conservation.					
			The school encourages students to create conservation-themed projects.					
			Learning at school motivates students to love the environment.					

Research instrument outline (*continued*)

S/N	Variable	Indicator	Statement	1	2	3	4	5
2	Inclusive education	Educational accessibility	Schools provide physical facilities that are accessible to all students, including those with disabilities.					
			There are no financial barriers preventing students from vulnerable groups from attending school.					
			Teachers and school staff receive training on the principles of accessibility in education					
		Acceptance of diversity	The school welcomes students from diverse social, economic, cultural, and religious backgrounds.					
			Students are encouraged to respect their peers' differences.					
			Teachers facilitate discussion spaces to recognize and understand diversity.					
		Curriculum adaptation	Teachers adapt strategies and methods, and use a variety of learning media to reach all students					
			The curriculum can be modified to be understandable to all students					
			Students with special needs are not separated from other students in the learning process					
		Leadership policy	The school has a written policy (SOP) that supports inclusive education.					
			The school leadership provides concrete examples in creating an inclusive environment.					
			The school involves all parties in decision-making regarding inclusive education					
		Participation of all stakeholders	Parents are involved in planning their children's education.					
			The school committee includes representation from parents of students with special needs.					
			Teachers, staff, students, and parents work together to create a supportive environment for all					
3	Principal leadership	Leader	The principal has the ability to develop and implement programs to realize the school's vision and mission					
			The principal accepts input, suggestions, and criticism from various parties					
			The principal has the ability to communicate effectively verbally with educators and education staff, students, parents/guardians, the school committee, and external parties					
		Educator	The principal involves teachers in various competency improvement training programs					
			The principal provides encouragement to use time effectively and efficiently in learning and competency development.					
			The principal provides opportunities for teachers to continue their education to a higher level.					
		Manager	The principal encourages and provides opportunities for students to develop their potential optimally.					
			The principal creates a school culture and climate that is conducive and innovative for student learning.					
			The principal encourages the involvement of educators and education staff in internal school activities.					
		Administrator	The principal encourages the school team to compile complete data on school administration, learning administration, guidance and counseling, and practical activities.					
			The principal encourages the school team to manage complete data on school administration, learning administration, guidance and counseling, and practical activities.					
		Innovator	The principal seeks new, creative ideas and methods in carrying out his/her duties.					
			The principal integrates all activities to create synergy to achieve school goals effectively and efficiently.					
			The principal acts based on rational, objective, and professional considerations regarding educators.					
			The principal is adaptable and flexible in facing new situations and strives to create a pleasant and easy-to-use work environment for educators.					
4	Knowledge management	Socialization	Sharing experiences about a job					
			Observing new things about a job					
			Having discussions about a job					
		Externalization	Recording important things in a job					
			Creating new terms to make work easier					
		Combination	Able to categorize knowledge according to job characteristics					
			Able to innovate in a job					
			Perform work according to the most appropriate procedures					

Research instrument outline (*continued*)

S/N	Variable	Indicator	Statement	1	2	3	4	5
		Internalization	Always access knowledge about a job					
			Be creative for job continuity					
			Improve personal skills in doing the job					
5	Quality of education	Teacher quality	Teachers have educational backgrounds relevant to the subjects they teach.					
			Teachers demonstrate exemplary behavior and are able to build positive relationships with students.					
			Teachers are involved in learning communities or professional teacher organizations.					
		Graduate quality	Students have literacy skills (reading and writing) according to the standards for their level of education.					
			Students demonstrate academic improvement over time.					
			Students can communicate ideas orally and in writing and think critically					
		Learning environment	The school has safe and clean classrooms and learning facilities.					
			The school environment supports students to learn comfortably and without feeling intimidated.					
			Proper sanitation facilities are available at the school.					
		Educational inclusivity	The school accepts students from various social backgrounds					
			The school does not discriminate based on gender, ethnicity, religion, or physical condition of students.					
			Learning activities are designed to accommodate all types of student differences.					
		Curriculum relevance	The school curriculum teaches 21st-century skills such as teamwork, communication, and problem-solving.					
			The curriculum integrates character education and human values.					
			Learning includes global issues such as climate change, peace, and sustainability.					
		Lifelong learners	The school encourages students to continue lifelong learning					
			Students have access to online learning and self-study resources.					
			The school encourages students to plan their future based on their interests and potential.					
6	Total quality management	Continuous Improvement	The school community, in accordance with their respective job responsibilities, continuously improves themselves to realize the school's vision, mission, and goals					
			The school community proactively records complaints within the school and follows up on them by making improvements.					
			The school community follows up on complaints by making immediate improvements.					
		Quality culture	The school community strives and consistently provides its capabilities to maintain the quality of educational services.					
			There are communication media that can be used by the entire school community, at least a bulletin board.					
			The school community is involved (collaborates) when the school faces a problem.					
		Teamwork	Cooperation among the school community is a crucial factor in achieving the school's vision, mission, and goals.					
			Each member of the school community provides psychological and physical encouragement.					
			The principal manages every school activity to achieve balanced cooperation among the school community.					
		Customer satisfaction	Students expressed their appreciation for the atmosphere, environment, and services provided by the school.					
			Parents/guardians expressed their appreciation for the atmosphere, environment, and services provided by the school.					
			Policymakers/partners expressed their appreciation for the atmosphere, environment, and services provided by the school.					

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