

# Exploring Professional Learning Community Effectiveness Through Thematic Analysis, Fuzzy Delphi Method, and Interpretive Structural Modeling in Malaysian Primary School Context

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## ABSTRACT

Professional Learning Communities (PLCs) are widely recognized as critical vehicles for enhancing teacher professional development and school improvement. However, their implementation often remains superficial, failing to leverage the full potential of collaborative practices. This study addresses this gap by systematically modeling the complex interdependencies that sustain effective PLCs in Malaysian primary schools. Using a qualitatively driven mixed-methods design, the research unfolds in three phases: (1) thematic analysis of open-ended survey responses from 78 teachers to identify key factors influencing PLC effectiveness, (2) refinement and prioritization of these factors through a Fuzzy Delphi Method (FDM) with six educational experts to establish consensus, and (3) stakeholder engagement via Interpretive Structural Modeling (ISM) involving teachers, school leaders, and external experts to map the hierarchical relationships among the validated factors. The findings reveal 11 critical elements categorized into Drivers, Linkages, and Dependents, with Leadership Support and Collaborative Culture emerging as foundational enablers. Notably, stakeholder comparisons expose variations in conceptual hierarchies, underscoring the need for role-sensitive frameworks. This study advances current literature by integrating complexity and systems theory to illustrate how structural, cultural, and relational dynamics interact to drive sustainable PLC practices. This study highlights actionable pathways for leaders, policymakers, and educators to foster adaptive, context-sensitive professional learning environments. Future research should extend this multi-stakeholder modeling approach across diverse educational settings and explore longitudinal impacts on student outcomes. In conclusion, this triangulated approach provides a robust blueprint for aligning policy, leadership, and collaborative culture to achieve transformative and enduring educational reform.

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Professional Learning Communities (PLCs) play a crucial role in enhancing educational reform and teacher development by fostering collaborative environments that improve instructional practices and student outcomes. In Malaysia, PLCs have been formally recognized and promoted through the Malaysia Education Blueprint 2013–2025, particularly under Shift 4: Transforming Teaching into the Profession of Choice, which emphasizes peer-led professional learning and collaborative culture among educators. Additionally, the New Narrative of Educational Practice, introduced by the Ministry of Education in 2019, reaffirmed PLCs as a strategic approach to strengthen teacher capacity and instructional quality. Research has shown that effective PLCs foster continuous professional growth, engagement, and shared responsibility among educators. For example, collaborative support within PLCs has been linked to increased teacher leadership capabilities and greater work engagement, which are essential for addressing challenges in educational settings (Abendaño, 2024; Andini & Andriani, 2024). Furthermore, the promotion of collegial trust and shared practices enhances organizational performance, making PLCs integral to institutional success in educational frameworks (González, 2023).

Despite policy support, PLC implementation in Malaysian primary schools is often constrained by structural limitations and inconsistent stakeholder engagement. Teachers frequently struggle to align PLC practices with institutional goals, indicating a need for clearer definitions and guidelines to ensure that PLCs effectively contribute to educational improvement and teacher professional development (Napitupulu & Wibawanta, 2022; Townley, 2020). Participation in PLCs helps address emotional and instructional challenges faced during reform implementation, providing a crucial support structure for educators (Datnow, 2018). This signals a critical knowledge gap: How do educators conceptualize and experience PLCs within complex, multi-layered school systems? To address this, this study adopts a complexity and systems thinking lens, viewing educational institutions as dynamic networks of interdependent actors, which are teachers, leaders, students, and external stakeholders, whose interactions shape professional learning outcomes. In this study, key constructs such as PLC effectiveness are defined as the degree to which collaborative practices lead to sustained instructional improvement and teacher growth. Collaborative culture refers to the shared norms of trust, openness, and mutual accountability that underpin meaningful professional engagement.

This study aims to model the effectiveness of PLCs in Malaysian primary schools through a three-phase mixed-methods approach: (1) thematic analysis of teacher narratives to identify critical factors, (2) expert validation using the Fuzzy Delphi Method, and (3) stakeholder mapping via Interpretive Structural Modeling. It seeks to capture teacher perceptions regarding PLC effectiveness using thematic analysis, identifying key factors that define successful PLCs. These factors will be validated and prioritized using the Fuzzy Delphi Method, allowing for consensus among experts (Dastgahian & Scull, 2021). This combination of qualitative insights and expert opinions will provide a comprehensive view of the dynamics within PLCs. Furthermore, Interpretive Structural Modeling (ISM) diagrams will be developed to visually represent the interrelationships among the identified PLC factors across different stakeholder groups, including teachers, school leaders, and external experts. This modeling technique will clarify the hierarchical structures that govern effective PLC practices, yielding strategic insights into how various components interact to enhance the overall efficacy of PLCs. This study aims to contribute to a nuanced understanding of PLC dynamics that can inform policy and practice in educational settings (Andini & Andriani, 2024). In conclusion, leveraging PLCs as a drive for educational reform necessitates addressing the conceptual and implementation challenges that currently limit their potential. By integrating qualitative insights with systems modeling, this study contributes a nuanced, stakeholder-informed framework for understanding and enhancing PLCs in Malaysian educational settings.

## **2. Literature Review**

### ***2.1. Professional Learning Community (PLC)***

The foundational models of Professional Learning Communities (PLCs) articulated by Hord (2009) and DuFour and Eaker (1998) have profoundly shaped collaborative practices in schools. Yet, they have also attracted critiques regarding their overly linear conceptualizations. DuFour's (2009) widely adopted framework emphasizes recurring cycles of collective inquiry and action, grounded in four critical questions that guide teams to clarify learning

objectives, assess student understanding, provide timely interventions, and extend learning for all students. Similarly, Hord's (2009) model highlights key dimensions such as shared vision, supportive leadership, collective learning, and shared practice, providing a structural lens for schools to operationalize collaboration (Hudson, 2023). However, researchers caution that these frameworks risk becoming mechanistic checklists if implemented superficially, overlooking the dynamic, relational, and context-specific nature of authentic professional learning (Hudson, 2023). Recent critiques indicate that the linearity embedded in classic PLC models can limit their effectiveness in accommodating the iterative and adaptive processes required for deep, sustained teacher learning and transformative practice. For instance, it has been proposed that moving beyond rigid cycles towards more fluid, equity-focused, and responsive forms of collaborative inquiry may better serve the diverse needs of educators and students (Ampanon, 2024). The nature of contemporary educational environments demands a deeper understanding of PLCs, incorporating flexibility and responsiveness to adapt to evolving challenges in teaching and learning (Pan & Chen, 2023).

Moreover, alternative frameworks and approaches to PLCs emphasize collaborative culture and data-informed decision-making as integral to achieving successful outcomes. Past literature shows that incorporating networked learning communities can enhance teachers' receptivity to change by promoting learner-centered practices through structured peer interactions (Chauraya & Barmby, 2022). Additionally, the Learning Community under Leadership for Learning programs highlights how teachers benefit from lesson study practices for sustained professional development, further enriching the PLC environment (Andini & Andriani, 2024). The significance of triangulating teacher, leader, and expert perspectives within PLCs is crucial. A well-rounded approach that integrates these various stakeholder views fosters more in-depth discussions and insights into professional development practices (Zabidi et al., 2023). Findings suggest that the integration of collaborative culture, data-informed decision-making, and participatory professionalism are vital components that shape how PLCs operate effectively in different educational contexts. Recent studies support the notion that a supportive environment, characterized by trust and collective responsibility, is essential for the successful implementation of PLCs. This collaborative culture promotes a shared commitment to improving practice and outcomes for students (Mingsiritham et al., 2020). Moving forward, schools should remain aware of the complexities inherent in professional learning and adapt PLC frameworks accordingly to maximize their impact on teacher development and student achievement. Therefore, establishing effective Professional Learning Communities requires more than merely adopting foundational models. It necessitates understanding the complexities of teacher collaboration and development, alongside a commitment to fostering an adaptive culture that supports continuous growth, responsiveness, and equity in educational practices.

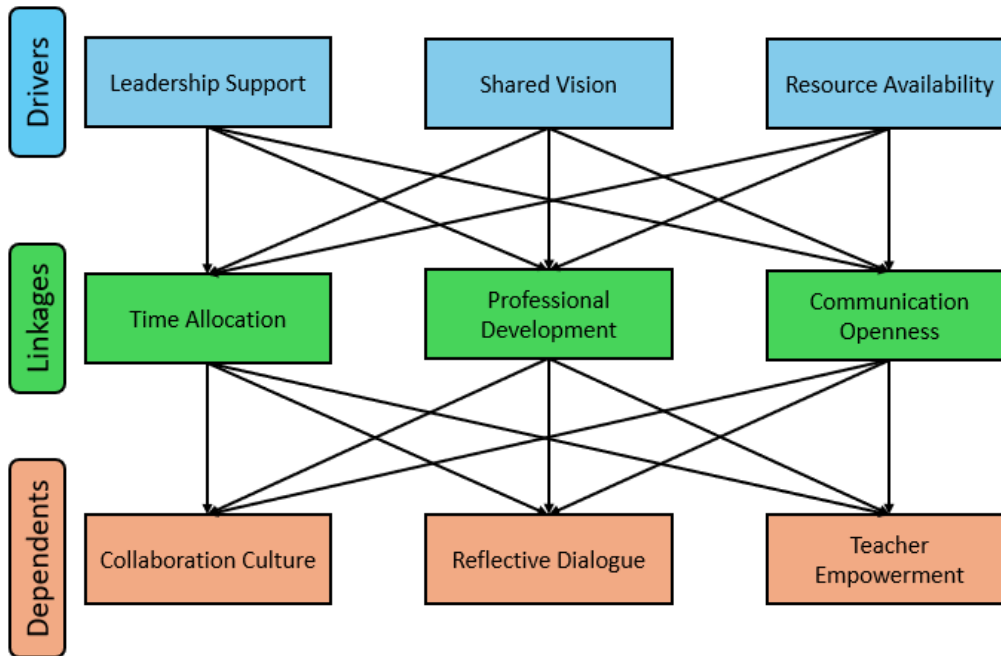
## ***2.2. Critical Synthesis and Conceptual Framework***

Previous international and Malaysian studies have consistently highlighted the potential of Professional Learning Communities (PLCs) to enhance teacher collaboration, instructional quality, and school improvement. Foundational models (DuFour & Eaker, 1998; Hord, 2009) emphasize shared vision, collective inquiry, and supportive leadership. However, critics point to their overly linear nature, which fails to capture the adaptive and relational dynamics of real-world educational settings (Hudson, 2023; Ampanon, 2024). In Malaysia, despite policy support through the Malaysia Education Blueprint (2013–2025), PLCs are often implemented superficially, with limited structural support and inconsistent stakeholder engagement (Zabidi et al., 2023). Teachers report that PLCs frequently devolve into compliance-driven routines rather than transformative practices. This persistent gap underscores the need to explore the interdependencies among structural, cultural, and relational factors that sustain effective PLCs. Complexity and systems thinking offer a valuable lens to understand these dynamics, viewing schools as multi-layered networks of interacting stakeholders.

By employing a mixed-methods approach, which combines thematic analysis, Fuzzy Delphi Method, and Interpretive Structural Modeling, this study models how foundational supports (leadership, shared vision), capacity-building mechanisms (professional development, time allocation), and cultural anchors (collaborative culture, reflective dialogue) interact to shape PLC effectiveness in Malaysian primary schools. Figure 1 shows the conceptual framework of PLC effectiveness in Malaysian primary schools. This framework illustrates the interdependencies among structural supports (Drivers), capacity-building mechanisms (Linkages), and cultural anchors (Dependents) using a system thinking lens.

**Figure 1**

*Conceptual Framework of PLC Effectiveness In Malaysian Primary Schools.*



## **2.2. Complexity and Systems Theory**

Complexity and Systems Theory (Senge, 1990) provides a lens through which to view educational systems as dynamic and interrelated networks comprising various components such as teachers, students, administrative structures, and curriculum practices. This theoretical framework acknowledges that educational reform is not a linear process; rather, it involves a complex interplay of factors that influence one another in real time (Sailer et al., 2023; Ogden et al., 2023). Key elements like teacher collaboration, leadership styles, student engagement, and curriculum design are intrinsically linked, illustrating how changes in one area can reverberate throughout the educational system.

Recent empirical studies support the application of this theory to educational settings, emphasizing its relevance in fostering adaptive and resilient educational practices. For example, Sailer et al. (2023) illustrate how patterns of interdependence and coordination within educational teams can enhance flexibility and responsiveness to changing circumstances, highlighting the importance of understanding relational dynamics in fostering effective collaboration. Such insights highlight the necessity for educational leaders to consider the holistic nature of their environments when implementing changes. In the context of Professional Learning Communities (PLCs), understanding the nuances of complexity is crucial for tailoring interventions that foster collaboration among educators and improve student outcomes. For example, the interdependence of educators' professional development and student performance can be seen as a non-linear relationship where the development of one directly influences the other (Ogden et al., 2023). By adopting a complexity-oriented approach, educational leaders can recognize the emergent phenomena arising from interactions among individuals within a PLC, enabling them to implement strategies that enhance collective efficacy.

Moreover, Ogden et al. (2023) provide evidence that recognizing the relational nature of educational experiences allows for a deeper understanding of how educators construct meaning in their collaborative efforts. Their analysis stresses the importance of context, suggesting that successful educational reform designs must account for the existing social and cultural dynamics within school environments. As educational systems encounter complex challenges, the adoption of a systems perspective also encourages a shift in focus from individual behaviors to

collective practices. Research on coordinated interdependence emphasizes how patterns of action contribute to team effectiveness, as mentioned by Sailer et al. (2023). In this light, fostering a collaborative culture within PLCs becomes essential for navigating the complexities inherent in educational settings. Stakeholders, including educators, administrators, and policymakers, must recognize their interconnected roles in driving reform initiatives to optimize their collective impacts on student learning outcomes. Therefore, employing Complexity and Systems Theory in this study offers valuable insights into the intricate interplay of components within educational systems. By recognizing the dynamic interdependencies that shape these environments, stakeholders can develop adaptive approaches to reform that enhance teaching and learning experiences for educators.

### **2.3. Related Studies**

Past studies show that the integration of collaborative culture, data-informed decision-making, and participatory professionalism is increasingly essential in contemporary educational settings. These interconnected elements foster an environment conducive to improved teaching practices, enhanced student learning, and overall school effectiveness. A comprehensive examination of recent literature reveals the significance of each component and its interdependence in promoting a successful educational change.

#### **2.3.1. Collaborative Culture**

A collaborative culture is founded on shared values of trust, respect, and collective responsibility among educators. It creates an environment where teachers, school leaders, and stakeholders collaborate to achieve common goals. Jarrett et al. (2021) stated that participating in professional conversations enhances interpersonal relationships among educators and leads to innovative teaching practices that respond to the complexities of modern educational demands. Additionally, Hord emphasizes that collaborative cultures deploy professional learning communities (PLCs) as a strategy to engender continuous improvement in teaching methodologies and student outcomes through shared inquiry and mutual support; however, this was not supported by a specific reference in the provided citations. Research highlights the impact of collaborative cultures on data-informed decision-making. Jarrett et al. (2021) further assert that professional conversations within educational communities generate actionable insights drawn from the collective experiences of educators and administrators. Such discussions create a conduct for knowledge sharing, enabling participants to reflect iteratively on instructional practices and collaboratively address challenges faced in teaching and learning.

#### **2.3.2. Data-Informed Decision-Making**

Data-informed decision-making involves utilizing empirical evidence to guide instructional practices and policy decisions in educational institutions. According to Ogden et al. (2023), effective data utilization is underscored by the ability to interpret information within the context of the educational environment, allowing educators to tailor interventions based on the specific needs of their students. Lim et al. (2019) indicate that the successful integration of data-informed practices requires frameworks that support professional development and continuous learning, enabling educators to navigate complex systems and make informed choices that enhance the quality of education. Furthermore, data-informed practices intersect with collaborative cultures by promoting shared responsibility for student outcomes. By examining performance data collectively, educators can identify trends and areas needing attention, fostering a team-oriented approach to instructional improvement (McKendree & McKim, 2021). This interplay equips educators to create targeted interventions that cater to their students' diverse needs, ultimately leading to better academic success.

#### **2.3.3. Participatory Professionalism**

Participatory professionalism emphasizes the active engagement of educators in their professional development and decision-making processes. McKendree and McKim (2021) illustrate how participatory professional development fosters a sense of ownership among educators, allowing them to contribute as collaborators and experts in their fields. This engagement not only enhances their capabilities but also empowers them to influence their instructional strategies actively. Participatory professionalism enhances collaborative cultures by breaking down hierarchical

barriers and promoting equality among educators. Levitan and Johnson (2020) emphasize that collaborative curriculum development with marginalized communities illustrates the power of participatory practices to ground educational decisions in the lived experiences and realities of learners. This approach helps ensure that curricula not only respond to academic standards but also resonate with students’ cultural contexts. Moreover, the shift toward participatory models reflects an understanding that education is not a one-size-fits-all process. According to Sousa et al. (2019), integrating children's rights and empowerment into pedagogical practices embodies a commitment to a participatory approach, thereby enriching educators' practice and supporting the overall learning environment.

### 3. Method

This study employed a qualitatively driven mixed-methods design, structured in three sequential phases to comprehensively explore, validate, and structurally model stakeholder perspectives. The structuring of phases facilitates a comprehensive understanding of collaborative dynamics, supporting the design of effective educational interventions. Table 1 explains the three-phase research design of this study.

**Table 1**

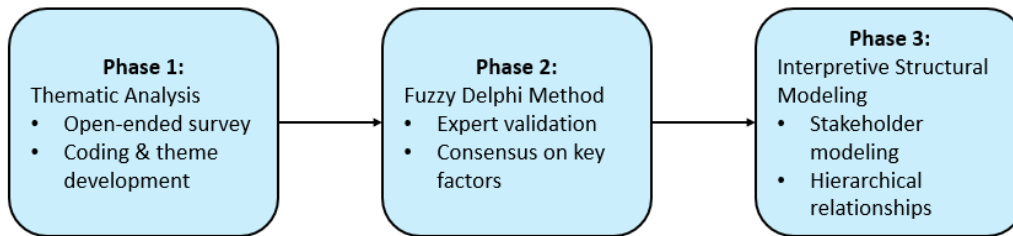
*Three-phase research design of this study*

Phase	Key Activities	Key Outputs
Phase 1 Thematic Analysis	<ul style="list-style-type: none"> <li>Collected open-ended survey responses from 78 teachers</li> <li>Systematic coding and iterative theme development using Braun &amp; Clarke (2002)</li> <li>Grouped similar codes into overarching themes</li> </ul>	<ul style="list-style-type: none"> <li>Identified initial factors</li> <li>Descriptive framework of teacher perspectives</li> <li>Basis for FDM</li> </ul>
Phase 2 Fuzzy Delphi Method (FDM)	<ul style="list-style-type: none"> <li>6 experts are engaged</li> <li>Administered structured FDM with triangular fuzzy numbers</li> <li>Achieved consensus (<math>d \leq 0.2</math>; <math>\geq 75\%</math> agreement)</li> </ul>	<ul style="list-style-type: none"> <li>Refined and prioritized key factors (11 of 18 key factors)</li> <li>Final validated set of key factors for ISM</li> </ul>
Phase 3 Interpretive Structural Modeling (ISM)	<ul style="list-style-type: none"> <li>Involved new stakeholder groups: school leaders and external experts</li> <li>Conducted pairwise comparisons, reachability matrix, and level partitioning</li> <li>Developed comparative ISM diagrams</li> </ul>	<ul style="list-style-type: none"> <li>Mapped hierarchical interdependence</li> <li>Visualized Drivers, Linkages, Dependents</li> <li>Revealed stakeholder alignment and divergence</li> </ul>

Figure 2 illustrates the sequential integration of Thematic Analysis (Phase 1), Fuzzy Delphi Method (Phase 2), and Interpretive Structural Modeling (Phase 3), highlighting the progression from qualitative data collection to expert validation and stakeholder modeling.

**Figure 2**

*Flow of the Three-Phase Mixed-Methods Design*



### **3.1. Phase 1: Thematic Analysis from Open-Ended Survey Responses**

In Phase 1, open-ended survey responses were collected from 78 teachers working at three Malaysian primary schools, which are School A (urban, 731 students, 48 teachers), School B (semi-urban, 156 students, 18 teachers), and School C (rural, 78 students, 12 teachers). The teacher cohort included a mix of novice and experienced educators, with teaching experience ranging from 2 to 25 years. An open-ended survey was developed based on key PLC dimensions such as leadership support, collaborative culture, and professional development. Sample questions included: “Describe how leadership influences your participation in PLCs” and “What factors enable or hinder collaboration among teachers in your school?” These questions were reviewed by two education researchers to ensure alignment with the study’s objectives.

The data was analyzed using thematic analysis, which involves systematic coding and iterative theme development. This qualitative approach allows for nuanced insights into teachers’ experiences and perceptions, emphasizing the need for capturing rich, descriptive accounts of their views on PLC effectiveness (Valentino et al., 2021). The use of thematic analysis aligns with best practices in qualitative research as outlined by Braun and Clarke (2002), where themes are derived through an iterative process, ensuring that the analysis remains grounded in the data (Valentino et al., 2021). The process commenced with an initial coding phase, where phrases and statements from the surveys were examined and categorized into preliminary codes. Subsequent iterations involved grouping similar codes into broader themes, resulting in a descriptive framework that reflects the collective perspectives of the teacher cohort. This phase is crucial as it lays the groundwork for the subsequent stages of the study by identifying key areas of focus addressed in later analyses.

### **3.2. Phase 2: Refinement and Prioritization through the Fuzzy Delphi Method**

In Phase 2, six experts engaged in the Fuzzy Delphi Method (FDM) to refine and prioritize the identified themes. A structured questionnaire that utilized triangular fuzzy numbers was administered to these educators to reach consensus on the relevance and importance of each theme (Zulkifli et al., 2022). The six experts were selected based on their extensive experience in educational leadership, PLC implementation, and academic research. Although FDM studies often recommend 10 or more experts, the sample size of six was justified due to the high level of expertise and availability constraints (Okoli & Pawlowski, 2004; Aguboshim, 2021). Triangular fuzzy numbers were derived by asking experts to rate each item on a 5-point scale. The minimum, most likely, and maximum values were used to construct fuzzy numbers. The consensus was defined using a threshold distance ( $d \leq 0.2$ ) and at least 75% agreement, consistent with established FDM protocols. Only one round was required to reach consensus. Calculations were performed using Microsoft Excel with embedded formulas for fuzzy mean and threshold distance.

The FDM facilitates nuanced agreement measurement by allowing participants to express their evaluations on a scale that accommodates uncertainty and vagueness, which is representative of real-world educational contexts (Muthmainnah et al., 2023). The consensus was determined based on a threshold distance ( $d \leq 0.2$ ) and required at least 75% agreement among participants. This methodological rigor ensures robustness and validity in the final prioritization of the themes, making the findings more reliable for subsequent application in interventions. As noted by Gengatharan et al. (Gengatharan et al., 2023), employing the FDM allows for the systematic aggregation of expert

opinions, thereby providing clearer insights into the perceived collective importance of various factors influencing PLC effectiveness.

### **3.3. Phase 3: Stakeholder Engagement through Interpretive Structural Modeling**

For Phase 3, new participant groups comprising school leaders and external experts were introduced to the deliberative process. The ISM phase involved 21 participants: 10 teachers, 5 school leaders, and 6 external experts. The ISM process followed standard steps: (1) constructing the Structural Self-Interaction Matrix (SSIM), (2) forming the reachability matrix, (3) partitioning levels, and (4) classifying factors into Drivers, Linkages, and Dependents. Disagreements during ISM workshops were resolved through facilitated discussions and majority consensus. The ISM process followed a structured sequence of steps:

- a) Constructing the Structural Self-Interaction Matrix (SSIM): Participants were asked to assess the contextual relationships between each pair of factors using four symbols (V, A, X, O) to indicate directionality and influence. This matrix captured expert judgments on whether one factor influences another.
- b) Forming the Reachability Matrix: The SSIM was converted into a binary matrix by applying standard ISM rules. Transitivity was checked and enforced to ensure logical consistency. This matrix revealed which factors were reachable from others and which served as foundational influences.
- c) Partitioning Levels: The reachability matrix was used to derive reachability and antecedent sets for each factor. By comparing these sets, levels were assigned to each factor, indicating their position in the hierarchy. Factors at the top levels were outcomes (dependents), while those at the bottom were foundational (drivers).
- d) Classification of Factors: Based on their driving and dependence power, factors were categorized into:
  - Drivers: High driving power, low dependence (for example, Leadership Support, Shared Vision).
  - Linkages: Moderate driving and dependence power (for example, Professional Development, Time Allocation).
  - Dependents: Low driving power, high dependence (for example, Collaborative Culture, Reflective Dialogue).

Each stakeholder group contributed to the interpretation of factor relationships, ensuring triangulated insights. These stakeholders participated in the Interpretive Structural Modeling (ISM) phase, which included pairwise comparisons, reachability matrix development, level partitioning, and generation of comparative ISM diagrams. This method serves to elucidate hierarchical interdependencies across stakeholder groups, offering a visual representation of the complex relationships among factors influencing PLC effectiveness (Asfaw et al., 2023). Disagreements during pairwise comparisons were addressed through facilitated discussions. Participants were encouraged to justify their reasoning, and consensus was reached through majority agreement. This approach ensured that the final ISM models reflected collective stakeholder understanding while preserving contextual nuances. The resulting ISM diagrams provided a comprehensive understanding of how different stakeholder perspectives align or diverge in terms of their perceived importance, contributing to richer insights into the collaborative dynamics within PLCs.

### **3.4. Ethical Considerations**

This study adhered to rigorous ethical standards throughout all phases of data collection and analysis. Informed consent was obtained from all participants, ensuring they were aware of their rights and the study's objectives. Anonymity and confidentiality were strictly maintained; data were anonymized during analysis and securely stored according to institutional data protection protocols. These measures ensured the integrity of the research process and fostered a trustworthy environment for participants, in line with ethical guidelines for educational research (Razali et al., 2023). To ensure reliability, thematic coding was conducted independently by two researchers. Inter-coder agreement was calculated at 87%, indicating a high level of consistency in theme identification.

Discrepancies were resolved through collaborative discussion and consensus. Bias was managed by triangulating data sources (teacher responses, expert input, and stakeholder modeling), anonymizing participant identities, and maintaining reflexive memos throughout the analysis process.

## 4. Results

This section presents the results of the study’s three-phase methodology, which integrated qualitative insights, expert consensus, and structural modeling to explore stakeholder perspectives on PLC effectiveness. Each phase contributed distinct layers of understanding, culminating in a triangulated model of collaborative dynamics within three Malaysian primary schools.

### 4.1. Phase 1: Thematic Analysis of Teacher Narratives

Thematic analysis of open-ended responses from 78 teachers from three primary schools revealed three overarching themes that reflect the lived realities of PLC implementation. These themes formed the basis for identifying 18 key factors for further validation in Phase 2 (see Table 2).

**Table 2**

*Thematic analysis of teachers’ responses*

Theme	Key Factors	Example Codes	Frequency (n)	Percentage (%)
Theme 1: Systemic Support Needs	Leadership Support	Principal backing, senior team	52	67%
	Shared Vision and Goals	School vision, goal clarity	50	64%
	Time Allocation	Protected time, PLC schedule	45	58%
	Resource Availability	Materials, funding access	40	51%
	Stakeholder Engagement	Parents, board involvement	35	45%
	Flexible Structures and Policies	Adaptable guidelines	33	42%
	Community Partnerships	NGOs, external experts	29	37%
Theme 2: Capacity- Building Mechanisms	Professional Development Opportunities	Workshops, CPD sessions	53	68%
	Peer Coaching and Mentoring	Peer observation, feedback	43	55%
	Monitoring and Evaluation Mechanisms	Review cycles, assessments	37	47%
	Distributed Leadership	Shared roles, committees	41	53%
	Innovation Encouragement	New ideas, creativity	32	41%
	Recognition and Incentives	Awards, motivation schemes	30	38%
Theme 3: Cultural Anchors	Collaborative Culture	Teamwork, shared practice	55	70%
	Reflective Dialogue	Open talk, feedback loops	48	62%
	Teacher Empowerment	Autonomy, decision-making	42	54%
	Data-Informed Decision-Making	Using data to guide action	38	49%
	Communication Openness	Transparency, info sharing	47	60%

The thematic analysis of teachers’ responses reveals three overarching themes essential for fostering effective school improvement practices: (1) systemic support needs, (2) capacity-building mechanisms, and (3) cultural anchors. Under systemic support needs, leadership support emerged as a prominent factor, with 67% of respondents citing principal backing and involvement of the senior leadership team as crucial. Closely aligned with this were shared vision and goals (64%) and time allocation (58%), reflecting the importance of strategic alignment and dedicated time for professional learning communities (PLCs). Resource availability (51%), stakeholder engagement (45%), and flexible structures and policies (42%) also featured significantly, highlighting the multifaceted nature of institutional

support. Community partnerships, although less frequently mentioned (37%), underscore the value of engaging NGOs and external experts.

Moreover, capacity-building mechanisms (Theme 2) constituted another critical theme, with professional development opportunities leading to 68%, particularly through workshops and CPD sessions. Peer coaching and mentoring (55%) and distributed leadership (53%) further emphasized the collaborative and decentralized approaches to professional growth. Monitoring and evaluation mechanisms (47%), innovation encouragement (41%), and recognition and incentives (38%) were also noted, suggesting that a robust developmental ecosystem must include feedback systems, creativity stimulation, and motivational strategies. The third theme, cultural anchors, underscored the relational and value-based foundations of school improvement. Collaborative culture was the most frequently cited factor (70%), with teamwork and shared practices seen as essential. Reflective dialogue (62%) and communication openness (60%) were also prominent, reflecting the importance of transparent, dialogic engagement. Teacher empowerment (54%) and data-informed decision-making (49%) pointed to the need for autonomy and evidence-based action among educators. Collectively, these findings illustrate that systemic, developmental, and cultural enablers must operate in tandem to nurture sustainable and effective educational practices.

#### 4.2. Phase 2: Validation and Prioritization via Fuzzy Delphi Method

In Phase 2, six educational experts participated in the Fuzzy Delphi Method (FDM) to refine and prioritize the 18 key factors derived from thematic analysis. Using triangular fuzzy numbers, participants rated each factor’s relevance and importance. Table 3 shows the 11 key elements that remain as below.

**Table 3**

*Results of validation and prioritization*

No.	Element	TFN (m1, m2, m3)	Fuzzy Mean	Threshold Value (d)	Consensus	Decision
1.	Leadership Support	(0.80, 0.90, 1.00)	0.90	0.15	90%	Accepted
2.	Shared Vision	(0.70, 0.80, 0.90)	0.80	0.18	85%	Accepted
3.	Collaborative Culture	(0.80, 0.90, 1.00)	0.90	0.14	92%	Accepted
4.	Reflective Dialogue	(0.70, 0.80, 0.90)	0.80	0.17	87%	Accepted
5.	Teacher Empowerment	(0.70, 0.80, 0.90)	0.80	0.16	85%	Accepted
6.	Professional Development	(0.70, 0.80, 0.90)	0.80	0.18	83%	Accepted
7.	Time Allocation	(0.60, 0.70, 0.80)	0.70	0.19	80%	Accepted
8.	Resource Availability	(0.60, 0.70, 0.80)	0.70	0.20	78%	Accepted
9.	Data-Informed Decision-Making	(0.60, 0.70, 0.80)	0.70	0.18	80%	Accepted
10.	Communication Openness	(0.60, 0.70, 0.80)	0.70	0.19	78%	Accepted
11.	Peer Coaching and Mentoring	(0.60, 0.70, 0.80)	0.70	0.18	78%	Accepted
12.	Community Partnerships	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
13.	Distributed Leadership	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
14.	Innovation	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
15.	Encouragement and Recognition	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
16.	Incentives	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
17.	School-Based Facilitators	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected
18.	Structured Peer Coaching	(0.55, 0.65, 0.75)	0.65	0.25	60%	Rejected

Based on Table 3, the findings indicate that out of the original 18 key factors, 11 factors achieved a strong consensus among the six educational experts. Notably, Leadership Support and Collaborative Culture received the highest fuzzy mean scores (0.90), showing that these factors are perceived as the most critical for ensuring the success of professional learning communities (PLCs). All accepted elements recorded threshold values (d) below 0.20 and consensus percentages above 75%, fulfilling the standard FDM acceptance criteria. The findings confirm that supportive leadership, a shared vision, and a culture of collaboration and open dialogue are foundational for

sustaining meaningful PLC practices. Furthermore, factors like Teacher Empowerment, Professional Development, and Peer Coaching and Mentoring reflect the importance of empowering educators and fostering continuous growth. Seven factors were removed due to fuzzy means below the 0.75 cutoff and high distance values ( $d > 0.2$ ), indicating low consensus among experts. The remaining eleven factors met the criteria for inclusion in the ISM phase, with strong consensus and relevance ratings. These results provide a robust basis for subsequent structural modeling in Phase 3.

### **4.3 Phase 3: Structural Modeling through ISM and Stakeholder Triangulation**

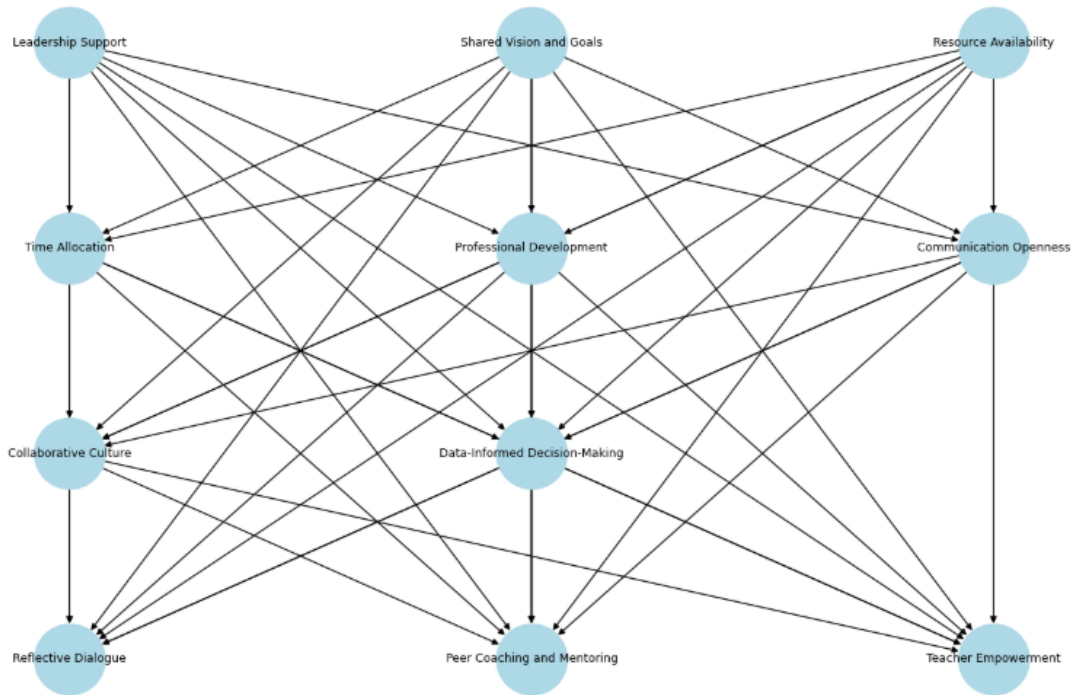
In Phase 3, new stakeholder groups comprising school leaders and external experts participated in the Interpretive Structural Modeling (ISM) process. This phase aimed to map the hierarchical relationships among the validated factors and compare how different groups conceptualize their interdependencies. The study revealed a structured hierarchy of factors influencing the effectiveness of Professional Learning Communities (PLCs), categorized into Drivers, Linkages, and Dependents (Thakkar, 2021). In an ISM model, drivers are the foundational factors with strong driving power but low dependence. They initiate and sustain change within the system. For example, Leadership Support or Shared Vision often emerge as key drivers because they shape all other actions. Linkages are the connecting elements that both influence and are influenced by other factors. They act as bridges within the system, helping transfer the impact of Drivers to Dependents. For example, Professional Development or Peer Coaching may serve as Linkages that operationalize the Drivers' intent (Sreenivasan et al., 2023). Dependents have high dependence but low driving power. They are the outcomes that benefit when Drivers and Linkages are strong, like Collaboration Culture or Reflective Dialogue. These factors reflect the visible success of PLC practices when upstream conditions are supportive. This category reflects the perceived interdependencies and progression of influence among the themes.

#### **4.3.1. Teacher ISM Model**

The findings of this study reveal a structured hierarchy of factors influencing the effectiveness of Professional Learning Communities (PLCs), categorized into drivers, linkages, and dependents based on teachers' perspectives (see Figure 2). In the teacher ISM model, drivers, which consist of Leadership Support, Shared Vision, and Resource Availability, were consistently identified as foundational enablers that initiate and sustain PLC practices. These elements provide the structural and motivational groundwork necessary for collaborative engagement. Linkages, including Time Allocation, Professional Development, and Communication Openness, function as intermediary mechanisms that translate foundational support into actionable collaboration. They facilitate the operationalization of PLCs by enabling consistent interaction, capacity building, and transparent dialogue among educators. The dependents consist of Collaborative Culture, Data-Informed Decision-Making, Reflective Dialogue, Peer Coaching, and Teacher Empowerment, which emerged as outcomes that are contingent upon the presence of both drivers and linkages. Notably, teachers emphasized that Collaborative Culture and Data-Informed Decision-Making do not arise in isolation but are cultivated only when robust structural supports are in place. This layered interdependence highlights the importance of a systemic and well-supported approach to PLC implementation, where foundational leadership and resources must be complemented by strategic linkages to foster meaningful professional collaboration and instructional improvement.

**Figure 2**

*Teacher ISM Model*

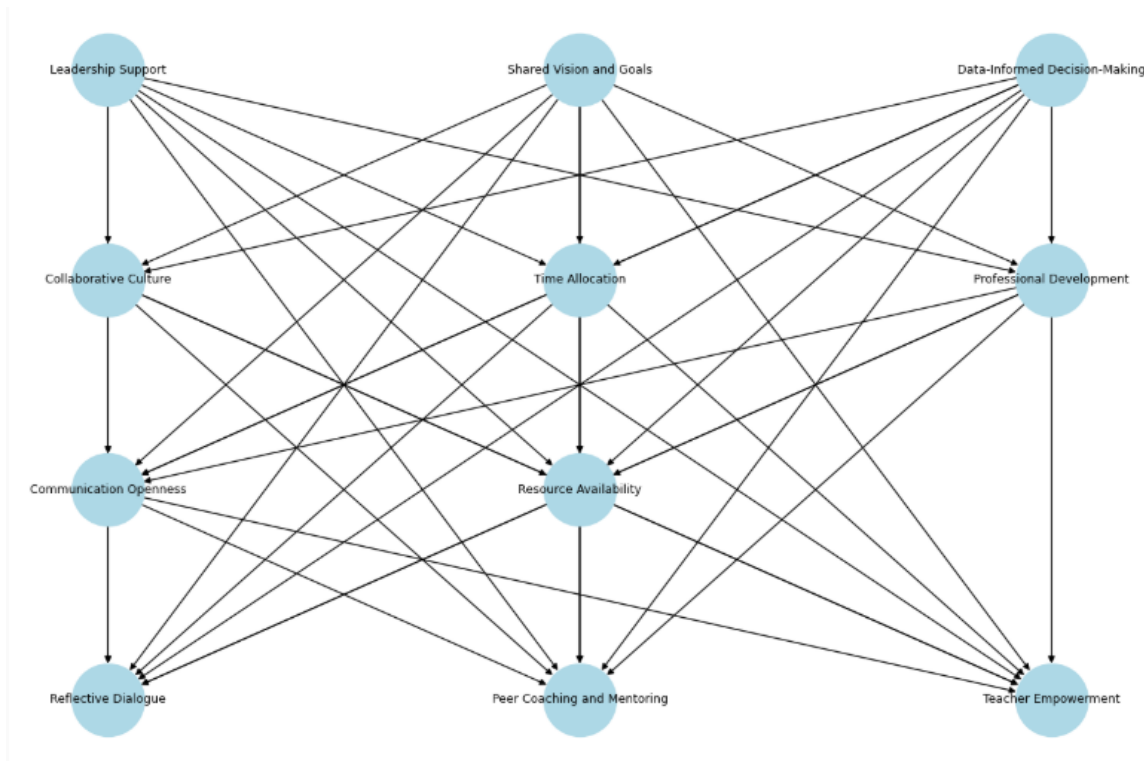


**4.3.2. Leadership ISM Model**

The Interpretive Structural Modeling (ISM) analysis in Figure 3 reveals a clear multi-level hierarchy of influence among the nine core factors that shape effective Professional Learning Communities (PLCs). Leadership Support, Shared Vision and Goals, and Data-Informed Decision-Making were consistently placed at the highest level as Drivers. These factors exert strong driving power and set a strategic direction for implementation. The next level identifies Collaborative Culture, Time Allocation, and Professional Development as critical Linkages. These linkages connect the Drivers to the day-to-day practices, enabling the strategic goals to materialize through supportive structures, scheduled collaboration, and skill development. Reflective Dialogue, Peer Coaching and Mentoring, and Teacher Empowerment emerged as Dependents. These factors reflect the visible, on-the-ground outcomes that flourish only when both Drivers and Linkages are robust. The directional arrows in the model illustrate how influence flows through the system, highlighting the interconnected and cascading nature of PLC successful pathways. This hierarchical pattern aligns with ISM literature, which highlights the importance of clarifying relational dependencies to inform leadership actions (Dahiru & Kayod, 2022; Nasir et al., 2023).

**Figure 3**

*Leadership ISM Model*

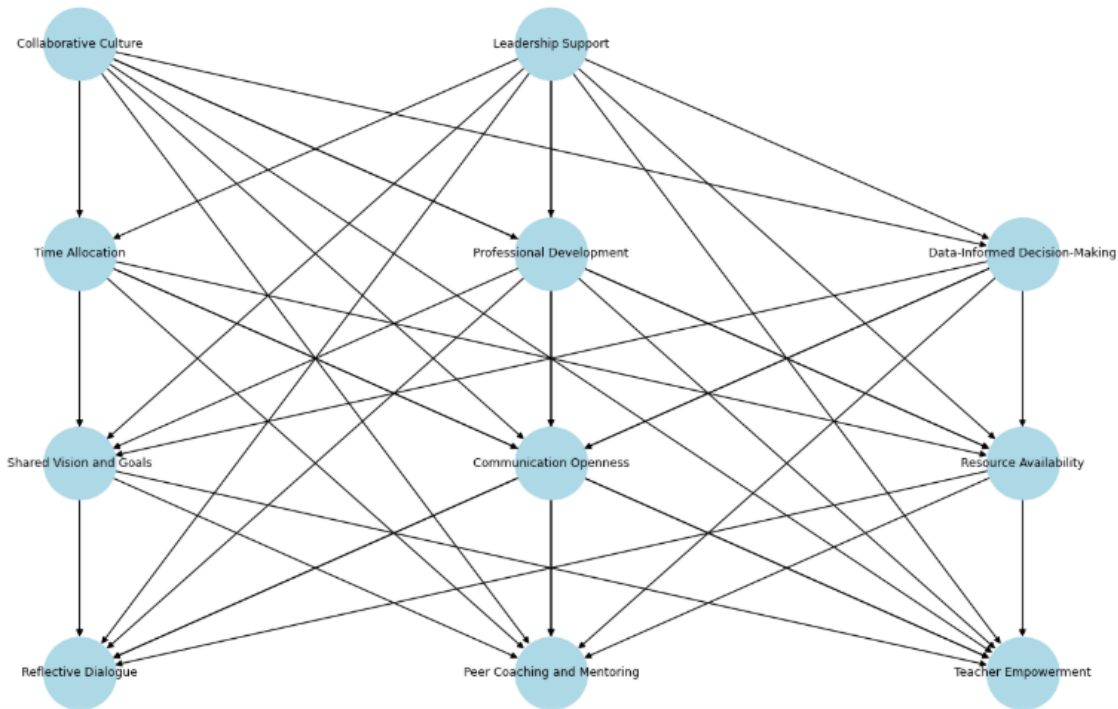


### 4.3.3. Expert ISM Model

In the Expert ISM model (see Figure 4), the structural analysis highlights a shift in emphasis compared to the Leadership ISM: Collaborative Culture is elevated as the most critical Driver, reflecting experts' belief that a culture of trust and shared responsibility must be firmly embedded first to unlock all other PLC dynamics. Leadership Support remains foundational but works in tandem with a collaborative ethos. Data-Informed Decision-Making, Time Allocation, and Professional Development emerge as key Linkages. These elements bridge the strategic Drivers to day-to-day implementation, ensuring that accountability, protected time, and continuous learning create the conditions for meaningful practice (Cordingley & Buckler, 2012). Finally, Reflective Dialogue, Peer Coaching and Mentoring, and Teacher Empowerment remain Dependents, acting as observable outcomes that flourish when Drivers and Linkages are strong. Their presence signals that the PLC has progressed towards maturity and sustainable teacher professional development.

**Figure 4**

*Expert ISM Model*



#### 4.3.4. Comparative Findings of Triangulated ISM Models

The comparative analysis of stakeholder perspectives through triangulated ISM diagrams revealed both convergence and divergence in conceptualizing the dynamics of Professional Learning Communities (PLCs). Across all groups, leaders, experts, and teachers, there was a strong consensus on the foundational importance of Leadership Support and Shared Vision, affirming their role as essential drivers of systemic change. However, notable divergence emerged in the positioning of Collaborative Culture and Data-Informed Decision-Making, reflecting distinct role-based priorities and epistemological orientations. Leaders tended to elevate Data-Informed Decision-Making as a strategic imperative, aligning with accountability-driven frameworks, while experts emphasized Collaborative Culture as a systemic enabler that must be cultivated early to activate deeper learning processes. However, teachers consistently interpret collaborative culture as an emergent, relational outcome contingent upon pre-existing structural support, aligning with perspectives that define collaboration as a product of psychological safety and trust-building over time. These differences show how stakeholder roles shape their interpretations of what drives and sustains effective collaboration. The comparative analysis further illuminated complementary tensions between relational, strategic, and systemic perspectives, suggesting that successful PLC implementation requires a multi-layered approach that integrates diverse stakeholder logics. This insight reinforces the need for adaptive frameworks that are sensitive to context and capable of bridging conceptual gaps between policy, leadership, and practice.

## 5. Discussion

### 5.1 Interpretation of Findings

This study employed a qualitatively driven mixed-methods design to explore and structurally model stakeholder perspectives on Professional Learning Community (PLC) effectiveness. The thematic analysis revealed three core

dimensions, which are (i) systemic support, (ii) capacity-building mechanisms, and (iii) cultural anchors, that reflect teachers' lived experiences. These themes were refined through the Fuzzy Delphi Method (FDM), resulting in 11 validated factors. The Interpretive Structural Modeling (ISM) phase, conducted with school leaders, teachers, and external experts, revealed distinct hierarchies and interdependencies among these factors. The comparative ISM diagrams demonstrated that while all stakeholder groups agreed on the foundational importance of leadership and shared vision, they diverged in their treatment of collaborative culture and data-informed decision-making. Teachers viewed these as outcomes, leaders as strategic levers, and experts as systemic drivers. This divergence highlights the complexity of PLC implementation and the need for role-sensitive frameworks that accommodate varying priorities and needs.

The hierarchical relationships revealed through Interpretive Structural Modeling (ISM) align strongly with systems and complexity theory, which conceptualize educational institutions as dynamic systems composed of interdependent layers. In this study, Leadership Support, Shared Vision, and Collaborative Culture consistently emerged as foundational drivers across stakeholder models. This interdependence makes theoretical sense: leadership sets direction, shared vision aligns efforts, and collaborative culture sustains relational dynamics, together forming a feedback loop that drives systemic change. These findings confirm and extend existing PLC literature, which emphasizes that effective PLCs require more than structural mandates—they depend on relational trust, inclusive participation, and guided learning processes. Prior studies (e.g., Hord, 2009; DuFour & Eaker, 1998) have identified leadership and shared goals as essential, but this study adds nuance by showing how stakeholder roles shape the perceived hierarchy of influence. For instance, experts elevated collaborative culture as a strategic driver, while teachers viewed it as an emergent outcome contingent on structural support. Moreover, the study reinforces that representation of diverse voices, time for trust-building, and intentional facilitation are not optional; they are prerequisites for sustainable PLCs. These insights challenge linear models and support a complexity-informed approach to PLC implementation, where adaptive leadership and contextual sensitivity are key to fostering meaningful professional learning.

The differences in factor prioritization among teachers, school leaders, and external experts reflect their distinct professional roles and responsibilities within the educational system. For instance, school leaders' emphasis on data-informed decision-making can be interpreted through their accountability roles, which often require them to monitor performance metrics and align practices with policy mandates (O'Connor & Park, 2023). Their strategic focus is shaped by institutional pressures and the need to demonstrate measurable outcomes. In contrast, teachers prioritized structural support and cultural conditions, such as time allocation and collaborative culture. This reflects their lived experience of navigating day-to-day constraints, including limited time, rigid schedules, and inconsistent leadership support. Teachers often view collaboration as an emergent process that depends on trust and psychological safety, which are the conditions that require time and relational investment to develop (Datnow, 2018; Vangrieken et al., 2017). Experts, meanwhile, tended to elevate collaborative culture and professional development as systemic drivers. Their broader perspective, often informed by research and policy analysis, positions these elements as levers for long-term change. This triangulation of perspectives confirms existing literature on role-based interpretations of PLCs, which suggests that stakeholders conceptualize effectiveness through the lens of their responsibilities and constraints (Levitan & Johnson, 2020; Hollweck & Lofthouse, 2021). These findings underscore the importance of inclusive design and differentiated support in PLC implementation. Recognizing and integrating diverse stakeholder logics is essential for building adaptive, context-sensitive professional learning environments.

## **5.2. Comparison with Previous Research**

The comparative findings of this study significantly advance the existing literature on Professional Learning Communities (PLCs), particularly by integrating stakeholder-specific hierarchies within a triangulated Interpretive Structural Modeling (ISM) model. Consistent with the foundational contributions of scholars such as Hord (2009) and DuFour and Eaker (1998), the study reaffirms the critical roles of Leadership Support and Shared Vision as systemic drivers affecting PLC sustainability (Tagscherer & Carbon, 2025). Their substantial prominence corroborates the understanding that effective leadership and an articulated purpose are fundamental to nurturing PLCs. This study uncovers additional insights regarding the interactions of these drivers with relational and structural conditions, thereby offering a more nuanced understanding of the dynamics at play. Specifically, the multifaceted nature of

Collaborative Culture, as explored through this lens, aligns with the knowledge that collaboration is not merely an outcome but rather a lever for improvement, a perspective supported by both Vangrieken et al. (2017) and Savitz-Romer et al. (2018). This conceptualization resonates with Senge's (1990) systems theory, which advocates viewing organizations through a holistic lens, where interactions between components foster teacher growth and development (Hansen et al., 2020).

Moreover, the study addresses the operationalization of Data-Informed Decision-Making (DIDM) within the context of PLCs. Echoing O'Connor and Park's (2023) emphasis on the importance of data literacy, it is evident that the implementation of DIDM remains largely contingent upon strong foundational and relational supports. This highlights the reality that data-driven initiatives cannot successfully flourish in isolation; rather, they necessitate robust relational frameworks to support their operationalization. For example, Ashiq and Warraich (2022) demonstrate that in the emerging field of data librarianship, continuous training through workshops and refresher courses not only builds technical proficiency but also cultivates a collaborative mindset necessary for effectively integrating data into practice. Professional development programs that foster mentorship, reflective practices, and network building are critical in ensuring that data-driven approaches are contextually grounded and practically relevant (Kiran et al., 2024).

In contrast to prior models that often treat PLC factors in isolation, this study significantly discusses the interdependence of various drivers, their linkages, and dependents. This study reaffirms the calls in the literature for contextual capacity-building mechanisms that enhance the sustainability and effectiveness of PLC initiatives. By recognizing these interdependencies, the findings resonate with previous research suggesting that PLCs thrive in environments where collaborative and structural supports are actively cultivated. For example, Sigurðardóttir et al. (2021) stated that cultural context significantly influences the success of PLC initiatives. School leaders who cultivate a collaborative environment through intentional professional development initiatives help create conditions for shared leadership and collective responsibility, reinforcing the entire system. Zulu and Mukeredzi's (2021) case study of teacher learning communities in KwaZulu-Natal demonstrates that PLCs thrive when they actively involve all stakeholders, including teachers, support staff, and sometimes even community members. Their findings suggest that robust collaborative practices, which involve both structured meetings and informal peer interactions, facilitate a dynamic exchange of ideas and continuous improvement.

Collectively, this critical comparison of this study articulates that the implementation of PLCs demands navigation through the intricate interplay between policy imperatives, effective leadership practices, and the relational cultures that ultimately influence professional growth. Indeed, Wang (2020) asserts that emotional factors play a significant role in educational leaders' decision-making processes, thereby potentially influencing how PLC dynamics are established and operationalized. For example, Ishaque and Audi (2024) demonstrate that establishing effective PLCs in higher educational institutions involves not only structural investments but also an acute awareness of the emotional dynamics of leadership. Their Interpretive Structural Modeling (ISM) approach reveals that leaders who manage their emotional responses and foster supportive environments can more effectively navigate policy requirements and promote a shared purpose. This underscores the importance of emotional resilience and attune in implementing systems requiring both top-down policy support and bottom-up engagement. Similarly, Martin (2024) explores virtual PLCs, emphasizing that professional development is most effective within these communities when it leverages collective stakeholder experiences and acknowledges the affective dimensions of adult learning. In virtual settings, where physical cues are limited, emotional intelligence becomes even more crucial. Martin's research shows that when educators feel emotionally invested and valued, collaboration is enhanced, leading to reflective practices that serve as powerful tools for professional growth. This example reinforces the necessity of balancing evidence-based policies with emotionally supportive cultures in effective PLCs. Understanding these emotional dimensions can further enrich the dialogue surrounding PLC frameworks, offering a more comprehensive toolkit for practitioners aiming to foster robust educational environments.

This study not only extends the traditional frameworks surrounding PLCs but also contextualizes findings within a contemporary landscape marked by a complex interrelationship of variables. It signals a pivotal shift toward adopting a systemic approach that recognizes the nuanced and multifaceted nature of collaboration, data usage, and leadership within educational settings. For example, Bautista et al. (2023) challenge conventional Western PLC paradigms by demonstrating that in non-Western contexts, such as Chinese preschools, PLCs require tailored

approaches that account for local agency and autonomy. This finding underscores that collaboration and data usage cannot be divorced from the cultural context in which they are embedded. Similarly, Theurl et al. (2024) explain through their study of student teachers during internships that PLCs, when integrated early in teacher education, operate as dynamic systems wherein leadership and peer collaboration mutually reinforce practical learning outcomes. The insights provided by Hollweck and Lofthouse (2021) on contextual coaching serve as a prime example of how capacity-building mechanisms can bridge the gap between policy and practice. Their study demonstrates that targeted coaching initiatives promote collaborative professionalism and nurture systemic capacity for continuous improvement, reflecting the complex interrelationships highlighted in the current research. This literature underscores the study's assertion that framework extensions must consider both hierarchical and horizontal relational dynamics to capture the full spectrum of PLC functioning.

### **5.3. Implications**

This study offers significant theoretical and practical implications to the field of educational research, particularly in the context of Professional Learning Communities (PLCs). Theoretically, it advances a multi-stakeholder systems thinking approach by employing comparative Interpretive Structural Modeling (ISM) to reveal how different stakeholder groups, which consist of teachers, school leaders, and external experts, conceptualize the interdependencies among structural, cultural, and instructional factors. This aligns with complexity theory in education, which posits that meaningful change emerges from the dynamic interaction of diverse perspectives within a system. The study also introduces the concept of role-sensitive hierarchies, demonstrating that the perceived importance of key constructs such as Collaborative Culture and Data-Informed Decision-Making varies depending on stakeholder roles. This challenges uniform models of PLC implementation and supports the development of adaptive, context-sensitive frameworks. Methodologically, the integration of thematic analysis, the Fuzzy Delphi Method (FDM), and Interpretive Structural Modelling (ISM) across stakeholder groups represents a novel and replicable model for participatory systems mapping in school improvement research.

Practically, the findings offer actionable insights for multiple stakeholder groups. For school leaders and administrators, the ISM diagrams provide a diagnostic tool to identify misalignments between leadership intentions and teacher experiences, enabling targeted interventions that prioritize relational assets like collaborative culture. Teachers and PLC facilitators can use these models to reflect on their lived experiences, advocate for enabling conditions, and recognize the systemic levers, such as leadership and resource allocation, that must be activated for cultural outcomes to emerge. For policymakers and district officers, the triangulated model highlights the need for differentiated support strategies that go beyond structural mandates to include cultural alignment and stakeholder buy-in. It also informs the design of professional development programs that balance technical competencies with relational skills. Finally, for educational researchers, this study provides a methodological blueprint for conducting stakeholder-informed ISM analysis and encourages future inquiry into how these hierarchies evolve or differ across school contexts, such as rural versus urban settings.

### **5.4. Limitations**

In acknowledging the limitations of the study conducted within three primary schools, it is critical to recognize that findings derived from a confined academic environment often lack external validity, thereby restricting their applicability to broader contexts. This concern is echoed in previous literature, which notes that studies conducted at single sites can share similar limitations, specifically highlighting challenges associated with the generalizability of results due to restricted participant diversity and ecological validity (Rubin et al., 2021). The study was conducted in a specific cultural and policy context. The findings may not fully translate to other educational systems without adaptation. Future research should replicate this multi-phase approach across diverse settings and consider integrating quantitative outcome measures to validate the conceptual models. This suggests the need for caution when extrapolating the findings of the current study to other educational institutions or populations.

Further limitations arise from the analytical techniques employed, specifically the Fuzzy Decision-Making (FDM) and Interpretive Structural Modeling (ISM) methods. Both methodologies provide structured frameworks for insight generation but are contingent upon subjective participant judgments, which can be significantly influenced by

cognitive biases and individual perceptions (Bojke et al., 2021). Expert ratings in FDM are influenced by personal experience and interpretation, while ISM diagrams reflect perceived relationships rather than empirically tested causal links. This subjectivity raises questions about the reliability of outcomes derived from these methodologies, paralleling findings that suggest concerns regarding expert elicitation processes in healthcare, where decisions can be swayed by participant bias, thereby impacting the integrity of model comparisons (Kapol et al., 2023). As such, the ISM models should be viewed as conceptual frameworks that map stakeholder understanding, not definitive causal hierarchies.

Additionally, the small sample size, particularly within expert and leadership groups, poses a significant limitation in the study. Studies have indicated that small sample sizes can reduce the power and robustness of comparative analyses, resulting in less reliable results and conclusions (Besselink, 2024). This limits the generalizability of the findings. Although the Fuzzy Delphi Method (FDM) is robust for consensus-building, existing guidelines often recommend larger expert panels (typically 10–15 participants) to enhance reliability and reduce individual bias. For example, a well-documented analysis noted limitations regarding small sample sizes that may not adequately represent the community or field being studied, ultimately raising questions about the statistical significance and applicability of findings derived from such limited data (Besselink, 2024). These limitations show the necessity for future research to include larger, more diverse samples and multiple settings to enhance the validity of results.

### **5.5. Future Directions**

Future research should critically expand the current ISM-based PLC frameworks by embracing longitudinal and multi-perspective designs to capture the dynamic and context-dependent evolution of Professional Learning Communities. Longitudinal case studies illuminate how the hierarchical positioning of drivers, linkages, and dependents shifts as schools mature or face disruption, adding empirical depth to what is often treated as static structural mapping (Durand et al., 2022). Additionally, incorporating student and parent voices would enrich stakeholder triangulation, acknowledging that PLCs do not operate in isolation but shape and are shaped by broader school communities (Linh & Kasule, 2022). Methodologically, the use of AI-driven thematic analysis holds promise for enhancing the rigor and replicability of qualitative pattern detection, especially in large, open-ended data sets (Hamilton et al., 2023). Testing ISM models across diverse school contexts, which are rural, urban, high-performing, and under-resourced, could generate comparative insights into how local conditions mediate factor interdependencies. Finally, future studies should bridge structural models with outcome metrics by exploring links between PLC effectiveness, student learning gains, and indicators of school climate, strengthening the empirical case for PLCs as levers for holistic school improvement (Ampanon, 2024).

## **6. Conclusion**

This study offers a robust and context-sensitive framework for understanding the dynamics that sustain effective Professional Learning Communities (PLCs). The findings reaffirm that Leadership Support and Shared Vision are indispensable drivers of PLC success. Importantly, Collaborative Culture is revealed to be both an outcome and a driver, depending on stakeholder perspective, where teachers view it as emergent from structural support, while experts see it as a foundational enabler. These insights highlight the need for adaptive PLC frameworks that integrate structural, cultural, and relational dimensions. Methodologically, this study contributes a novel triangulated approach by integrating Thematic Analysis, Fuzzy Delphi Method (FDM), and Interpretive Structural Modeling (ISM). Few PLC studies have employed this combination, and its use here enables a multi-layered understanding of stakeholder perspectives, consensus-building, and hierarchical interdependencies. This design enhances the robustness of the findings and offers a replicable blueprint for future PLC research. Future research should explore longitudinal studies to track the evolution of PLC hierarchies over time and include student and parent voices to enrich stakeholder triangulation. Researchers are encouraged to test the ISM-based model across varied school contexts, particularly in rural and under-resourced settings, to examine how local conditions shape PLC dynamics. Additionally, the use of AI-supported thematic analysis could enhance scalability and pattern detection in large qualitative datasets. Finally, linking PLC effectiveness to student learning outcomes and school climate indicators would strengthen the empirical case for PLCs as levers for holistic school improvement.

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## **Competing Interests**

None.

## **Ethical Statement**

This research was conducted following ethical guidelines. All participants provided informed consent before participation, and measures were taken to protect anonymity and confidentiality in all data collection and reporting processes.

## **Author's Contribution**

**Goh Kok Ming**<sup>1</sup>: Conceptualization, Data curation, Formal analysis, Writing – original draft, Methodology, Resources, Software, Writing – Review and editing, Validation, Investigation

## **Data availability**

The data was collected and analyzed based on mixed-methods through structured open-ended questions, thematic analysis, Fuzzy-Delphi Method (FDM), and Interpretative Structural Modelling (ISM). The collection and analysis processes were detailed in the Method section of this study.

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