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Data-Based Instructional Leadership: A Strategic Model for Improving Multidimensional Numeracy at the Junior High School Level

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Abstract: Numeracy is a crucial interdisciplinary skill for the modern era; however, the performance of Indonesian students remains subpar, as evidenced by results from PISA 2022 and domestic educational assessments. This study seeks to develop a strategic leadership framework aimed at enhancing numeracy skills in junior high schools (SMP), with a specific focus on Maja District in Majalengka Regency. Employing a qualitative descriptive methodology designed as a case study, the research examines the interplay of three central elements: Instructional Leadership as the initiating force, Professional Learning Communities (PLC) as the collaborative teacher-level process, and Assessment for Learning (AfL) as the classroom-based implementation tool. Data were gathered via intensive interviews, direct observation, and documentary analysis, followed by thematic analysis using the Miles and Huberman approach supported by NVivo software. The resulting "Golden Triangle" model advocates for school principals to shift from administrative management to a more evaluative and instruction-focused leadership role. Such a shift is designed to strengthen collective teacher effectiveness through structured PLCs and to cultivate students' capacity to utilize feedback via AfL strategies. This integrated model presents a novel perspective by connecting data-informed leadership with multifaceted numeracy instruction within the framework of Indonesia's Independent Curriculum.

Keywords: Instructional Leadership, Community of Professional Practitioners (PLC), Assessment for Learning (AfL), Numeracy, Independent Curriculum.

INTRODUCTION

Junior secondary education is a crucial phase in the cognitive development of students, especially in the mastery of literacy and numeracy, which is the foundation for higher-order thinking skills. However, the numeracy achievement of students in Indonesia still faces serious challenges. Based on the results of the Programme for International Student Assessment (PISA) in 2022, the numeracy ability of Indonesian students is still below the OECD average. At the

local level, data from the Majalengka Regency Regional Education Public Service Report Card (RLPPD) in 2024 shows that the numeracy achievement at the junior high school level has only reached 41.84, which is classified as a low category (Abdal, 2024).

This gap indicates that the problem of numeracy is not just a problem of teaching methods in the classroom, but a systemic problem involving school governance and leadership. Preliminary studies show that there is a gap between ideal and factual conditions. The principal's leadership often emphasizes administrative functions rather than instructional functions, and academic supervision has not touched the substance of numeracy learning. In addition, teachers are still stuck in routine practice questions without encouraging adaptive reasoning, and have not been optimal in utilizing Education Report data for continuous improvement (Kusnandar & Sauri, 2025).

The novelty offered in this article is the integration of three key variables referred to as the "Golden Triangle": Instructional Leadership as a driver, Professional Learning Community (PLC) as a teacher collaboration mechanism, and Assessment for Learning (AfL) as a mechanism for interaction in the classroom. Thus, this study aims to analyze how the principal's leadership strategy can orchestrate the two mechanisms to improve students' numeracy skills in SMP Negeri Kecamatan Maja.

METHOD

This study uses a qualitative approach with a descriptive method to understand the phenomenon of leadership strategies in depth and naturally. The research design is a case study carried out at a State Junior High School in Maja District, Majalengka Regency. This location was chosen purposively because schools in this region are implementing the Independent Curriculum, but still have varied numeracy achievements.

Research Participants were selected using purposive sampling techniques, consisting of: (1) Principal as a policy setter (Key Informant), (2) Mathematics Teacher as a learning implementer, (3) Deputy Head of Curriculum, (4) School Supervisor, and (5) Students as impact recipients.

Data Collection and Analysis Data collection techniques include semi-structured in-depth interviews, participatory observation at learning activities and teacher meetings, as well as documentation studies (Education Report Cards, Teaching Modules, PLC Minutes). Data analysis was conducted using the Miles & Huberman Interactive Analysis Model, which includes data reduction, data presentation, and conclusions drawn. To ensure the validity and traceability of the analysis (audit trail), data processing is assisted using NVivo software. The coding process is carried out in three stages: Open Coding (identification of initial concepts), Axial Coding (grouping of themes), and Selective Coding (synthesis of models).

RESULTS AND DISCUSSION

The Role of Instructional Leadership as a Key Driver of Numeracy Improvement

The results of NVivo coding reveal the strategic role of school principals in focusing efforts to improve numeracy in schools, with three main functions: instructional vision, learning management, and data-driven monitoring. First, the principal at SMP Negeri Kecamatan Maja began to build an instructional vision that explicitly made numeracy a performance priority, in line with Hallinger's (2011) findings regarding the importance of clear instructional direction. This vision is then realized in concrete programs such as numeracy clinics, teacher assistance, and numeracy integration in various subjects (Aslam et al. , 2022).

Second, in learning management, the principal not only manages schedules and resources, but also guides teachers in using the Independent Curriculum module adaptively, with an emphasis on the development of tasks that spur reasoning as well as the principle of adaptive reasoning. Third, regarding data-based monitoring, school principals use Education Report Cards and formative assessments, although their use is still surface-level, such as

reviewing achievements without delving into student misconceptions. According to Walean et al's note that, data requires analytical capacity to drive change. Overall, instructional leadership is the driving force for other mechanisms such as PLC and AfL, but needs to be strengthened especially in the deepening of data analysis.(Qoidatun et al., 2025).

Table 1. The Strategic Role of the Principal

Leadership Functions	Description & Practice	Challenges & Implications
Instructional Vision	Building a vision that makes numeracy a priority for school performance. Translated into concrete programs such as numeracy clinics, teacher mentoring, and cross-subject integration.	Align with Hallinger's (2011) findings on the importance of clarity of instructional direction.
Learning Management	Not only managing schedules and resources, but also guiding teachers in using the Independent Curriculum module in an adaptive manner, focusing on the development of tasks that spur reasoning.	In line with the principle of adaptive reasoning (Kilpatrick et al., 2001).
Data-Driven Monitoring	Utilizing Education Report Cards and formative assessments as data sources.	Utilization is still surface level (e.g., only reviewing achievements). It requires a more in-depth analytical capacity, according to the records of Schildkamp (2019).
Conclusion & Recommendations	Instructional leadership acts as a driving force for other mechanisms (such as PLC and AfL).	It needs to be strengthened, especially in terms of deepening data analysis to drive more effective change.

Based on Table 1 above, it can be discussed that the strategic role of school principals in improving numeracy is multidimensional and hierarchical, starting from the level of strategic planning to implementation and evaluation. The function of the Instructional Vision serves as

the foundation that determines the direction of policy, while the Learning Management becomes an operational mechanism to translate the vision into adaptive pedagogical practice. On the evaluation side, Data-Based Monitoring functions as a verification tool, although the findings show that its use is still surface level and has not led to in-depth cognitive analysis. Overall, these three functions are interconnected and form a coherent leadership cycle, where Instructional Leadership is the main driver for teacher capacity building (PLC) and classroom learning transformation (AfL). However, the effectiveness of this cycle is still hampered by limited analytical capacity, so systematic reinforcement is needed, especially in deepening the use of data for more accurate learning diagnosis and more targeted follow-up.

Professional Learning Community (PLC) as a Collaborative Mechanism for Teacher Strengthening

Analysis of PLC minutes and teacher meeting observations revealed a shift in professional culture towards more structured collaboration, with three main themes: teaching reflection, sharing of good practices, and data-driven improvement. In the aspect of teaching reflection, mathematics teachers begin to conduct post-learning discussions to identify students' numeracy difficulties, a process that is in accordance with the characteristics of reflective inquiry in an effective PLC. Meanwhile, in sharing good practices, teachers from schools with high numeracy achievement act as mentors for other teachers in the group, strengthening professional networks and becoming a path for knowledge transfer, although the intensity is still highly dependent on individual motivation and has not yet become a standard system. (Herlambang, 2023).

In the realm of data-driven improvement, PLC has facilitated the analysis of diagnostic questions to identify common misconceptions, such as understanding scale, comparison, and interpretation of graphs. However, data discussions still tend to be limited to technical aspects, such as the difficulty of the questions and have not led to in-depth cognitive analysis.

The flowchart in Figure 1 manages to clearly map the internal mechanisms and dynamics of PLCs, showing how its three main themes, teaching reflection, good practice sharing, and data-driven improvement, operate as interconnected subsystems in one collaborative ecosystem. The diagram not only shows the process flow from practice to impact, but also critically inserts theoretical foundations (such as reflective inquiry) and specific challenges (such as reliance on individual motivation) into each branch, thus providing a holistic and nuanced picture. By connecting all elements towards one key conclusion, the graph effectively visualizes the research's core proposition that the significant impact of PLCs on instructional quality is highly dependent on the consistency and depth of the process in each of its chains, which is a synthesis of empirical findings and theoretical frameworks. (Herlambang, 2023) (Maula & Hidayatullah, 2024).

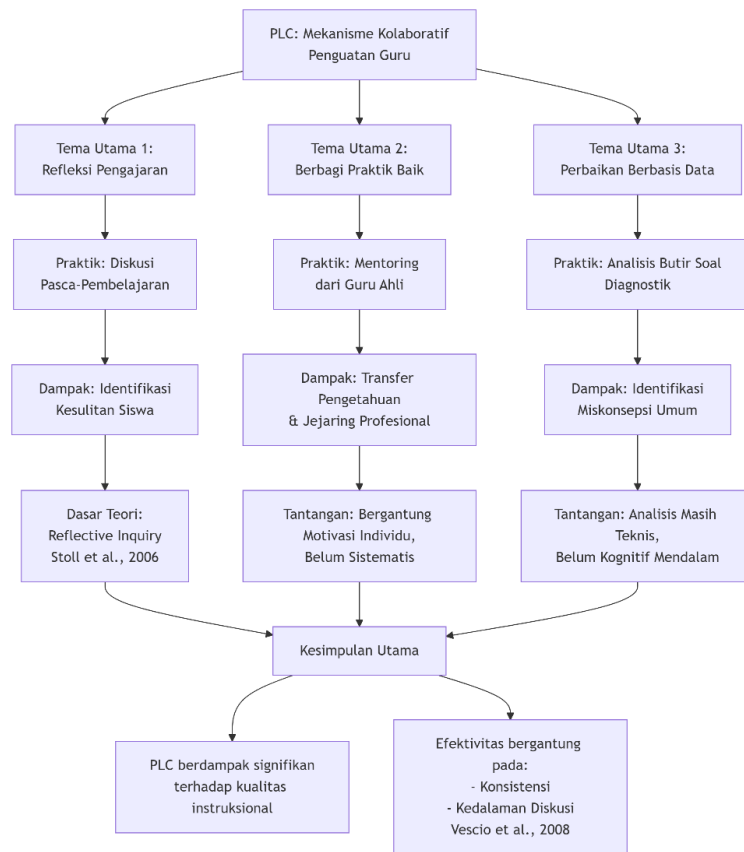


Figure 1. Flow Diagram of the Mechanism and Impact of PLC in Strengthening Teacher Capacity.

Assessment for Learning (AfL) as a Mechanism for Numeracy Learning Interaction in the Classroom

Classroom observations show that teachers have begun to implement elements of Assessment for Learning (AfL), especially in three aspects: providing formative feedback, utilizing diagnostic assessments, and student involvement in the evaluation process. In the first aspect, formative feedback is given more specifically, specifically on reasoning skills, where the teacher encourages students to explain the steps of completion and not just focus on the final answer. This practice is in line with the research of Sholeh (2017), which emphasizes the role of high-quality feedback in improving learning outcomes. In the second aspect, teachers have used initial diagnostic assessments to map students' numeracy skills before starting a new topic. Although it is possible to identify groups of students with competency gaps, follow-up strategies, especially for low-ability students, have not been carried out systematically. (Laughter et al.,2025).

In the third aspect, teachers begin to implement peer assessment techniques, although they are still limited to simple tasks. Students' understanding of assessment criteria, such as learning intentions and success criteria, still needs to be deepened so that AfL can truly encourage learning independence. Overall, the implementation of this AfL has reached the development stage, but has not reached the level expected in the Independent Curriculum, where students are able to monitor their learning progress independently.(Qoidatun et al., 2025)

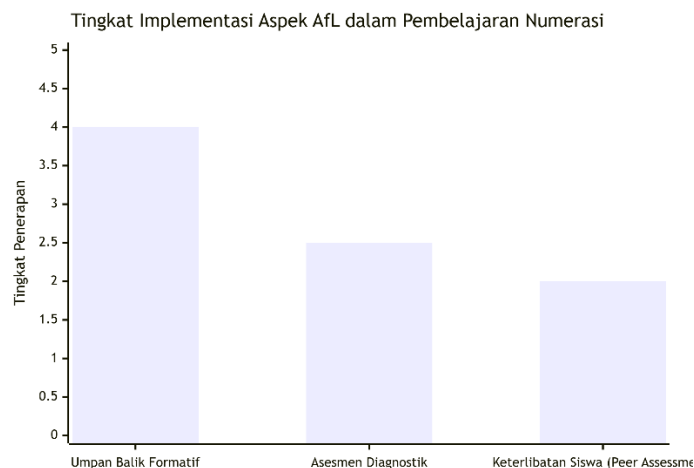


Figure 2. Implementation of AfL Aspects in Numeracy Learning

Based on the visualization of the graph in Figure 2, it can be discussed that the implementation of Assessment for Learning (AfL) in numeracy learning shows an uneven development among the three aspects observed. The formative feedback aspect has reached a relatively mature and specific level of implementation, particularly in encouraging student reasoning, which is in line with the principles of AfL. However, two other aspects still face significant challenges: the use of diagnostic assessments is still hampered by a lack of systematic follow-up, especially for low-ability students, while students' involvement in evaluation through peer assessment remains limited and superficial due to their understanding of the success criteria that have not been well developed. Overall, the gap between actual practice and expectations of the Independent Curriculum, which emphasizes learning independence, is still quite wide, indicating that the current AfL interaction mechanism has only reached a developing stage and has not yet fully become a means for students to monitor and manage their learning process independently.

"Golden Triangle" Integration: Numeracy Enhancement Orchestration Model

The most significant finding was that effective numeracy improvements did not occur if all three variables, instructional leadership, PLC, and AfL, ran separately. Through analysis, an integrative pattern is formed: Instructional leadership acts as a driver of the direction of change by establishing a numerical focus, providing time for PLCs, and ensuring formative assessment practices (Kusnandar & Sauri, 2025). PLC then acts as a vehicle that strengthens teacher capacity through data interpretation, strategy development, and improvement of teaching modules. Meanwhile, AfL serves as a translator that brings immediate change in the classroom, transforming teacher collaboration into a learning experience that facilitates students' numerical reasoning and adaptive thinking. (Laughter et al. , 2025)

These three elements form a multi-tiered synergistic relationship: Instructional leadership as a Driver, PLC as an Engine, and AfL as well as improvement of numeracy learning outcomes as Output. This model supports the findings of Grissom et al. (2021) regarding the indirect effects of leadership on student achievement, while extending it to the specific context of increasing numeracy in the implementation of the Independent Curriculum in Indonesia. (Wiryanto et al. , 2023).

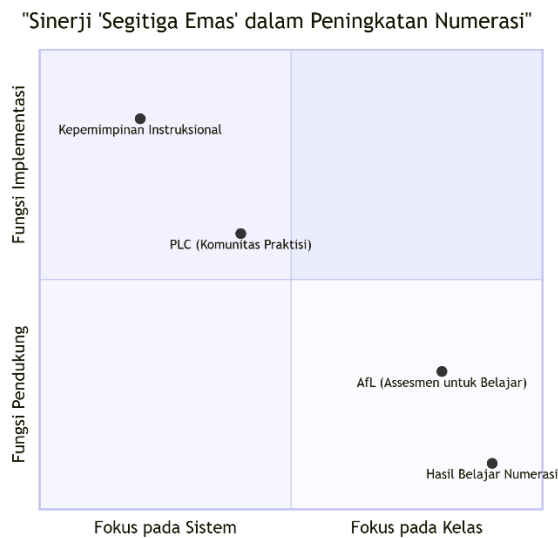


Figure 3. Interconnection Radar Diagram (Showing the Strength of Synergies)

The radar diagram in Figure 3 visually reinforces the main thesis of synergistic integration in the "Golden Triangle" by placing the four components, Instructional Leadership, PLC, AfL, and Numeracy Learning Outcomes, in one continuous interconnected plane. The position of "Instructional Leadership" in the upper left quadrant (focus on systems and support functions) graphically confirms its role as a strategic driving force and enabler. Meanwhile, "PLC" is in the middle area, describing its role as an engine that bridges policy with practice by translating directives into structured collaboration. The "AfL" position that is more towards the bottom right (focusing on the classroom and implementation function) confirms its function as the final translator who operationalizes the strategy into a hands-on learning interaction. Finally, "Numeracy Learning Outcomes" is placed furthest toward implementation and classroom focus, suggesting that it is the final output that students immediately feel. The interweaving of lines connecting these four points visually represents a relationship of interdependence and a dynamic flow of influence, in which no single element stands alone, thus concretizing the statement that numeracy enhancement is only effective if all three variables are integrated, rather than running separately.

Critical Discussion: Implementation Challenges

Several strategic obstacles were identified in the implementation of the numeracy improvement program. First, the capacity to analyze teacher data is still limited so that the use of instruments such as Education Report Cards is not optimal. Second, the culture of professional collaboration is not yet fully institutionalized and still highly dependent on individual initiative. On the other hand, the effective implementation of Assessment for Learning (AfL) demands a change in the teaching paradigm, while some teachers still tend to stick to traditional teaching patterns.(Supriadi et al., 2022).

Obstacles also arise from the instructional leadership side, where the administrative burden of principals often shifts their focus away from the more in-depth teaching function. These challenges are overall in line with the findings of Supovitz & Klein (2020) who affirm that learning transformation requires leadership coherence, that is, systematic alignment and focus, not just the addition of new programs without strong coherence (Herlambang, 2023).

Strengthening Theoretical and Empirical Discussions

The findings of this study show that the effectiveness of instructional leadership is highly dependent on the ability of school principals to build instructional coherence, namely the

alignment between vision, strategies, and learning practices. Although this concept is in line with the framework of Hallinger & Murphy (2013) which places the principal as the main architect of change, the results of research in Maja District reveal that this coherence is still in its early stages. The vision has been formulated, but it has not yet been fully realized in teachers' daily pedagogical routines, thus explaining why the optimal impact of numeracy interventions has not been achieved. On the other hand, the integration of PLCs and AfL in the "Golden Triangle" model reinforces the argument that numeracy improvements require an integrated, rather than a single, approach. Field findings confirm that PLCs are only effective in sustainable, data-driven collaborative structures, while PLCs in sample schools still show limited depth of data analysis (Sri et al., 2021).

In the realm of Assessment for Learning (AfL), the results of the study indicate that teachers have applied basic elements, but the development of feedback literacy or students' ability to utilize feedback is still very low. In fact, according to Carless & Boud (2018), the maximum impact of AfL is achieved when students can independently interpret and use feedback. This condition shows that AfL still functions as a teacher's instrument and has not succeeded in creating an independent classroom learning culture. Thus, this study emphasizes the importance of interlocking mechanisms: instructional leadership as a director, PLC as a teacher capacity enhancer, and AfL as a form of change in the classroom. These three elements not only support each other, but also depend on each other to create a continuous increase in numeracy (Andi Kamal Ahmad et al., 2022).

Comparison of Findings with Previous Research

Compared to previous studies, this study makes a more in-depth and contextual contribution. The findings of the study not only support Grissom et al.'s (2021) theory about the indirect influence of leadership on student achievement, but also reveal that this influence is only optimal when principals have a close and deep understanding of the pedagogical practice of numeracy, a nuance that has not been widely raised in the international literature. Furthermore, this study confirms the view of Schildkamp (2019) that raw data will not bring change without analytical capacity, while enriching this view by showing the real role of PLC as *a collective sense-making* that actively bridges data interpretation into concrete learning strategies. While numeracy research in Indonesia tends to be fragmented on classroom interventions or teacher training separately, this study shifts the paradigm by positioning numeracy as a systemic issue that requires strong instructional leadership. Thus, this research offers a more integrative and strategic framework, thus enriching the national academic discourse on improving numeracy in schools.

CONCLUSION

The discussion of the results of this study shows that increasing numeracy at the junior high school level requires strategic orchestration between instructional leadership, teacher collaboration (PLC), and the implementation of Assessment for Learning (AfL). The findings on instructional leadership confirm the central role of principals in building instructional coherence, although its implementation, such as data utilization, is still descriptive. Meanwhile, PLCs have moved towards inquiry-based collaboration, but the depth of data analysis needs to be improved to achieve systemic instructional redesign.

At the classroom level, the implementation of AfL shows progress in terms of formative feedback and diagnostic assessment. However, students' literacy feedback is still limited, so they are not yet able to fully regulate self-learning—a challenge in traditionally procedurally oriented math classes. The integration of these three elements in the "Golden Triangle" model offers a new conceptual framework, where leadership serves as a driver, PLC as a capacity cultivator, and AfL as a tool for transformation in the classroom, so that school strategies, teacher practices, and student learning experiences work in harmony.

Although promising, the implementation of this model faces challenges such as uneven teachers' analytical capacity, an uninstitutionalized culture of collaboration, and the administrative burden of school principals that can shift instructional focus. These findings support the view that transformation requires sustained leadership coherence. Overall, this study confirms that increasing numeracy is a systemic issue that goes beyond mere pedagogical innovation. The resulting "Golden Triangle" model is a conceptual contribution to instructional leadership theory and at the same time offers a relevant practical framework for the implementation of the Independent Curriculum.

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