

Teachers' Data Literacy for Curriculum: A Comparative Study in Four Developing Countries

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ABSTRACT

This comparative study examined how national education policies translated teacher data literacy into curriculum improvement across four developing countries: Indonesia, Vietnam, Kenya, and Colombia. Using a directed document review, the study analyzed internationally validated policy reports from UNESCO, the World Bank, and the OECD to explore the alignment between policy ambition and classroom-level practice. The analysis was structured around three key dimensions: technological infrastructure readiness, continuity of professional development, and pedagogical use of assessment data. The findings indicated that while all four countries had expanded access to educational data, teachers' capacity to transform data into meaningful instructional action remained uneven. Vietnam demonstrated strong professional integration through collaborative practices, Kenya excelled in community-based and coaching-oriented interventions, while Indonesia and Colombia were undergoing critical transitions that required greater investment in human capital. Across cases, constraints were driven more by systemic and institutional factors than by individual teacher willingness or competence. The study concluded that effective teacher data literacy depended less on data availability and more on sustained professional support, contextual interpretation, and coherent policy frameworks. By synthesizing diverse national approaches, this study offered policy-relevant insights for strengthening teacher capacity and bridging the persistent gap between macro-level data systems and micro-level curriculum enactment

Keywords: *comparative education, curriculum improvement, data-driven decision making, developing countries, teacher data literacy*

1. INTRODUCTION

Teacher data literacy refers to the ability to access, analyze, interpret, and use educational data to make effective, evidence-based instructional decisions (Mandinach & Gummer, 2016; Lee et al., 2024). This competency is not merely technical; it includes the ability to leverage information for curriculum reform, which is increasingly critical as educational data becomes more available through systems ranging from national assessments to digital learning platforms. In the digital and globalized era, these skills are essential; however, teacher data literacy in developing countries remains a significant challenge requiring special attention (OECD, 2024a; UNESCO, 2023).

Data literacy for teachers is often mistakenly equated solely with the technical ability to navigate digital dashboards or calculate statistical means. Mandinach and Gummer (2016) emphasize that data literacy is a complex construct involving the transformation of information into actionable instructional knowledge. In developing

contexts, this definition must be expanded to include *contextual data literacy*, referring to the ability to interpret data within resource-constrained environments where longitudinal data may be fragmented (Glewwe, 2005). The shift from *assessment of learning* (summative) to *assessment for learning* (formative) requires not only analytical skills but also pedagogical content knowledge to adjust curriculum delivery based on real-time evidence.

The global education landscape is undergoing a transformation driven by the “Data Revolution.” International organizations such as UNESCO and the OECD promote Data-Driven Decision Making (DDDM) as a mechanism to advance educational equity (UNESCO Institute for Statistics, 2023). DDDM assumes that systematic data collection should inform all levels of the education system, from ministry-level curriculum design to classroom-level differentiation. However, studies in the Global South indicate a largely compliance-oriented adoption of DDDM, in which data are used primarily for administrative reporting rather than instructional improvement (World Bank, 2019b). This study addresses this tension by examining how four developing countries negotiate the gap between administrative accountability and pedagogical utility.

Despite growing global attention to data-driven decision making, research on teacher data literacy in developing countries remains fragmented and largely single-country in scope. Prior studies have examined technical competencies, professional development initiatives, or the effectiveness of specific digital tools (Mandinach & Gummer, 2016; Ansyari et al., 2022a; Lee et al., 2024). Comparatively fewer studies have analyzed how national data policies are enacted across developing country contexts, particularly in relation to infrastructure readiness, professional learning continuity, and pedagogical integration of assessment data. Consequently, the relationship between macro-level policy design and micro-level instructional practice remains underexplored in cross-national settings. This study addresses this gap through a comparative analysis of Indonesia, Vietnam, Kenya, and Colombia, examining how teacher data literacy is shaped by institutional structures and policy environments.

This comparative study examined how teachers in four developing countries—Indonesia, Vietnam, Kenya, and Colombia—leverage educational data to improve curriculum and instructional practices. The cases were selected to represent distinct trajectories of curriculum development within the Global South. Indonesia serves as the primary analytical reference, reflecting rapid national policy transformation. Vietnam functions as a strategic benchmark due to its strong PISA performance relative to economic capacity. Kenya and Colombia were purposively selected as regional exemplars from Africa and Latin America, respectively, based on their distinctive and resilient approaches to data utilization. By synthesizing these cases, the study generates insights relevant to curriculum development both globally and within the

Indonesian context, highlighting strategic opportunities to strengthen teacher data literacy through policy and institutional design.

2. METHODOLOGY

2.1 Research Design

This study employs a Directed Document Review approach, a form of qualitative policy and document analysis grounded in qualitative content analysis (Hsieh & Shannon, 2005). This method does not aim to generate primary empirical data from participants, nor does it constitute a systematic literature review (SLR) or bibliometric study. Instead, it focuses on the systematic examination of policy documents, international reports, and validated institutional publications to evaluate how existing theoretical frameworks are operationalized across national contexts.

Directed document review begins with an a priori conceptual framework to guide coding and interpretation. In this study, the Teacher Data Literacy Framework proposed by Mandinach and Gummer (2016) serves as the analytical lens, allowing the analysis to assess the alignment between policy intentions and implementation practices. This approach is widely used in comparative education research to examine policy enactment across countries, particularly when the objective is to compare structural conditions, governance mechanisms, and professional capacity development rather than individual perceptions or behaviors (Rusydiyah et al., 2021).

By adopting this method, the study systematically compares how four developing countries—Indonesia, Vietnam, Kenya, and Colombia—design and implement data-related education policies, highlighting convergences, divergences, and contextual adaptations. The method is especially suitable for cross-national analysis where access to primary field data is limited, and where policy coherence and institutional design are the primary units of analysis.

The document corpus was purposively selected based on three criteria: international validation by recognized global institutions, direct relevance to teacher data literacy or curriculum-related policies, and publication within the last ten years to ensure analytical currency. Documents published between 2018 and 2025 that met these criteria resulted in a focused corpus of core international and national policy reports for comparative analysis. To enhance analytical rigor, only documents that provided explicit policy guidance, evaluative findings, or implementation insights were included in the analysis, rather than aiming for exhaustive coverage of all available publications.

2.2 Data Sources and Search Strategy

Data collection was restricted to high-credibility sources published between 2018 and 2025 to ensure relevance to the current educational landscape. The primary

inclusion criteria encompassed official government policy documents related to education data or digital transformation, country-specific reports from international organizations such as the OECD, World Bank, and UNESCO, as well as peer-reviewed empirical studies focusing on teacher practices in the target countries. Specifically, data sources were selected to represent key policy instruments for each nation. For Indonesia, the analysis centered on Rapor Pendidikan documentation, Platform Merdeka Mengajar (PMM) usage reports, and Ministry of Education regulations on Merdeka Belajar. For Vietnam, the focus was placed on the OECD TALIS 2024 Country Notes and national digital competence frameworks. In the African context, Kenya's analysis drew from EdTech Hub reports on the Tusome and PRIEDE projects, while for Colombia, data was derived from World Bank assessments of the Evaluate to Advance strategy and UNESCO reports on Media and Information Literacy.

2.3 Data Analysis Process

The analysis was carried out through three distinct stages. First, a thematic synthesis was conducted to identify recurring patterns, challenges, and best practices in teacher data literacy based on three key indicators: infrastructure readiness, professional development continuity, and pedagogical application. This was followed by a synthesis of empirical findings to evaluate the reported effectiveness of professional development interventions on student learning outcomes by reviewing seminal studies, such as those by Ansyari, Groot, and De Witte (2022a) and Hidayah et al. (2023). This stage moved beyond statistical meta-analysis to a descriptive review of impact. Finally, a comparative analysis was performed to contrast policies, practices, and outcomes across the four countries. This process highlighted converging trends and unique contextual adaptations, leading to the formulation of globally relevant policy recommendations based on the identified cross-national evidence.

3. RESULTS AND DISCUSSION

While the four countries exhibit differing strengths and constraints, the analysis applies a consistent analytical framework across all cases to ensure balanced comparison rather than normative ranking. The collected documents were analyzed through a three-phase process. First, thematic coding identified recurring constructs related to infrastructure, professional development, and classroom data use. Second, pattern matching was employed to align national policies with the Teacher Data Literacy Framework (Mandinach & Gummer, 2016). Finally, a cross-case synthesis revealed converging trends and context-specific challenges, forming the basis for globally relevant policy recommendations.

3.1 Indonesia: Integration of Education Report and Training

Teachers in Indonesia are increasingly adopting data use in learning planning and formative assessment (Ansyari et al., 2022a). This development reflects a strategic shift in national education policy through the Rapor Pendidikan (Education Report) and the One Education Data system (Kemendikbudristek, 2024; World Bank, 2024). These systems integrate national assessment results with school climate indicators, providing principals and schools with concrete diagnostic information on institutional strengths and weaknesses. At the classroom level, data literacy is further operationalized through the Platform Merdeka Mengajar (PMM), a digital ecosystem that functions not only as a repository of instructional resources but also as a mechanism for tracking teachers' professional development trajectories.

The PMM platform encourages a self-directed learning cycle in which teachers analyze students' literacy and numeracy outcomes from the National Assessment (AN), select relevant training modules, and apply pedagogical adjustments in their classrooms (Kemendikbudristek, 2024). This process forms a closed-loop model of data utilization that distinguishes Indonesia from the other countries examined by shifting the locus of instructional improvement from centralized supervision to individual practitioner agency. In practice, this approach is reinforced through the 'Identify, Reflect, and Improve' (IRB) model, which positions the Rapor Pendidikan as a diagnostic instrument rather than a compliance tool (Rusydiyah et al., 2021). Nevertheless, significant challenges persist, particularly uneven access to professional development between urban and rural contexts and wide variation in teachers' ability to translate data insights into concrete instructional actions (World Bank, 2024).

This pattern indicates strong policy alignment in data access and professional scaffolding, yet reveals persistent gaps in teachers' interpretive and pedagogical data-use capacities, underscoring a partial realization of the Teacher Data Literacy framework in classrooms.

3.2 Vietnam: Data-Driven Assessment and TALIS Standards

Vietnam demonstrates a strong commitment to educational quality through its participation in the OECD's TALIS. The 2024 survey indicates that 64% of Vietnamese teachers have used AI in teaching, placing the country fifth among 55 participating systems (OECD, 2024a). At the classroom level, adoption tends to be pragmatic and efficiency-oriented, with teachers frequently using generative AI to support lesson planning. In parallel, professional collaboration appears robust, as 95% of teachers reported that professional learning activities were impactful and 69% engaged in team teaching, creating favorable conditions for evidence-informed instructional improvement (OECD, 2024a).

Despite these positive indicators, significant structural constraints persist. Approximately 71% of teachers reported inadequate infrastructure to support AI integration, while limited time availability restricts meaningful engagement with instructional data (OECD, 2024a). In response, the Ministry of Education and Training has emphasized the need to establish national digital competency standards, particularly to address the absence of clear ethical and pedagogical guidelines for emerging technologies. Local research suggests that although teacher enthusiasm for digital tools is high, insufficient preparation in digital pedagogy remains a major barrier to effective implementation (Pham et al., 2024). Without a coherent regulatory and professional framework, the widespread use of AI risks remaining an efficiency-driven practice rather than a catalyst for sustained curriculum innovation.

This case underscores the limits of assessment-driven reform, as rapid uptake of digital tools outpaces the development of professional standards required to embed data use within everyday instructional decision-making.

3.3 Kenya: Collaborative Communities and Evidence-Based Interventions

Kenya has prioritized approaches placing practitioner voices at the heart of policy-making through partnerships with EdTech Hub. By creating 'Sandboxes' for experimentation, the government fosters an environment where teachers can test data-driven strategies without fear of punitive compliance (EdTech Hub, 2025). Research on the *Dignitas LeadNow* app revealed that participants who received coaching alongside data tools demonstrated improved formative assessment practices (Piper et al., 2023). However, intensive data use still faces barriers like limited analysis skills and fragmented data systems (Jawuor, 2020). Locally grounded research reinforces this, noting that despite abundant assessment data, many teachers lack the specific training to perform in-depth analysis for instructional improvement (Omoso & Odindo, 2019).

Addressing these constraints, the success of the Tusome early literacy program provides a critical case study in "low-tech" data literacy. Unlike the digital-heavy approaches in Colombia or Indonesia, Tusome used simple tablet-based data entry for Curriculum Support Officers (CSOs) who visited schools. The data provided teachers with immediate feedback on instructional pacing and student fluency rates. This "short-loop" feedback mechanism proved that high-end infrastructure is not a prerequisite for effective data use; rather, the timeliness of data and the presence of a human coach to interpret it were decisive factors (Piper et al., 2023).

Kenya's experience highlights the central role of collaborative professional communities and sustained coaching as mediating mechanisms that enable teachers to translate evidence into practice, even in contexts of limited digital infrastructure.

3.4 Colombia: Digital Dashboards and Curriculum Evaluation

Colombia utilizes digital dashboards such as *Evaluate to Advance*, which integrate lesson planning features with adaptive student learning content (OECD, 2024b). These tools support a pedagogical shift from passive content delivery toward more active, diagnostic forms of instruction. Data from TALIS indicate that Colombia performs strongly in formative assessment practices, with 91.3% of teachers reporting the provision of written feedback to students, reflecting a well-established culture of ongoing evaluation (OECD, 2024b).

Despite these advances, a persistent gap remains between policy ambitions and classroom-level implementation. This gap is particularly evident in urban–rural disparities in technological access and the absence of clearly articulated data literacy regulations guiding instructional data use (Durán-Becerra et al., 2023). To address these challenges, Colombia has piloted the UNESCO Media and Information Literacy (MIL) curriculum within teacher education programs. This initiative extends beyond technical proficiency by emphasizing critical cognitive skills required to interpret and apply complex educational data (Durán-Becerra et al., 2023). Through the integration of MIL in pre-service training, Colombia seeks to cultivate teachers who are not merely users of digital dashboards but reflective analysts of student learning trajectories, thereby strengthening the human capacity necessary to realize the pedagogical potential of digital tools (World Bank, 2019a).

This case illustrates that digital dashboards can expand formative assessment practices, but their instructional impact ultimately depends on the development of teachers' critical data interpretation skills and the presence of coherent regulatory guidance to support equitable curriculum improvement.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The comparative analysis revealed clear divergences in how teacher data literacy was operationalized across the four countries. Vietnam and Colombia primarily emphasized technology-driven approaches, relying on digital dashboards, standardized assessment systems, and emerging AI tools to support instructional data use. In contrast, Indonesia and Kenya placed greater emphasis on human-centered mechanisms, particularly coaching models, professional learning communities, and practitioner-led interpretation of data. Despite these differences, a converging pattern emerged across all cases: while access to educational data has expanded significantly, teachers' capacity to translate data into sustained curriculum improvement remains uneven. This gap is driven less by data availability than by the adequacy of pedagogical support, professional learning continuity, and institutional alignment. Accordingly, effective teacher data literacy development requires not only robust data systems but

also sustained investment in human capital to bridge the persistent divide between policy ambition and classroom practice.

4.2 Recommendations

Building on the comparative analysis across Indonesia, Vietnam, Kenya, and Colombia, this study underscores that the effectiveness of teacher data literacy initiatives is shaped less by the sophistication of data systems than by the extent to which teachers are supported to interpret and apply data pedagogically. From a theoretical perspective, these findings call for a reconceptualization of teacher data literacy as a contextual and relational competence, situated at the intersection of policy design, professional learning, and classroom practice. Such a reconceptualization helps explain why similar data infrastructures yield divergent instructional outcomes across national contexts.

In practical terms, the study suggests that investments in educational data systems must be accompanied by professional development models that are continuous, collaborative, and closely aligned with teachers' instructional realities. Evidence from the four cases indicates that teachers engage more meaningfully with data when learning opportunities are embedded in practice. This engagement is further strengthened by coaching, peer collaboration, and short feedback cycles. These conditions enable data to function as a tool for reflective practice rather than as an administrative requirement. As a result, the instructional relevance of data is more likely to be sustained.

At the policy level, the findings highlight the need for coherent national frameworks that explicitly define teacher data literacy, including its ethical, pedagogical, and contextual dimensions. Without such clarity, data-driven reforms risk remaining compliance-oriented and unevenly implemented. Greater alignment among curriculum reform, teacher education, and data governance can help bridge the persistent gap between macro-level policy ambitions and micro-level instructional decision-making. Ultimately, strengthening teacher data literacy through integrated policy and practice offers a viable pathway for transforming educational data from a reporting instrument into a lever for sustained curriculum improvement and instructional quality.

4.3 Limitations and Future Research Directions

While this study provides a comparative policy-level analysis across four developing countries, its methodological scope is necessarily bounded. The directed document review draws on secondary institutional sources that may privilege normative policy narratives over lived classroom realities. As a result, the analysis does not capture teachers' experiential perspectives or informal data practices that extend beyond documented frameworks. Nevertheless, this approach is well aligned with the

study's objective of examining structural conditions, governance mechanisms, and policy coherence across national contexts. Future research could extend these findings through empirical designs, including teacher interviews, classroom observations, or mixed-method approaches, to deepen understanding of how data literacy is enacted at the instructional level.

Building on these policy-oriented recommendations, future research could extend this comparative analysis by examining how teachers interpret, negotiate, and enact data use in everyday instructional contexts. In particular, qualitative and longitudinal studies, as well as evaluations of targeted professional learning interventions, would be valuable for capturing how teacher data literacy develops over time. Such inquiry would help clarify the conditions under which data-driven policies translate into sustained curriculum improvement at the classroom level.

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