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Exploring Differentiated Project-Based Learning Assessment Practices to Strengthen Numeracy Literacy in Elementary Schools

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ABSTRACT

Purpose – This study investigates differentiated project-based assessment practices as a strategic approach to strengthening literacy and numeracy in elementary schools within the spirit of *Merdeka Belajar* (Freedom to Learn). Emerging from the gap between the paradigm of *assessment as learning* and conventional, outcome-oriented practices, this study examines how teachers design, implement, and reflect on student-centered assessments grounded in authentic life contexts.

Methodology – A multi-case qualitative approach was employed across three elementary schools in East Java: SDN Manukan Kulon (Surabaya), SDN Kedung 1 (Probolinggo), and SDN Kanten 1 (Bojonegoro), with data collected through in-depth interviews, participatory observations, and analysis of assessment documents.

Findings – The findings reveal four consistent cross-contextual patterns: contextualized assessment planning, differentiated implementation of processes and products, the use of authentic instruments that evaluate thinking processes, and teachers' professional reflection that strengthens pedagogical awareness. The integration of these four dimensions yielded the *Differentiated Project-Based Assessment Framework (DiPBAF)*, a synthesized model that represents a reflective and equitable learning cycle. This model underscores an epistemological shift in assessment—from a mere measurement tool to a transformative learning vehicle that fosters autonomy, empathy, and collaboration.

Contribution – Theoretically, this research enriches the discourse on 21st-century assessment oriented toward process and reflection; practically, it offers new directions for contextual assessment policies that promote teacher professionalism and high-quality human-centered learning.

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INTRODUCTION

Over the past two decades, literacy and numeracy have become primary indicators of global educational quality, as measured by the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). The OECD report (2023) indicates that more than 50% of students aged 10–15 years in developing countries have not yet reached minimum proficiency levels in both domains. This condition underscores the urgency of 21st-century pedagogical innovation that emphasizes collaboration, critical thinking, and creativity. One approach considered effective in addressing this challenge is Project-Based Learning (PjBL), which connects academic concepts with contextual experiences to enhance higher-order thinking skills (Turmanidze & Tavdgiridze, 2025).

Globally, PjBL has been shown to improve literacy and numeracy competencies when integrated with formative assessment and differentiated instruction. Zhou (2024) found that integrating PjBL and differentiated instruction increases student engagement across diverse learning styles and varying levels of academic readiness. These findings are reinforced by Kristiyuana and Wuriningsih (2025), who reported that project-based differentiated learning effectively reduces achievement gaps in elementary schools across Southeast Asia. However, such practices require teachers to possess strong assessment competencies to adapt evaluation methods to each learner's unique needs.

From a theoretical perspective, PjBL is rooted in Vygotsky's social constructivist theory, which emphasizes social interaction and authentic contexts in learning (Bender, 2012). This approach is further strengthened by Tomlinson's (2014) theory of differentiation, which advocates adapting content, process, and product based on learner characteristics. Within this theoretical framework, assessment functions not merely as a tool for measuring outcomes, but also as a diagnostic mechanism for understanding students' learning needs and determining appropriate instructional interventions (Galvan & Coronado, 2014). Consequently, assessment in differentiated project-based learning serves a dual function: measuring learning outcomes while simultaneously guiding the learning process.

Nevertheless, challenges in implementation persist. Andriyani, Wijayanti, and Ubaidah (2024) reported that many teachers continue to experience difficulties in designing project-based assessment instruments aligned with diverse student learning profiles. Conversely, Andriani, Wibawa, and Firtriawati (2025) found that mastery learning–based assessment within PjBL can sustainably enhance numeracy literacy when supported by adequate teacher training. These contrasting findings highlight ongoing debates about the effectiveness of differentiated assessment in PjBL contexts, underscoring the need for further exploration to identify best practices for elementary education settings.

In the national context, results from the National Assessment (*Asesmen Nasional*) (Kemendikbudristek, 2023) reveal that 52.3% of elementary school students have not yet achieved minimum literacy competence, while 61.8% remain below the average level of numeracy. These data emphasize the need for adaptable learning strategies that accommodate student diversity. Sari and Fanny (2024) emphasize that implementing differentiated strategies through PjBL can optimize students' potential by linking projects to local and sociocultural contexts. This approach aligns with the principles of *Merdeka Belajar*, which emphasize flexibility, contextualization, and learner autonomy (Vito, 2025).

Assessment plays a central role in ensuring the effectiveness of such approaches. Widianingsih and Jampel (2025) demonstrated that formative assessment based on learning styles can enhance early literacy through interactive media. Similarly, Setiawan, Hutauruk, and Ardiansyah (2024) reported that challenge-based assessment supported by STEAM technology strengthens foundational numeracy through contextual project experiences. However, Parwati and Anggoro (2025) noted that research on differentiated assessment remains limited, particularly at the elementary school level. Existing studies predominantly focus on the effectiveness of PjBL in improving learning outcomes, rather than on the underlying assessment mechanisms.

This research gap indicates the need for studies that explore how assessment within differentiated PjBL is implemented to strengthen literacy and numeracy competencies. Sari (2025) argues that literacy and numeracy learning are often fragmented, resulting in a loss of interdisciplinary integration. Differentiated

PjBL offers a solution by integrating literacy and numeracy competencies within authentic projects, assessed through formative mechanisms. This approach enables students to learn in contextual, collaborative, and reflective ways, aligned with their individual needs and capacities.

Based on this analysis, the present study aims to address both theoretical and practical gaps by exploring differentiated project-based learning assessment practices in strengthening literacy and numeracy in elementary schools. This study is expected to enrich the understanding of assessment strategies that not only measure learning outcomes but also foster students' critical and collaborative thinking skills. Furthermore, the findings are anticipated to contribute theoretically to the development of differentiated project-based assessment models and practically to support teachers in implementing adaptive and inclusive learning practices.

Accordingly, this study holds not only academic significance but also direct implications for improving the quality of elementary education in Indonesia. The implementation of differentiated project-based assessment is expected to serve as an effective strategy for realizing competency-oriented learning, aligning with the *Merdeka Belajar* policy, and addressing the challenges of enhancing literacy and numeracy in the era of global educational transformation.

METHODOLOGY

Research Design

This study employed a naturalistic, exploratory, qualitative approach to gain an in-depth understanding of differentiated project-based assessment practices in elementary schools. This approach was selected because it enables the interpretation of meanings derived from teachers' lived experiences within their natural instructional contexts, without manipulation of variables. The research was conducted at three elementary schools: SDN Manukan Kulon Surabaya, SDN Kedung 1, Bantaran District, Probolinggo Regency, and SDN Kanten 1, Trucuk, Bojonegoro, during the period of August to November 2025. The selection of the three elementary schools was conducted purposively to represent diverse educational contexts in East Java, thereby enabling a richer cross-case comparison. SDN Manukan Kulon (Surabaya City) represents an urban school with relatively strong access to digital infrastructure and established experience in implementing the Kurikulum Merdeka. SDN Kedung 1 (Bantaran District, Probolinggo Regency) is located in a semi-rural context, characterized by heterogeneous student abilities and limited resource availability.

Meanwhile, SDN Kanten 1 (Trucuk, Bojonegoro Regency) represents a rural school setting with strong community engagement and contextual learning practices. The inclusion of these three distinct typologies (urban, semi-rural, and rural) was intended to ensure contextual variation and to examine how differentiated project-based assessment practices operate across different sociogeographical conditions. This variation strengthens the relevance of the findings to the broader objective of exploring adaptable and context-sensitive assessment practices in elementary education.

Participants

The research participants consisted of six classroom teachers across Grades I–VI as the primary data sources, three school principals as triangulation informants, and nine students as supporting data sources. The participants consisted of 18 individuals: six classroom teachers, three school principals, and nine students. The six teachers (two from each school) were selected as primary informants because they had direct experience designing and implementing differentiated project-based assessment within the *Kurikulum Merdeka* framework. The three school principals served as triangulation informants, providing institutional perspectives on policy implementation and school-level support. Nine students (three from each school) served as supporting participants, providing insights into their learning experiences and the perceived impact of differentiated assessment practices.

Inclusion criteria for teacher participants were: (1) actively teaching in Grades I–VI during the research period; (2) having at least three years of teaching experience; (3) having implemented project-based learning

aligned with differentiated assessment principles; and (4) willingness to participate voluntarily in interviews and classroom observations. For student participants, inclusion criteria included: (1) active involvement in project-based learning activities; (2) representation of varying academic readiness levels (high, medium, and emerging); and (3) parental consent for participation. Principals were included based on their formal leadership role and involvement in supporting assessment policy implementation.

Exclusion criteria encompassed teachers who had not implemented project-based learning within the current academic year, temporary substitute teachers, students with irregular attendance during the observation period, and participants who withdrew consent at any stage of the research. These criteria were applied to ensure data credibility, contextual relevance, and alignment with the study's objective of deeply exploring differentiated project-based assessment practices in authentic classroom settings.

Conceptual Framework

The conceptual framework of this study illustrates the relationship between Project-Based Learning (PjBL), Differentiated Assessment, and the strengthening of literacy and numeracy competencies in elementary schools. PjBL functions as a contextual and collaborative learning approach, while differentiated assessment serves as an adaptive evaluation strategy responsive to students' diverse needs. These components interact to form differentiated project-based assessment practices implemented across three stages: planning, implementation, and reflection. Through this practice, teachers are expected to develop authentic, student-centered assessments that enhance literacy and numeracy competencies.

The conceptual framework above illustrates the interaction between project-based learning and differentiated assessment approaches as implemented by teachers. The integration of these two approaches yields differentiated project-based assessment practices that account for students' abilities and strengthen literacy and numeracy in elementary schools through reflective, contextual learning processes. This study uses a naturalistic, exploratory, qualitative approach to examine in depth the meanings of teachers' experiences.

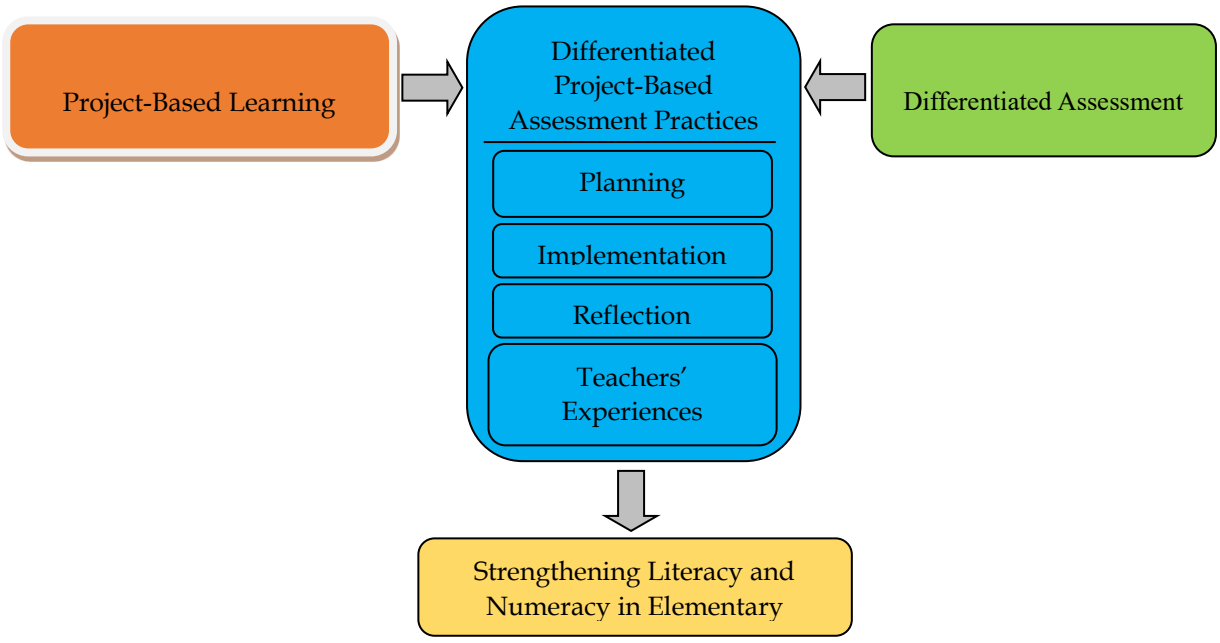

Figure 1. Naturalistic Exploratory Qualitative Conceptual Framework

Instruments

The primary research instrument in this study was the researcher, supported by auxiliary instruments including interview guidelines, observation sheets, and document analysis protocols. The interview guidelines were developed around three main themes: planning, implementation, and reflection on project-based assessment. Observation sheets were used to document teacher and student behaviors during project activities, while document analysis focused on lesson plans, assessment rubrics, student work products, and

teachers' reflective notes. Data validity was ensured through source and technique triangulation and member checking.

Data Analysis

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña (2020), encompassing three core processes: data reduction, data display, and conclusion drawing. Data reduction involved selecting, coding, and categorizing data according to the primary research themes. Data were then presented through descriptive narratives and thematic matrices that linked emergent categories. Conclusions were drawn iteratively and verified through triangulation and the maintenance of an audit trail. This approach enabled an in-depth interpretation of the meanings underlying teachers' practices in differentiated project-based assessment.

FINDINGS

The Findings at SDN Manukan Kulon Surabaya

Descriptive Phase: Contextual Characteristics and Data

The study conducted at SDN Manukan Kulon Surabaya involved six participants representing Grades IV to VI. All teachers had more than five years of experience implementing the *Kurikulum Merdeka* and demonstrated a strong understanding of the importance of formative and summative project-based assessment. Data were collected through in-depth interviews, classroom observations, and documentation of assessment rubrics used in thematic literacy and numeracy project activities. This approach enabled an in-depth exploration of differentiated assessment practices and teachers' adaptive strategies in responding to diverse student abilities (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

Initial analysis revealed that all teachers designed project-based assessments using a three-stage structure: contextual planning, collaborative implementation, and formative reflection. A typical pattern identified was the integration of literacy and numeracy within authentic project contexts, such as writing digital procedural texts, constructing models of human organ systems, and analyzing household expenditures. All projects were designed to stimulate higher-order thinking skills (HOTS) and students' collaborative capacities.

Table 1. Main Themes from NVivo Coding – SDN Manukan Kulon Surabaya

Main Theme	Subtheme	Participants	Observation Focus
Project-Based Assessment Planning	Literacy–numeracy integration, adaptive rubric design	T1, T3	Selection of contextual topics and development of four-level rubrics
Implementation of Differentiation	Heterogeneous grouping, task choice, and scaffolding	T2, T5	Strategies to ensure active participation aligned with student abilities
Assessment Instruments and Evaluation	Analytic rubrics, process observation, and self-reflection	T4, T6	Process- and product-based assessment
Teachers' Professional Reflection	Pedagogical awareness, empathy, and paradigm shift in assessment	All	The teacher's role as a learning facilitator rather than an evaluator

Analytical Phase: Thematic Patterns and Initial Interpretation

Based on thematic analysis, four key themes emerged that characterize differentiated project-based assessment practices at SDN Manukan Kulon.

1. Context-Based Assessment Planning

All teachers began assessment planning by grounding projects in students' real-life contexts. This is evident in the interview data below.

"*If the project is not relevant to children's lives, they quickly lose interest. So before creating a column, I always start by asking myself: Is this relevant to their daily lives?*" (T4, Interview, September 2025).

The data emphasized that the success of project-based assessment depends on clear learning objectives and authentic contextual alignment, such as projects on *Procedural Text Writing* and *Human Digestive System Models*. This approach aligns with authentic assessment theory, which positions contextual learning experiences as a means of fostering literacy and numeracy competencies (Gulikers et al., 2017; Wiggins, 2019). Teachers also demonstrated awareness of the importance of developing adaptive rubrics that accommodate students' varying abilities, consistent with the principles of differentiated instruction (Tomlinson, 2017).

2. Implementation of Differentiated Project-Based Assessment

During implementation, the primary strategies included heterogeneous grouping, offering task choices based on student interests, and scaffolding for learners who required additional support. This is evident in the interview data below.

"*I intentionally create mixed groups. Children who grasp the material more quickly can help their peers. That is where I assess the collaborative process.*" (T1, Interview, September 2025).

This approach reflects a balance between academic rigor and individual learning needs (Hall, Strangman, & Meyer, 2018). The data show the importance of providing students with exploratory space in real-world, problem-based projects. Such practices support the development of learner autonomy and strong social collaboration, as documented in elementary-level project-based learning research (Kokotsaki et al., 2016; Thomas, 2020).

3. Use of Authentic Assessment Instruments

Teachers employed a range of formative and summative assessment tools, including four-level analytic rubrics, observation sheets, and student self-reflections. This is evident in the interview data below.

"*The final grade is not just the product, but also how they discuss, divide tasks, and resolve conflicts.*" (T3, Interview, September 2025).

The data emphasized that open-ended rubrics enabled teachers to monitor students' collaborative and communication skills more effectively. These findings reinforce the notion that project-based assessment evaluates not only outcomes but also students' thinking processes and interactions (Darling-Hammond & Adamson, 2014; Black & Wiliam, 2018). Consequently, assessment functioned as a tool for continuous learning rather than merely an evaluative mechanism (Shepard et al., 2020).

4. Teacher Reflection and Professionalism

All participants reported that implementing differentiated project-based assessment had a significant impact on their professional practice. Teachers experienced a paradigm shift from being "outcome evaluators" to "facilitators of thinking processes." This is evident in the interview data below.

"*The project made me realize that every child has a different learning style.*" (T2, Interview, September 2025).

This finding aligns with international research highlighting teacher reflection as a key factor in the development of pedagogical competence (Korthagen, 2017; Zeichner & Liston, 2016). Teachers also demonstrated increased empathy and awareness of students' diverse learning needs, reinforcing their role as reflective practitioners within 21st-century education paradigms (Fullan & Quinn, 2016).

Interpretive Phase: Cross-Theme Patterns and Contextual Meaning

The findings indicate that differentiated project-based assessment practices at SDN Manukan Kulon Surabaya fostered a collaborative, reflective, and student-centered learning ecosystem. The emerging pattern

revealed interconnectedness among the four main themes: planning, implementation, assessment instruments, and reflection operating as a continuous cycle. Teachers functioned as designers of learning experiences rather than mere outcome assessors (Andrade & Brookhart, 2020).

This phenomenon signals an epistemological shift in elementary school assessment practices in Indonesia, moving from traditional assessment paradigms toward *assessment as learning* (Diemer et al., 2020). Teachers developed a renewed understanding that assessment is not the terminal stage of learning but a diagnostic and growth-oriented tool for students' intellectual development.

Furthermore, differentiation emerged as a critical success factor by ensuring meaningful participation for all students based on their readiness levels and learning styles (Subban, 2017). These findings support the view that differentiated project-based assessment is not merely a pedagogical strategy but a transformative learning culture in elementary education that emphasizes equity, participation, and authentic learning.

The Findings at SDN Kedung 1, Bantaran District, Probolinggo Regency

Descriptive Phase: Research Context and Data Characteristics

The study at SDN Kedung 1, Bantaran District, Probolinggo Regency involved six participants representing Grades I to VI. These teachers represented a complete range of elementary grade levels and possessed diverse teaching experience, ranging from 7 to 20 years.

Research data were obtained through in-depth interviews, observations of project-based learning activities, and document analysis of assessment instruments, including rubrics, observation checklists, teachers' reflective notes, and students' project products. Data analysis employed thematic analysis using the coding–categorizing–thematizing procedure (Braun & Clarke, 2021), enabling the identification of patterns in teachers' practices and professional awareness regarding differentiated project-based assessment in literacy and numeracy contexts.

The school context reflects a semi-rural setting characterized by high heterogeneity in students' abilities. This condition required teachers to adapt learning strategies to individual needs and limited resources. Nevertheless, all teachers demonstrated adaptive and reflective capacities in designing inclusive, contextual, and student-centered assessment practices aligned with the principles of the *Kurikulum Merdeka*.

Table 2. NVivo Coding Results – Main Themes at SDN Kedung 1, Probolinggo Regency

Main Theme	Subtheme	Participants	Observation Focus
Contextual and Adaptive Assessment Planning	Real-life–based project selection	T7, T8	Project design aligned with students' developmental stages and numeracy outcomes
Differentiation of Process and Product	Heterogeneous grouping, scaffolding, and task choice	T12, T10	Collaborative activities adapted to individual abilities
Use of Authentic Assessment Instruments	Descriptive rubrics, process observation, and self-reflection	T9, T11	Holistic evaluation of thinking processes and project outcomes
Teacher Professional Reflection	Paradigm shift in assessment, reflective awareness, and peer collaboration	All	Transformation of teacher roles into facilitators and learning mentors

Analytical Phase: Thematic Patterns and Key Findings

1. Contextual and Adaptive Assessment Planning

Teachers at SDN Kedung 1 initiated project-based assessment by designing contextual plans that aligned literacy and numeracy outcomes with students' everyday experiences. This is evident in the interview data below.

"I provide more intensive support to children who are still struggling, but I keep them in groups so they do not feel isolated." (T11, Interview, September 2025)

From the data, those who taught lower grades developed simple projects such as Counting School Supplies and Shopping at the Mini Canteen to develop foundational numeracy skills concretely. Meanwhile, teachers at middle and upper grades designed more complex projects, such as Measuring Object Lengths in the School Environment *and* Fraction Analysis in Healthy Entrepreneurship Contexts.

Assessment planning took into account students' learning readiness, interests, and levels of abstraction, reflecting the application of constructive alignment authentic assessment principles that position real-life experience at the center of learning activities (Gulikers et al., 2017). These findings support the view that contextual relevance enhances student motivation and conceptual understanding (Wiggins, 2019).

2. Implementation of Differentiated Project-Based Assessment

Differentiation was implemented across three primary dimensions: content, process, and product. Teachers adapted the content by varying the task complexity based on students' abilities. At the process level, students were organized into heterogeneous groups and supported through graduated scaffolding. At the product level, students were given choices in demonstrating learning outcomes, such as written reports, oral presentations, or visual artifacts. This is evident in the interview data below.

"When it comes to abstract fractions, they struggle. So, I start with dividing up food or pocket money." (T12, Interview, September 2025)

The data highlighted the use of small-group instruction and peer tutoring to strengthen collaboration. At the same time, the teacher modified advanced numeracy projects, such as Fraction Comparisons in Daily Life, for high-achieving students. These practices align with differentiated instruction theory (Tomlinson, 2017) and Universal Design for Learning (UDL) principles (CAST, 2018), which promote equitable participation without discrimination based on ability.

Classroom observations revealed increased student motivation and active engagement. Students demonstrated a willingness to take on challenging tasks, collaborate with peers, and deepen their understanding of numeracy. These findings are consistent with Levy and Fox (2020), who reported that project-based differentiated assessment strengthens numeracy literacy while fostering learner confidence.

3. Use of Authentic Assessment Instruments

Teachers employed four-level analytic rubrics (emerging–adequate–competent–proficient), observation sheets, indicator checklists, and anecdotal records. These instruments assessed four core dimensions: conceptual understanding, work process, collaboration, and reflective capacity. This is evident in the interview data below.

"I give them options: some write reports, others present. Not all children are comfortable with long writing sessions." (T8, Interview, September 2025)

The data highlighted the importance of balancing process-oriented and product-oriented assessment. Sri Hastuti implemented portfolio-based assessment to document students' individual learning trajectories, while Siti Fatimah utilized continuous assessment with formative feedback and opportunities for revision.

These practices reflect the assessment for learning paradigm (Black & Wiliam, 2018), positioning assessment as a diagnostic and learning-enhancement tool. The findings confirm that project-based assessment in elementary education can foster critical thinking, problem-solving, and student self-reflection (Earl, 2013; Shepard et al., 2020).

4. Teacher Professional Reflection and Awareness

All participants demonstrated heightened professional reflectivity following the implementation of differentiated project-based assessment. Teachers recognized that assessment is not merely an administrative task but an integral component of the learning process. This is evident in the interview data below.

"The project has made me more sensitive to the children's differing abilities." (T7, Interview, September 2025)

The data reported increased sensitivity toward student diversity. Next, the data enhanced the capacity to design equitable and relevant learning activities. This reflective process aligns with the reflective practice model (Korthagen, 2017; Zeichner & Liston, 2016), which emphasizes introspection and collegial collaboration for instructional improvement.

Teachers also began forming informal professional learning communities (PLCs) to share assessment experiences and strategies. This development indicates that project-based assessment impacts not only students but also serves as a medium for sustained teacher professional growth (Fullan & Quinn, 2016; Darling-Hammond et al., 2020).

Interpretive Phase: Integration of Meaning and Implications

Cross-grade analysis at SDN Kedung 1 reveals that differentiated project-based assessment serves a dual function: as an authentic evaluation tool and as a humanistic active learning strategy. The four major themes: adaptive planning, differentiated implementation, authentic assessment, and professional reflection, collectively form a continuous reflective learning cycle.

Teachers at this school demonstrated a paradigm shift from assessment of learning toward assessment as learning in which assessment becomes embedded within the learning process itself. The findings further strengthen empirical evidence that differentiated project-based assessment simultaneously enhances literacy and numeracy competencies, fosters collaborative learning cultures, and reinforces teacher professionalism (Andrade & Brookhart, 2020; Levy & Fox, 2020).

Moreover, the results indicate that teachers were able to adapt assessment practices to local realities without compromising academic rigor. Thus, differentiated project-based assessment at SDN Kedung 1, Probolinggo Regency, may be regarded as a best practice model for contextual, adaptive, and student-centered learning in elementary education.

The Findings at SDN Kanten 1, Trucuk, Bojonegoro

Descriptive Phase: Research Context and Data Characteristics

The study at SDN Kanten 1, Trucuk, Bojonegoro, involved six teachers from different grade levels. These participants represented a wide range of teaching experiences, from early-grade concrete learning to complex project-based assessment at upper elementary levels.

Data were collected through in-depth interviews, classroom observations, and document analysis of assessment artifacts, including scoring rubrics, teachers' reflective notes, and students' project reports. Data analysis employed thematic network analysis (Attride-Stirling, 2001), enabling the identification of core themes and subthemes that formed the overall meaning structure of differentiated project-based assessment practices.

The context of SDN Kanten 1 indicates a high level of readiness for implementing the *Kurikulum Merdeka*. Teachers at this school were accustomed to designing project-based learning activities but faced challenges related to student ability differentiation and project time management. Interview data revealed that all teachers perceived project-based assessment not merely as an evaluation tool, but as a learning medium that fosters creativity, collaboration, and learner autonomy.

Table 3. NVivo Coding Results – Main Themes at SDN Kanten 1, Trucuk, Bojonegoro

Main Theme	Subtheme	Participants	Observation Focus
Adaptive and Contextual Assessment Planning	Integration of literacy and numeracy in authentic projects	T13, T14	Alignment of projects with students' real-life contexts

Flexible Differentiated Implementation	Task choice, group roles, scaffolding	T15, T16	Adaptation of activities to students' learning styles and abilities
Use of Technology and Assessment Innovation	Gamification, digital platforms, and visual media	T17, T18	Digital integration to sustain student motivation
Teacher Reflection and Competency Development	Reflective awareness, peer collaboration, and paradigm shift in assessment	All participants	The teacher's role as a learning facilitator and practitioner-researcher

Analytical Phase: Thematic Patterns and Key Findings

1. Adaptive and Contextual Assessment Planning

Interview findings indicate that all teachers initiated assessment planning by identifying learning outcomes and literacy and numeracy indicators relevant to students' everyday lives. This is evident in the interview data below.

"*Kids are more enthusiastic if the project is about a small business or a home activity.*" (T13, Interview, September 2025)

The Data illustrated simple projects such as Counting Household Items and Healthy Canteen Entrepreneurship, which simultaneously developed numeracy skills and communication competencies while instilling values of responsibility.

Teachers at SDN Kanten 1 adopted contextualized project-based assessment, ensuring that projects were meaningful and rooted in students' lived experiences (Kokotsaki, Menzies, & Wiggins, 2016; Gulikers et al., 2017). This practice reflects a strong understanding of constructivist pedagogy, which positions learners as active meaning-makers through social and reflective activities.

2. Implementation of Differentiated Project-Based Assessment

Differentiation strategies were implemented comprehensively across content, process, and product dimensions. This is evident in the interview data below.

"*I provide different instructions based on each group's needs.*" (T15, Interview, September 2025)

The data provided tiered task variations, organized heterogeneous groups, modified instructions, and supplied additional learning aids for students with specific learning needs.

These practices align with Universal Design for Learning (UDL) principles and Vygotsky's zone of proximal development, emphasizing graduated support to enable all learners to progress in line with their potential. Teachers also assessed collaborative processes rather than focusing solely on final products, consistent with formative assessment models (Black & Wiliam, 2018). Differentiated implementation was found to increase students' active participation, self-confidence, and interpersonal communication skills.

3. Use of Technology and Assessment Innovation

A distinctive feature of SDN Kanten 1 was the integration of technology and innovative assessment practices. This is evident in the interview data below.

"*With Google Forms, I can provide immediate feedback without waiting long.*" (T17, Interview, September 2025)

The data were collected through digital platforms such as Quizizz and Google Forms for formative assessment activities. They developed digital projects themed *Household Budget Planning*, which required students to analyze numerical data and present visual representations.

These innovations indicate a transition toward digital formative assessment, which has been shown to enhance student motivation and digital literacy (Pellegrino, 2021; Redecker & Punie, 2017). The integration of digital media also facilitated differentiation across visual, auditory, and kinesthetic learning preferences.

4. Teacher Professional Reflection

All participants demonstrated heightened reflective awareness following the implementation of differentiated project-based assessment. Teachers identified a shift in their roles from evaluators to facilitators and learning mentors. This is evident in the interview data below.

"*Now I feel like I am not just assessing them, but also guiding their learning process.*" (T13, Interview, September 2025)

The data reported that differentiated projects encouraged deeper understanding of students' individual strengths and emphasized that project-based assessment enabled her to assess students' *thinking processes* rather than merely their *final outputs*.

These findings reinforce the concept of the teacher as a reflective practitioner (Korthagen, 2017; Zeichner & Liston, 2016) and demonstrate that project-based assessment also serves as a medium for continuous professional development. Collaborative reflection among teachers fostered a culture of shared best practices, consistent with the principles of professional learning communities (Fullan & Quinn, 2016).

Interpretive Phase: Integration of Meaning and Implications

The findings from SDN Kanten 1, Trucuk, Bojonegoro, reveal that differentiated project-based assessment not only enhances students' literacy and numeracy achievement but also transforms teachers' pedagogical paradigms. Four major themes: adaptive planning, flexible implementation, digital innovation, and professional reflection interacted to form a cyclical learning ecosystem, in which assessment functioned as a continuous reflective tool.

This pattern suggests that differentiated project-based assessment holds strong potential to bridge the gap between *assessment as a learning* theory and actual classroom practice in elementary schools (Earl, 2013). Flexible and contextual assessment practices enabled student-centered learning, strengthened educational equity, and promoted higher-order thinking skills (Hattie & Timperley, 2007; Andrade & Brookhart, 2020).

Furthermore, the integration of technology and reflective professionalism indicates a progressive direction for assessment in the digital era, where teachers act not only as assessors but also as learning designers who create meaningful and adaptive learning experiences (Redecker & Punie, 2017). Accordingly, differentiated project-based assessment practices at SDN Kanten 1 may be regarded as a mature, inclusive, and visionary model for elementary education.

Cross-Case Analysis

Descriptive Phase: Overview of Cross-School Contexts

The cross-case analysis in this study encompassed three elementary school contexts in East Java: SDN Manukan Kulon in Surabaya City, SDN Kedung 1 in Probolinggo Regency, and SDN Kanten 1 in Bojonegoro Regency. These three schools were purposively selected to represent diverse sociogeographical and educational typologies—urban, semi-rural, and rural—thereby enabling a richer comparative understanding of differentiated project-based assessment practices across varied institutional settings. SDN Manukan Kulon reflects an urban school environment characterized by relatively strong access to digital infrastructure and structured assessment systems. In contrast, SDN Kedung 1 represents a semi-rural context marked by heterogeneous student abilities and moderate resource availability, requiring adaptive and inclusive instructional strategies. Meanwhile, SDN Kanten 1 illustrates a rural educational setting with strong community engagement and contextualized learning practices. The inclusion of these three contrasting contexts provides a comprehensive foundation for examining how differentiated project-based assessment is implemented, adapted, and interpreted across diverse environmental, cultural, and institutional contexts in elementary education.

These schools represent distinct typologies: urban, semi-rural, and rural, each generating unique dynamics in the implementation of differentiated project-based assessment. SDN Manukan Kulon

demonstrated relatively structured and innovative assessment practices supported by digital infrastructure; SDN Kedung 1 exhibited adaptive practices emphasizing inclusivity and simplicity of assessment instruments; while SDN Kanten 1 highlighted strong contextualization of learning and teacher collaboration within reflective communities.

Despite differences in resource availability and school context, teachers across all three schools shared a common orientation toward a central goal: positioning assessment as a medium for meaningful learning *(*assessment as learning*)*, rather than merely as a tool for measuring outcomes. This finding reflects the growing professional awareness among elementary school teachers in implementing the principles of *Merdeka Belajar* through differentiated assessment practices (Darling-Hammond et al., 2020).

Table 4. Comparison of Key Dimensions of Differentiated Project-Based Assessment Across Schools

Analytical Dimension	SDN Manukan Kulon	SDN Kedung 1	SDN Kanten 1
School Context	Urban with high access to technology	Semi-rural with high heterogeneity of student abilities	Rural with strong community collaboration
Primary Focus	Structured rubrics and authentic assessment	Adaptive differentiation of process and product	Strong contextualization and teacher reflection
Differentiation Approach	Based on student interests and learning styles	Based on cognitive readiness and scaffolding support	Based on local context and choice of learning products
Assessment Instruments	Analytic rubrics, digital feedback, and project presentations	Observation checklists, descriptive rubrics, and simple portfolios	Mixed rubrics, observation, and self-reflection
Impact on Students	Improved collaborative skills and critical thinking	Increased participation and self-confidence	Enhanced intrinsic motivation and meaningful understanding
Impact on Teachers	Strengthened reflective professionalism	Increased pedagogical empathy and creativity	Development of professional learning communities (PLCs)

Analytical Phase: Thematic Similarities and Differences

The comparative analysis across the three schools revealed four major cross-contextual patterns that consistently characterized the implementation of differentiated project-based assessment. First, contextual assessment emerged as a central mechanism for strengthening literacy and numeracy, as teachers in all settings grounded projects in students' real-life experiences to enhance conceptual understanding and relevance. Second, differentiation functioned as a foundation for inclusivity, ensuring that variations in students' readiness levels, interests, and learning profiles were accommodated through adaptive strategies in content, process, and product. Third, the authenticity of assessment instruments reflected a commitment to holistic evaluation, with teachers employing analytic rubrics, process observations, portfolios, and student reflections to assess not only final outputs but also thinking processes, collaboration, and metacognitive development. Finally, teacher reflection operated as a critical driver of professional growth, as educators continuously evaluated and refined their assessment practices through dialogue, peer collaboration, and self-examination. Together, these four interrelated patterns illustrate a coherent pedagogical transformation in which assessment is repositioned from a mere measurement tool to an inclusive, reflective, and learning-oriented practice.

1. Contextual Assessment and Literacy–Numeracy Relevance

Teachers in all three schools positioned real-life contexts as the starting point for project design. At SDN Manukan Kulon, projects such as Procedural Text Writing and Household Expenditure Analysis required data-based integration of literacy and numeracy. At SDN Kedung 1, simple projects such as Shopping at the Mini Canteen fostered basic numeracy and social transaction skills. Meanwhile, teachers at SDN Kanten 1 developed environment- and entrepreneurship-based projects as media for contextual literacy and numeracy learning.

This pattern confirms that contextual learning strengthens the connection between academic content and students' lived experiences, consistent with situated learning theory (Lave & Wenger, 1991) and contextual teaching and learning (Johnson, 2017). Moreover, project-based assessment rooted in students' real-world contexts has been shown to enhance knowledge retention and higher-order thinking skills (Bell, 2010; Thomas, 2020).

2. Differentiation as a Mechanism for Inclusivity

All three schools implemented differentiation through varying approaches while sharing a common objective: ensuring meaningful participation for every student. At SDN Manukan Kulon, differentiation was based on interests and learning styles; at SDN Kedung 1, it focused on cognitive readiness and task difficulty; and at SDN Kanten 1, it emphasized choice of products and modes of expression.

These practices demonstrate the application of equity pedagogy (Banks, 2015) and differentiated instruction (Tomlinson, 2017), which have been shown to increase motivation and engagement among students with diverse abilities effectively. The findings align with Levy and Fox (2020), who reported that combining project-based learning with differentiation strengthens intrinsic motivation and supports metacognitive development.

3. Authentic Assessment Instruments and Holistic Evaluation

Across all contexts, teachers employed assessment instruments reflecting the paradigm of authentic assessment, including analytic rubrics, direct observation, and student self-reflection. However, the complexity and depth of these instruments varied by context. SDN Manukan Kulon implemented digital rubrics and immediate feedback systems; SDN Kedung 1 emphasized engagement and process evaluation through observation sheets; while SDN Kanten 1 balanced assessment of product, process, and student reflection.

These practices align with assessment for learning principles (Black & Wiliam, 2018), which emphasize continuous formative assessment to support learning progression. Teachers shifted from normative assessment toward process-oriented and reflective evaluation (Andrade & Brookhart, 2020; Shepard et al., 2020).

4. Teacher Reflection and Professional Development

Teacher reflection emerged as the strongest cross-contextual dimension. Teachers at SDN Kedung 1 and SDN Kanten 1 reported that project-based assessment enhanced their understanding of student diversity and fostered sustained reflective practices. At SDN Manukan Kulon, reflection was supported through peer discussions and digital portfolios.

This pattern confirms the concept of reflective practice (Schön, 1983; Korthagen, 2017), in which assessment functions not only as an evaluative tool but also as a medium for professional growth. Furthermore, the emergence of professional learning communities (PLCs) at SDN Kanten 1 illustrates the systemic impact of assessment practices on collaborative teacher culture (Fullan & Quinn, 2016)

Interpretive Phase: Integration of Meaning and Conceptual Model

The cross-case analysis indicates that differentiated project-based assessment generates pedagogical transformation across interconnected levels of the educational ecosystem. At the micro level of the classroom, a significant shift occurs in teachers' assessment paradigms, moving from traditional, outcome-oriented

evaluation to a process-oriented, learning-centered approach in which assessment is embedded within instructional practice. Teachers increasingly emphasize students' thinking processes, collaboration, and reflective growth rather than merely final scores. At the meso level of the school, this transformation extends to the development of collaborative professional cultures, as teachers engage in shared reflection, exchange assessment strategies, and co-construct project designs that promote consistency and inclusivity. Such collegial practices contribute to the emergence of professional learning communities that sustain instructional improvement. At the macro or contextual level, these pedagogical shifts collectively strengthen students' literacy and numeracy competencies through meaningful, authentic, and student-centered learning experiences that connect academic concepts to real-world contexts. Together, these three levels illustrate how differentiated project-based assessment operates not only as a classroom strategy but also as a systemic driver of educational transformation.

Conceptually, these cross-school findings resulted in a synthesized model termed the Differentiated Project-Based Assessment Framework (DiPBAF), which positions four core dimensions: contextuality, differentiation, authenticity, and reflection as foundational pillars for strengthening literacy and numeracy in elementary education.

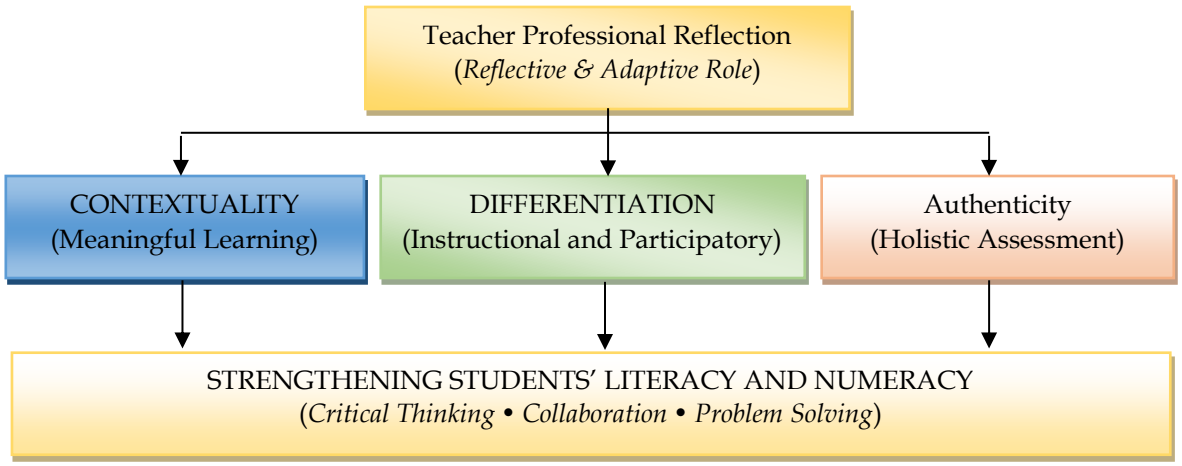

Figure 2. Conceptual Model of DiPBAF (Differentiated Project-Based Assessment Framework)

This model illustrates how four main dimensions interact to form a student-centered reflective learning cycle. Contextuality ensures the relevance of learning, differentiation guarantees participatory equity, authenticity ensures the integration of process and product assessment, while teacher reflection serves as the driving force for continuous improvement. These findings are consistent with international studies indicating that differentiated project-based assessment is practical in developing 21st-century skills and empirically fostering teacher professionalism (Hattie & Clarke, 2019).

DISCUSSION

The findings of this study indicate that differentiated project-based assessment practices in elementary schools have evolved into a pedagogical approach that is process-oriented, reflective, and student-centered. The three school contexts: SDN Manukan Kulon Surabaya, SDN Kedung 1 Probolinggo Regency, and SDN Kanten 1 Bojonegoro Regency exhibited different yet complementary dynamics in constructing the meaning of assessment as an integral component of learning. These empirical findings affirm that differentiated project-based assessment is not merely an assessment technique, but an educational paradigm that integrates contextual, inclusive, and reflective learning in alignment with the spirit of the *Kurikulum Merdeka*.

From a theoretical perspective, the practices observed across the three schools demonstrate convergence among three major theories: social constructivism, differentiated learning, and authentic assessment. Within the framework of social constructivism proposed by Vygotsky (1978), learning is viewed as a social process in which students construct knowledge through interaction and authentic experiences. Teachers function as

facilitators who create zones of proximal development through graduated scaffolding tailored to individual student needs. This was clearly evident in the practices at SDN Kedung 1 and SDN Kanten 1, where teachers provided differentiated support to students with varying abilities. This approach confirms that differentiated project-based assessment positions students as active subjects of learning who construct understanding through real-world contexts.

The theory of differentiation developed by Tomlinson (2017) further reinforces these findings. Teachers in all three schools consistently applied differentiation across three primary levels: content, process, and product. They provided task options based on students' interests and abilities, organized students into heterogeneous groups, and allowed variations in project outputs, including written reports, visual presentations, and practical artifacts. This application of differentiation not only facilitated student engagement but also fostered self-confidence, empathy, and responsibility in collaborative work. Thus, differentiation proved to be a primary mechanism of classroom inclusivity, ensuring that every student could participate meaningfully in learning (Levy & Fox, 2020; Hall, Strangman, & Meyer, 2018).

Authentic assessment, as articulated by Wiggins (2019) and Gulikers et al. (2017), emerged as the third pillar underpinning these practices. Across the three schools, assessment did not end at measuring learning outcomes but served as a process of reflection and learning in itself. Teachers employed four-level analytic rubrics, process observation sheets, student self-reflections, and project portfolios to assess both cognitive and social development. This approach aligns with the principle of *assessment as learning* (Earl, 2013), which views assessment as a means for students to understand their own learning progress and for teachers to adjust instructional strategies. Consequently, project-based assessment served a dual function: as a diagnostic tool and as a pedagogical instrument that continuously guides the learning process (Black & Wiliam, 2018; Andrade & Brookhart, 2020).

Cross-school findings further indicate that differentiated project-based assessment possesses adaptive capacity across diverse social, geographical, and resource contexts. At SDN Manukan Kulon, located in an urban area with high access to technology, teachers used digital media for learning documentation and for developing online rubrics. In contrast, at SDN Kedung 1, situated in a semi-rural setting, teachers adapted their approaches to limited facilities through direct observation and everyday-life–based projects such as *Shopping at the Mini Canteen* and *Measuring Object Lengths in School*. Meanwhile, at SDN Kanten 1, located in a rural area, teachers combined local innovation with simple technology in projects themed around healthy entrepreneurship and family financial management. These differences demonstrate that differentiated project-based assessment is flexible and contextual, enabling its implementation across diverse learning environments without compromising its pedagogical essence (Darling-Hammond et al., 2020; Johnson, 2017).

From a pedagogical transformation perspective, the findings reveal a fundamental shift in teachers' roles. Differentiated project-based assessment has moved teachers' paradigms from evaluators toward facilitators of learning. Teachers no longer merely assess outcomes but actively support students' thinking processes, exploration, and collaboration. Across all contexts, teachers developed reflective sensitivity toward student diversity and demonstrated a willingness to learn from their own practices, consistent with the concept of the *reflective practitioner* (Korthagen, 2017; Zeichner & Liston, 2016). This transformation also enhanced classroom interaction quality, as teachers increasingly provided formative feedback, discussed rubrics with students, and used assessment as a medium for two-way pedagogical dialogue.

In addition to transforming teachers' practices, differentiated project-based assessment also strengthened students' 21st-century skills, particularly critical thinking, communication, collaboration, and creativity. Authentic projects such as *Household Expenditure Analysis*, *Fraction Comparison in Healthy Entrepreneurship*, and *School Canteen Entrepreneurship* integrated literacy and numeracy within real-life contexts. These activities required students to collect data, perform calculations, write reports, and present findings. Such processes fostered problem-solving abilities and metacognitive skills (Hattie & Timperley, 2007; Bell, 2010). Thus, project-based assessment not only measured academic outcomes but also cultivated complex competencies relevant to 21st-century educational demands.

Conceptually, this study yielded a synthesized model, the Differentiated Project-Based Assessment Framework (DiPBAF)**.** This model delineates four core dimensions: contextuality, differentiation, authenticity, and reflection operating within a single reflective learning cycle. Contextuality ensures the relevance of learning to students' real lives; differentiation guarantees participatory equity through adaptation to individual needs; authenticity ensures integration between learning processes and products; and teacher reflection functions as the engine of continuous improvement. The DiPBAF model extends Tomlinson's (2017) differentiation theory by positioning assessment as the primary driver of the learning process. Accordingly, the model reorients assessment from a selection tool toward a humanistic learning empowerment instrument (Andrade & Brookhart, 2020; Earl, 2013).

The scientific contribution of this study lies in strengthening the position of assessment as a key element of differentiated learning in elementary education. Theoretically, the findings enrich the literature on authentic assessment by incorporating contextual and reflective dimensions into project design. Practically, the study guides teachers in developing adaptive rubrics, observation instruments, and formative feedback mechanisms aligned with students' needs. Teachers may use the DiPBAF as a framework for designing diverse and meaningful learning experiences. From a policy perspective, this model offers empirical support for strengthening the *Merdeka Belajar* program and the *Asesmen Kompetensi Minimum (AKM)*, which emphasize competency-based learning, teacher autonomy, and authentic assessment.

Nevertheless, this study has limitations that must be acknowledged. The naturalistic qualitative approach, with a limited number of participants, limits the generalizability of the findings. Observations conducted within a specific timeframe may not fully capture the long-term dynamics of teachers' pedagogical transformation. Therefore, future research is recommended to employ mixed-methods approaches that integrate in-depth interviews, classroom observations, and quantitative analyses of student learning outcomes (Creswell & Plano Clark, 2018). Longitudinal studies are also needed to examine the sustainability of teachers' reflective practices and the long-term impact of project-based assessment on students' literacy and numeracy development.

Beyond methodological limitations, this study has not yet extensively explored the potential of adaptive digital assessment within differentiated contexts. Future research may investigate the development of digital formative assessment as a strategic direction for strengthening data-driven assessment practices. Platforms such as Quizizz, Google Classroom, or Kahoot! offer potential tools for monitoring individual student progress and providing more immediate automated feedback (Redecker & Punie, 2017; Pellegrino, 2021). Further studies are also encouraged to examine the formation of cross-school Professional Learning Communities (PLCs**)** as a systemic strategy for enhancing teachers' capacity to design differentiated assessment practices (Fullan & Quinn, 2016).

The policy implications of this study are highly relevant to the direction of educational reform in Indonesia. First, the findings indicate that differentiated project-based assessment can serve as a micro-level policy model for implementing the *Kurikulum Merdeka*. Local governments and schools may adopt the DiPBAF framework as a guideline for teacher training and authentic assessment practices in elementary education. Second, differentiated project-based assessment should be integrated into the *Profil Pelajar Pancasila*'s assessment system, as it effectively evaluates character dimensions, collaboration, and critical thinking that cannot be adequately measured through standardized testing (Darling-Hammond et al., 2020). Third, policymakers should strengthen evidence-based policymaking by using empirical research findings, such as those presented in this study, as a foundation for curriculum decision-making and educational evaluation.

Overall, this study's results demonstrate that differentiated project-based assessment effectively bridges the gap between educational theory and classroom practice in elementary schools. It functions as a pedagogical strategy that integrates contextual learning, authentic assessment, and teacher professional reflection into a coherent and sustainable system. By applying the principles of contextuality, differentiation, authenticity, and reflection, differentiated project-based assessment not only enhances students' literacy and numeracy competencies but also fosters a humanistic, collaborative, and future-oriented learning culture.

CONCLUSION

This study concludes that differentiated project-based assessment constitutes a transformative pedagogical strategy that not only evaluates learning outcomes but also fosters reflective awareness, empathy, and collaboration among teachers and students. Practices observed in the three elementary schools demonstrate that contextual planning, adaptive implementation, the use of authentic instruments, and professional reflection collectively form a sustainable learning cycle. Differentiated project-based assessment has been shown to enhance literacy and numeracy through relevant, meaningful, and student-centered activities.

The primary contribution of this study lies in the development of the DiPBAF (Differentiated Project-Based Assessment Framework), which integrates the dimensions of contextuality, differentiation, authenticity, and reflection as the foundation for strengthening literacy and numeracy in elementary education. Theoretically, this model extends the *assessment-as-learning* paradigm toward an *assessment-for-growth* orientation; practically, it serves as a practical guide for teachers in designing inclusive and reflective assessment practices.

The limitations of this study include the restricted scope of contexts and the absence of an integrated adaptive digital assessment. Nevertheless, the findings provide evidence-based policy directions for strengthening the *Kurikulum Merdeka* and the national *Asesmen Kompetensi Minimum (AKM)* system. This study recommends cross-school collaboration through professional learning communities (PLCs) as a strategic effort to expand the impact of the DiPBAF model on assessment practices in Indonesia.

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