



Learning needs analysis for differentiated instruction in Indonesian elementary education

Ratna Novita Punggeti*, Raden Firman Nurbudi Prijambodo

Universitas Wiraraja, Sumenep, Jawa Timur, Indonesia

*Correspondence author: punggetifkip@wiraraja.ac.id

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ABSTRACT

Purpose: to analyze the learning needs of elementary school students and examine how learning needs analysis serves as the foundation for implementing differentiated instruction, as well as to identify the challenges and potential solutions for its implementation in Indonesian elementary education.

Method: this study used a narrative literature review with thematic analysis to synthesize research on elementary students' learning needs and differentiated instruction from relevant academic sources.

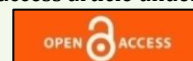
Findings: elementary students' learning needs are multidimensional, encompassing cognitive development, learning styles, readiness, and learning interests, which collectively shape differentiated instruction. The study shows that these aspects can be integrated into Tomlinson's framework of content, process, product, and learning environment differentiation. However, implementation in Indonesian elementary schools still faces challenges such as limited teacher competence, time constraints, classroom heterogeneity, and inadequate resources.

Implications: a conceptual framework to support teachers in conducting learning needs analysis and implementing differentiated instruction in elementary schools. It also offers guidance for curriculum developers and future research to improve assessment tools and instructional strategies under the merdeka curriculum.

Originality: a comprehensive integration of cognitive development, learning styles, readiness, and learning interests into a unified framework of learning needs, which has not been fully synthesized in previous studies on differentiated instruction in elementary education.



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Introduction

Elementary education currently faces increasingly complex challenges as a consequence of the increasing diversity of student characteristics within the classroom (Sihombing et al., 2024). In a single classroom, teachers encounter students with varying

academic abilities, learning readiness, interests, learning styles, motivations, and socioeconomic backgrounds (Bhandari et al., 2025). This situation means that a uniform (one-size-fits-all) learning approach is no longer able to accommodate the learning needs of all students optimally (Goyibova et al., 2025). Teachers are no longer sufficient to apply the same learning strategies to all students; instead, they are required to design learning experiences that are adaptive to individual student characteristics (Punggeti & Prijambodo, 2025b; Romlah & Suciptaningsih, 2023). Therefore, learning in elementary schools requires a student-centered approach through identifying learning needs as the basis for developing effective learning strategies.

This phenomenon has become increasingly relevant since the implementation of the merdeka curriculum, which places learning differentiation as one of the main principles of the learning process. The merdeka curriculum provides teachers with the flexibility to adapt materials, strategies, activities, and assessments based on student characteristics, so that each student receives learning opportunities that align with their potential (Kristiani et al., 2023; Soviyani et al., 2024). Implementation of this policy requires teachers to conduct a diagnostic assessment at the beginning of the lesson to identify students' learning readiness, interests, and learning characteristics before determining the learning strategies to be used (Haka et al., 2025; Punggeti & Prijambodo, 2024). However, various studies show that the implementation of learning differentiation in Indonesian elementary schools still faces various obstacles, including teachers' limited understanding of learning needs analysis, limited time in mapping student characteristics, and a lack of tools that can be used as a reference for systematically identifying learning needs (Nurhidayah et al., 2023).

Various previous studies have demonstrated that differentiated learning can improve learning engagement, motivation, and learning outcomes in elementary school students when based on individual student characteristics (Chen & Shih, 2025; Dermawan et al., 2024; Mulyawati et al., 2022; Nuraini & Ramadan, 2024). Other studies also confirm that diagnostic assessment is a crucial instrument in identifying students' learning readiness before learning begins (Iskak et al., 2023). Furthermore, studies on the implementation of differentiated learning within the merdeka curriculum are increasingly being conducted, focusing on implementation strategies, teacher practices, and evaluation of its implementation in elementary schools (Björk-Åman & Ström, 2025; Faishal & Ahmadi, 2025; Sari & Kowiyah, 2024; Soviyani et al., 2024). However, most of these studies still discuss the implementation of differentiated learning in general, while discussions on learning needs analysis as the main foundation of learning differentiation have not been comprehensively examined.

On the other hand, research on students' learning needs generally focuses on a single aspect, such as learning readiness, learning style, or learning interest, separately (Abdulrahman et al., 2026; Mulyati et al., 2024; Taş & Minaz, 2024). However, students' learning needs are a multidimensional concept involving the interrelationships between cognitive aspects, learning readiness, learning interests, and learning profiles, which collectively determine the effectiveness of differentiated learning processes (Tomlinson, 2023). Thus, a research gap remains in the absence of a conceptual study that integrates these four dimensions of learning needs in the context of implementing differentiated learning in Indonesian elementary schools. This study offers a novelty by compiling a comprehensive analysis of elementary school students' learning needs through the integration of cognitive development, learning readiness, learning interests, and learning profiles as a basis for developing differentiated learning in the implementation of the merdeka curriculum.

Conceptually, this research is based on the theory of differentiated learning developed by Tomlinson. According to Tomlinson (2001, 2017, 2023) differentiated learning is a proactive approach to designing learning based on students' learning needs through modifications to four main components: content, process, product, and learning environment. These adjustments are made based on three main characteristics of students: readiness to learn, interest in learning, and learning profile. This framework serves as a conceptual foundation for explaining how learning needs analysis can be translated into learning strategies that are responsive to student diversity. In addition to Tomlinson's theory, this research is also supported by Jean Piaget's cognitive development theory and Lev Vygotsky's zone of proximal development (ZPD) theory. Piaget explained that elementary school students aged around 7–11 years are in the concrete operational stage, a stage where children are able to think logically about real objects but still have difficulty understanding abstract concepts (Barrouillet, 2015; Marinda, 2020; Piaget, 1964). Meanwhile, Vygotsky (1978) emphasized that learning will take place optimally if students receive assistance (scaffolding) in their potential development area or ZPD so that they are able to achieve a higher level of competence (Aghdam, 2017; Rahman, 2024). Both theories reinforce the importance of identifying learning needs as a basis for developing learning experiences that are appropriate to the developmental characteristics of elementary school students.

Based on the above description, this study aims to: (1) comprehensively analyze the concept of learning needs of elementary school students, including aspects of cognitive development, learning readiness, learning interests, and learning profiles; (2) identify how learning needs analysis forms the basis for implementing differentiated learning in elementary schools; and (3) describe various challenges and alternative solutions in implementing differentiated learning based on learning needs analysis in Indonesian elementary schools. This research is important because the success of implementing differentiated learning is determined not only by teachers' understanding of differentiation strategies, but also by their ability to analyze students' learning needs accurately. Without comprehensive mapping of learning needs, learning differentiation has the potential to become merely an adjustment of learning activities without considering individual student characteristics. Therefore, the study of learning needs analysis is highly relevant in supporting the implementation of the merdeka curriculum while strengthening student-centered learning practices in elementary schools.

Theoretically, this research is expected to enrich the development of studies on students' learning needs through the integration of various theoretical perspectives that have so far been discussed only partially. This research also broadens understanding of the relationship between cognitive development, learning readiness, interests, and learning profiles as the foundation of differentiated learning. From a practical perspective, the research results are expected to serve as a reference for elementary school teachers in developing diagnostic assessments, systematically mapping students' learning needs, and designing differentiated learning that is more effective, adaptive, and appropriate to the characteristics of Indonesian students. Furthermore, the results of this research can serve as a reference for curriculum developers, teacher education institutions, and future researchers in developing a more comprehensive learning needs analysis model to support improving the quality of learning in elementary schools.

Method

This study employed a narrative literature review (NLR) approach to gain a comprehensive understanding of student learning needs analysis as a foundation for

implementing differentiated learning in elementary schools. This approach was chosen because it allows researchers to integrate various theoretical perspectives and empirical findings from various publications, thereby constructing a comprehensive conceptual synthesis of a complex topic (Lam & Sodhi, 2025; Punggeti & Prijambodo, 2025b). Unlike systematic literature reviews, which focus on synthesizing evidence through rigorous selection procedures, narrative literature reviews provide flexibility in interpreting, comparing, and connecting various research findings to generate a deeper understanding of a phenomenon (Figueroa et al., 2025). This approach also aligns with the research objectives, which focus not on testing the effectiveness of an intervention but rather on developing a conceptual framework regarding student learning needs in the context of differentiated learning (Apriliyanti et al., 2021; Islamiah et al., 2023).

The literature collection process began with determining the research focus and developing a search strategy. The research topics focused on the learning needs of elementary school students, differentiated learning, diagnostic assessment, and the implementation of the merdeka curriculum. The search was conducted using a combination of Indonesian and English keywords, namely learning needs assessment, learning needs analysis, differentiated instruction, differentiated learning, elementary school, primary education, readiness, learning profile, learning styles, interest, learning needs, learning needs analysis, differentiated learning, elementary school, learning readiness, learning styles, and learning interest. These keyword combinations were used interchangeably or with boolean operators to obtain literature directly related to the research focus. Literature sources were obtained from various academic databases and highly credible scientific repositories, including Google Scholar, ERIC, PubMed, Semantic Scholar, as well as institutional repositories of higher education institutions and official Indonesian government documents. In addition to journal articles, this study also utilized academic books, conference proceedings, educational policy documents, and publications from professional organizations relevant to differentiated learning and student learning needs. The use of various types of sources was carried out to obtain a broader conceptual picture of the development of research in this field.

Literature selection was conducted based on several inclusion criteria. The literature used must be relevant to the analysis of learning needs or differentiated learning in elementary schools; come from credible sources, such as peer-reviewed journals, academic books, or official government documents; be published within a timeframe that includes classic literature as a theoretical basis to the latest research, especially publications from the last five years to illustrate the latest developments; and be available in full text form to allow for a comprehensive analysis. Literature that discusses topics outside the context of elementary education, has no direct relationship to the research focus, or comes from unaccountable sources was not included in the analysis process.

The data obtained were analyzed using thematic content analysis techniques. The analysis was conducted through several interconnected stages. The first stage is the data reduction process, which involves critically reading all selected literature to identify information relevant to the research focus. The second stage involves coding and grouping data based on key themes emerging in the literature. These themes include the concept of learning needs, dimensions of student learning needs, differentiated learning theory, diagnostic assessment, the implementation of differentiated learning in Indonesian elementary schools, and its challenges and implementation strategies. The final stage is synthesis and interpretation, which connects various findings from each

source to build a comprehensive conceptual understanding and identify similarities, differences, trends, and research gaps that require further study.

To enhance the credibility of the study results, each finding was cross-referenced with various academically authoritative sources so that the resulting interpretation was not based solely on a single reference. The synthesis was conducted critically, taking into account conceptual consistency, theoretical developments, and the context of differentiated learning implementation in Indonesian elementary schools. All analysis results were then presented in a structured thematic narrative, providing a comprehensive overview of student learning needs analysis as the basis for implementing differentiated learning.

Results and discussion

Concept and characteristics of students' learning needs

Analysis of various literature shows that students' learning needs are a complex concept and cannot be reduced to a single measure. Etymologically, "need" comes from the root word "need," which means something that must be fulfilled to achieve a desired state. In the context of education, Grant emphasized that learning needs analysis is a crucial stage that can lead to significant changes in practice because this process aims to identify gaps between what students currently know and the competencies they are expected to achieve in the future (Abdulrahman et al., 2026; Dushkova & Ivlieva, 2024). The thinking framework in Bloom's Taxonomy is very useful for unraveling this complexity. Through this theory, learning needs are grouped into three dimensions. First, the cognitive aspect, which emphasizes insight and reasoning acuity. Second, the affective aspect, which concerns attitudinal tendencies, interests, and internalization of values. Third, the psychomotor aspect, which involves motor dexterity and physical synchronization (Casido, 2026). These three domains are organically interrelated; A student can have different levels of needs in each domain, so a partial analysis of only one domain will produce an incomplete picture of their learning profile.

A dynamic combination of internal and external factors specifically shapes the learning needs of elementary school-aged children. Internal factors include physical fitness, mental state, interests, learning motivation, and intelligence levels. External factors also contribute to these factors, including the home environment, the school atmosphere, social interactions, and the adequacy of learning support facilities (Punggeti & Prijambodo, 2024). Students aged 7–12 experience rapid development in various aspects, so their learning needs fluctuate and require ongoing monitoring (Barrouillet, 2015). Content analysis of various empirical studies shows that learning needs are not fixed; instead, they evolve along with students' cognitive growth, socio-emotional development, and accumulated learning experiences. Therefore, learning needs analysis cannot be conducted as a one-time activity at the beginning of the school year, but must be a continuous cycle integrated into every stage of learning.

Based on literature findings, four fundamental aspects can be identified as the focus of the analysis of elementary school students' learning needs: cognitive aspects, learning styles, learning readiness, and learning interests. These four aspects do not stand alone but interact with each other to form a unique learning needs profile for each individual. The cognitive aspect relates to the capacity to think and process information, which is influenced by the stage of cognitive development. Learning styles determine the preferred way students receive and organize information. Learning readiness reflects students' affinity with the material to be learned. Learning interests drive student

motivation and engagement in the learning process. These four aspects will be analyzed in depth in the following sub-chapters, integrating relevant educational theories as analytical lenses. The analytical approach used in this study does not separate the literature review from the discussion of the results, but rather integrates both into a coherent analytical narrative, where educational theories are used directly to analyze the empirical findings from various studies.

Cognitive aspect analysis: concrete operational development and ZPD

The cognitive aspect is a fundamental dimension of learning needs because it determines students' capacity to understand, analyze, and apply learning materials. Literature analysis shows that understanding the cognitive development of elementary school students cannot be separated from the theoretical contributions of Piaget (1964) and Vygotsky (1978). Piaget (1964), through his theory of cognitive development, identified that elementary school-aged students (7–11 years old) are in the concrete operational stage, which is characterized by the ability to think logically about concrete objects and events, understanding the concept of conservation, and the ability to classify and seriate (Marinda, 2020). This finding has significant pedagogical implications: abstract learning materials must be bridged through concrete and manipulative experiences to be understood by students at this stage.

However, analysis of research conducted in Indonesia reveals a worrying phenomenon: the majority of elementary school students (81.7%) have not fully reached the concrete operational stage even though chronologically they are at the age range that should reach that stage. This finding indicates a substantial gap between the curriculum structure and the actual cognitive readiness of students. This gap explains why many students experience learning difficulties when faced with material that requires concrete operational thinking, even though they are not yet fully developmentally ready. The implication is that the analysis of learning needs in the cognitive aspect cannot rely solely on age estimates, but must use diagnostic assessments that measure students' actual cognitive abilities.

Through the concept of the ZPD, Vygotsky (1978) offers a crucial new perspective in understanding children's cognitive needs. The ZPD itself is described as the space between the limits of students' independent problem-solving abilities and the maximum capacity they can achieve when accompanied by a mentor (Aghdam, 2017; Rahman, 2024). This concept fundamentally changes the perspective on learning needs: it is no longer simply identifying what students know, but also estimating what they can achieve with adequate support. In differentiated learning practices, understanding each student's ZPD is crucial because it determines the level of task difficulty and the type of scaffolding that needs to be provided (Rahman, 2024).

The practical implications of this cognitive analysis are significant for instructional design. Abstract subject matter, such as the mathematical concept of fractions or the scientific concept of the water cycle, needs to be realized through concrete media and direct experience to be understood by students at the concrete operational stage. The use of teaching aids, physical manipulatives, and hands-on activities is no longer simply a methodological choice but a pedagogical necessity dictated by the characteristics of students' cognitive development. The combination of Piaget's and Vygotsky's perspectives yields a more nuanced understanding of students' cognitive needs. Piaget (1964) explained the cognitive structures underlying learning abilities, while Vygotsky (1978) demonstrated the potential for development that can be achieved through social interaction. Together, these two perspectives emphasize that a

single learning approach cannot meet diverse cognitive needs. Students at different stages of cognitive development require different types of materials, activities, and support. Gardner (1983), through his theory of multiple intelligences (MI), enriches this analysis by identifying eight relatively independent types of intelligence (linguistic, logical-mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalist), which emphasizes that cognitive needs cannot be viewed monolithically (Berliana & Atikah, 2023; Prijambodo & Punggeti, 2025). Each student has a unique intelligence profile, so learning must be designed to accommodate diverse cognitive strengths.

Research by Esmeralda (2024) shows that multiple intelligences-based learning strategies significantly contribute to students' cognitive, affective, and psychomotor development, confirming that this approach has a holistic impact on student development. The combination of Piaget's, Vygotsky's, and Gardner's perspectives yields a comprehensive understanding: Piaget explains the cognitive structures underlying learning abilities, Vygotsky demonstrates the potential for development through scaffolding, and Gardner identifies various cognitive pathways that can be taken to achieve understanding.

Analysis of learning styles: modality preferences and learning profiles

The analysis of learning styles among elementary school students provides valuable insights into individual preferences for receiving, processing, and organizing information. The literature consistently suggests that learning styles should not be viewed as rigid categories but rather as flexible preferences that can evolve. The VAK (Visual, Auditory, Kinesthetic) model, developed by Neil Fleming, classifies learners into three primary modalities based on their dominant sensory channels. Visual learners tend to learn most effectively through images, diagrams, and written materials; auditory learners benefit from listening, discussion, and verbal explanations; whereas kinesthetic learners acquire knowledge best through physical activities and hands-on experiences (Tomlinson, 2014a, 2023). In elementary education, identifying students' learning preferences is particularly important because children are still developing effective learning strategies. Early awareness of these preferences can foster metacognitive skills that support lifelong learning.

Kolb (1984) offers an alternative framework through the experiential learning theory, which identifies four learning styles based on the experiential learning cycle: diverging (observation and reflection), assimilating (conceptual thinking and reflection), converging (abstract thinking and active experimentation), and accommodating (concrete experience and active engagement). Empirical research conducted with fifth-grade elementary students in South Korea demonstrated that instructional strategies aligned with Kolb's learning styles significantly improved students' learning outcomes, particularly when integrated with educational technologies such as digital mind maps (Kim & Kim, 2012). These findings suggest that adapting instructional approaches to students' learning preferences is not merely a theoretical proposition but a practical strategy with measurable effects on learning effectiveness.

Tomlinson further broadens the concept of learning styles by introducing the term learning profile, which encompasses not only learning styles but also multiple intelligences, gender-related preferences, and cultural influences (Tomlinson, 2001). This concept provides a more comprehensive perspective by recognizing that learning preferences are shaped by multiple interacting factors beyond dominant sensory modalities. According to Tomlinson (2001), educators should avoid assuming that

students possess a single, fixed learning style, although understanding learners' preferences remains essential. Instead, teachers are encouraged to design instruction using multimodal approaches that provide diverse learning experiences while simultaneously helping students develop the flexibility to learn through multiple modalities (Taş & Minaz, 2024). This perspective is supported by evidence indicating that students who engage with various learning approaches tend to become more adaptable and better equipped to succeed across different learning contexts.

Within the context of Indonesian elementary education, learning style analysis serves as an essential foundation for implementing differentiated instruction. For example, in a thematic lesson on environmental education, students with visual preferences may demonstrate their understanding by creating posters or concept maps; auditory learners may participate in presentations or group discussions; while kinesthetic learners may engage in experiential activities such as cleaning the school environment or planting trees (Tomlinson & Imbeau, 2023). These varied instructional activities ensure that all students can access learning experiences that align with their individual preferences while working toward the same learning objectives. Consequently, learning style analysis provides a practical basis for translating the principles of differentiated instruction into meaningful and measurable classroom practices.

Analysis of learning readiness: learning gaps and scaffolding

The analysis of learning readiness focuses on developing a comprehensive understanding of students' proximity to the knowledge, understanding, and skills targeted in the learning process. Tomlinson distinguishes readiness from ability, arguing that readiness is a more dynamic construct because it is influenced by students' prior learning experiences, attitudes toward school, thinking habits, and the immediate learning context (Anis et al., 2024; Tomlinson & Imbeau, 2013). This distinction is significant because it emphasizes that learning readiness is not a fixed characteristic inherent in students but rather a condition that continuously evolves in response to situational factors and ongoing learning experiences.

Empirical evidence from studies conducted in Indonesia demonstrates considerable variation in students' learning readiness, even within the same classroom. Research conducted at MIN 3 Ponorogo found that the learning readiness of fourth-grade students was distributed across three categories: high (11%), moderate (68%), and low (11%). This distribution illustrates the substantial heterogeneity of students' readiness levels and underscores the need for differentiated instructional approaches tailored to each readiness group. Similar findings have been reported at the senior high school level, where learning readiness comprises multiple dimensions, including physical readiness (71.17%), mental readiness (72.64%), emotional readiness (78.63%), and the availability of learning facilities and resources (80.37%). These findings indicate that learning readiness is a multidimensional construct that cannot be adequately represented by academic performance alone.

Vygotsky's (1978) theory of the ZPD provides a strong theoretical foundation for understanding the dynamics of learning readiness. Effective instruction should be positioned slightly above students' current level of readiness so that they are encouraged to extend their capabilities with appropriate scaffolding support (Rahman, 2024). When learning tasks are too easy relative to students' readiness levels, they are likely to experience boredom and reduced motivation. Conversely, when tasks are excessively challenging, students may experience frustration and anxiety that hinder the

learning process. Teachers who implement readiness-based differentiated instruction therefore strive to design learning tasks that represent a "good match" for each student, tasks that extend their knowledge and skills just beyond their current level of competence while remaining achievable with appropriate instructional support (Nuraini & Ramadan, 2024).

Assessing students' learning readiness requires systematic and continuous evaluation. Diagnostic assessment at the beginning of instruction plays a crucial role in identifying students' prior knowledge and determining the extent of their foundational understanding of the concepts to be learned (Punggeti & Prijambodo, 2025a). Such assessments may include written tests, oral assessments, or performance-based tasks designed to identify learning difficulties and individual learning needs. Throughout the instructional process, teachers employ formative assessment to monitor students' readiness as it develops over time. These ongoing assessments provide immediate feedback that enables teachers to adjust instructional strategies in real time according to students' emerging needs (Dermawan et al., 2024). Together, diagnostic and formative assessments offer a comprehensive and dynamic picture of students' learning readiness, recognizing that readiness is not static but continuously develops throughout the learning process.

Analysis of learning interests: intrinsic motivation and student engagement

The analysis of learning interests highlights the affective dimension of students' learning needs, which is often overlooked despite its significant influence on student engagement and learning outcomes. Tomlinson (2000) defines interest as "something that engages students' attention, curiosity, and involvement". Unlike cognitive readiness and academic ability, learning interests originate from students' personal experiences, cultural backgrounds, perceived needs, and natural curiosity. These subjective characteristics make learning interests one of the most individualized aspects of student learning while also presenting challenges for objective identification and assessment.

Empirical studies conducted in Indonesia have identified various factors that influence elementary school students' learning interests. These factors can generally be categorized into intrinsic and extrinsic dimensions. Intrinsic factors include students' physical well-being, emotional drive, concentration, memory capacity, innate talents, and natural curiosity. Extrinsic factors encompass the family environment (parental support, home atmosphere, and socioeconomic conditions), the school environment (teaching methods, learning facilities, and relationships with teachers and peers), as well as the broader community environment (peer groups, mass media, and social activities) (Tomlinson, 2014b). Research by Al-Said (2023) further demonstrates that instructional methods, learning environments, parental support, and individual motivation are significant determinants of students' learning interests. These findings suggest that learning interest does not emerge spontaneously but is shaped by multiple interrelated factors that can be intentionally supported and developed.

Within the framework of differentiated instruction, students' interests serve as an important basis for designing meaningful and engaging learning experiences. The primary objective of interest-based differentiation is to help students engage with new knowledge and skills by connecting them to topics and activities that they already perceive as interesting, relevant, and personally meaningful (Wahyudi et al., 2023). This approach is grounded in the premise that intrinsic motivation generated by personal interests is generally more powerful and sustainable than extrinsic motivation driven by rewards or external pressures. Teachers can implement interest-based differentiation

by providing learning resources that reflect diverse student interests, facilitating independent inquiry into topics chosen by students, or linking instructional content to students' personal experiences and everyday contexts (Rasdi et al., 2023).

It is important to recognize that students' learning interests are dynamic rather than fixed. Their interests naturally evolve as they mature and encounter new experiences. Effective teachers therefore do more than simply utilize students' existing interests; they also seek to broaden and deepen those interests by introducing relevant new topics and providing rich learning experiences. In this way, interest-based differentiation contributes not only to increasing short-term engagement but also to fostering intrinsic motivation and a lifelong love of learning (Cahyaningtyas & Mukhlisina, 2023). Consequently, a comprehensive analysis of students' learning interests, conducted through interviews, questionnaires, and continuous classroom observation is essential for the successful implementation of differentiated instruction in this dimension.

Integration of the four learning needs into the differentiated instruction model

The analysis of the four dimensions of students' learning needs, cognitive development, learning profile, learning readiness, and learning interests, requires a systematic framework to translate these dimensions into effective instructional practice. Tomlinson's differentiated instruction model provides such a framework by identifying four classroom elements that can be modified according to students' individual characteristics. These elements include content (what students learn), process (the activities through which students make sense of the content), product (how students demonstrate their learning), and the learning environment (the classroom atmosphere and organizational structure) (Mulyawati et al., 2022). The three student characteristics that guide these instructional modifications are learning readiness, learning interests, and learning profiles, all of which closely correspond to the four dimensions of learning needs discussed in the preceding sections.

Table 1 aspects of learning needs

Learning needs aspects	Identification instruments	Content differentiation	Process differentiation	Product differentiation
Cognitive	Diagnostic tests, task observations	Material at varying difficulty levels according to Piaget's developmental stages	Graded activities based on Vygotsky's ZPD	Final assignment complexity options based on Gardner's MI profile
Learning style	VAK/Kolb questionnaires, behavioral observations	Material in visual, audio, and kinesthetic formats	Activities based on learning modality preferences	Completion formats based on dominant learning profiles
Readiness to learn	Pretests, formative evaluation analysis	Remedial, enrichment, or regular materials	Intensive mentoring to independence with scaffolding	Assignments with varying levels of support and challenge
Learning interest	Interviews, interest questionnaires, ongoing observations	Material related to topics of the student's choice	Individual or interest group-based projects	Choice of topics, presentation methods, and work formats based on interests

Source: secondary data, processed

The integration illustrated in Table 1 demonstrates that Tomlinson's model not only bridges educational theory and classroom practice but also provides clear and measurable pathways for addressing diverse learning needs. For example, content differentiation based on learning readiness involves providing instructional materials at varying levels of complexity and readability, whereby advanced learners receive enrichment activities while students requiring additional support are provided with simplified materials or targeted scaffolding (Nuraini & Ramadan, 2024). Similarly, process differentiation based on learning profiles involves designing a variety of learning activities that accommodate different learning preferences, such as group discussions for auditory learners, hands-on experiments for kinesthetic learners, and visual analysis activities for students with visual preferences (Casido, 2026). A defining characteristic of differentiated instruction is its proactive nature, distinguishing it from reactive approaches that provide support only after students encounter learning difficulties. Tomlinson emphasizes that effective differentiation should be intentionally planned before instruction begins, based on a systematic analysis of students' learning needs (Mulyawati et al., 2022). This proactive approach enables teachers to anticipate learner diversity and prepare multiple instructional pathways in advance rather than merely responding to challenges as they arise during classroom instruction. Moreover, these four forms of differentiation can be implemented simultaneously by modifying one or more classroom elements according to one or more student characteristics, thereby creating learning experiences that are genuinely personalized, inclusive, and meaningful.

Implementation in Indonesian elementary schools: policy and practice

An analysis of the implementation of differentiated instruction in Indonesia reveals a strong alignment between its theoretical foundations and national curriculum policy. The merdeka curriculum, introduced in 2022, inherently supports differentiated instruction through its emphasis on student-centered learning, the development of the Pancasila Student Profile, and flexibility in achieving learning competencies. The official guidelines of the Merdeka Curriculum explicitly recommend differentiated instruction as an integral component of meaningful classroom practice (Hartutik et al., 2023). Furthermore, the curriculum incorporates three complementary forms of assessment, diagnostic, formative, and summative, which collectively support a continuous cycle of learning needs analysis. The assessment process begins with diagnostic assessment to identify students' initial competencies and learning profiles before instruction, followed by formative assessment integrated throughout the learning process to provide ongoing feedback and inform instructional adjustments. Finally, summative assessment is conducted at the end of a unit to evaluate students' overall learning achievement (Punggeti & Prijambodo, 2025b).

The assessment cycle embedded within the Merdeka Curriculum fundamentally supports the implementation of differentiated instruction. Diagnostic assessment conducted prior to instruction enables teachers to identify students' learning needs across the four dimensions discussed previously: cognitive development (level of cognitive functioning), learning profile (learning modality preferences), learning readiness (proximity to the intended learning objectives), and learning interests (topics that stimulate students' curiosity and engagement) (Dermawan et al., 2024). Teachers then use these assessment data as the foundation for designing differentiated instructional modules. During instruction, formative assessment provides continuous feedback, allowing teachers to modify instructional strategies in response to students' evolving learning needs. At the conclusion of instruction, summative assessment

evaluates students' overall learning outcomes and the extent to which instructional objectives have been achieved (Ningsi et al., 2024). This assessment cycle is inherently consistent with the principles of differentiated instruction, which require dynamic pedagogical responses to learner diversity.

Research conducted by Furoidah et al. (2026) provides empirical evidence of differentiated instruction within the context of the Merdeka Curriculum in Indonesian elementary schools. Their findings indicate that differentiation has been implemented across three major instructional elements: content (adapting learning materials according to students' readiness levels), process (varying instructional methods and learning activities), and product (offering students multiple options for demonstrating their learning). These practices were found to improve student engagement, deepen conceptual understanding, and create a more active and enjoyable classroom environment. Similar findings were reported by Faishal & Ahmadi (2025) at SD Negeri 2 Sidayu, where differentiated instruction was successfully implemented in fifth-grade classrooms through variations in content, process, and product that accommodated students' readiness, interests, and learning profiles.

The implementation of differentiated instruction in Indonesian elementary classrooms demonstrates a variety of practical strategies that have been successfully applied. Flexible grouping is one of the most widely used approaches, whereby students are organized into dynamic groups based on ability, interests, or learning profiles, with group membership changing according to instructional needs (Puspitasari et al., 2024). For example, during a thematic unit on economics, students may be grouped according to their interests: those interested in music compose songs about different types of human needs, students who enjoy reading and writing create concept maps, while students interested in sports design educational games illustrating economic processes (Tomlinson, 2017). Individualized support also constitutes an essential component of differentiated instruction, with teachers providing varying levels of guidance ranging from intensive assistance for students requiring additional support to greater autonomy for more independent learners (Björk-Åman & Ström, 2025). Beyond differentiating content, process, and product, the learning environment plays an equally important role in facilitating effective differentiation. Providing students with multiple workspace options, such as quiet areas for independent learning and collaborative spaces for group work, incorporating learning materials that reflect cultural diversity, and fostering a flexible and responsive classroom climate all contribute to successful implementation (Punggeti & Prijambodo, 2025a). Such learning environments enable students to feel psychologically safe to take learning risks, value their individual differences, and progress according to their own pace and learning pathways.

Despite these encouraging developments, evidence from numerous studies also identifies several recurring challenges in implementing differentiated instruction across Indonesian elementary schools. Research conducted by Sandi (2025) at SD Negeri 28 Rejang Lebong identified major obstacles, including limited educational facilities and learning resources, insufficient instructional time, and inadequate professional development opportunities for teachers. Interviews with classroom teachers further revealed additional challenges, such as difficulties in accurately identifying individual students' learning needs, substantial variation in learning pace and academic ability within the same classroom, limited assessment instruments capable of measuring individual learning needs comprehensively, and the diverse socioeconomic and cultural backgrounds of students (Sandi, 2025). Time constraints remain the most frequently reported challenge because planning differentiated instruction requires substantially

more preparation than conventional lesson planning (Furoidah et al., 2026). These challenges become even more complex in large classrooms, where teachers must analyze and respond to the learning needs of many students simultaneously. Limited teacher competence also represents a significant barrier, as many educators continue to hold only a partial understanding of differentiated instruction, often assuming that differentiation involves assigning different tasks without fully understanding its underlying pedagogical principles (Sandi, 2025). Furthermore, inadequate educational facilities and instructional resources, particularly in rural and remote elementary schools, restrict teachers' capacity to provide diverse and meaningful learning experiences that effectively address students' varied learning needs (Ravet & Mtika, 2024).

Challenges and strategic solutions

Based on the implementation challenges discussed above, several strategic recommendations can be proposed to optimize the implementation of differentiated instruction grounded in systematic learning needs analysis. First, comprehensive and continuous professional development for teachers is essential. Such training should extend beyond theoretical understanding of learning needs analysis and differentiated instruction to include practical experiences in designing, implementing, and evaluating differentiated learning activities. Professional development may be delivered through various mechanisms, including intensive workshops, professional learning communities, and ongoing instructional mentoring provided by educational facilitators (Furoidah et al., 2026). The Ministry of Education has developed training modules to support teachers in identifying students' learning needs. However, their implementation and sustainability at the school level require further strengthening.

Second, teacher collaboration offers an effective strategy for addressing the considerable time required to plan differentiated instruction. By sharing instructional planning responsibilities, teachers can collaboratively develop multiple versions of learning materials, instructional activities, and assessment tasks more efficiently. Well-established and sustainable professional learning communities also provide valuable opportunities for teachers to exchange best practices, instructional resources, and reflective experiences related to differentiated instruction (Furoidah et al., 2026). Third, the integration of educational technology and digital learning resources can help overcome limitations in physical facilities and instructional materials. Numerous digital learning platforms provide instructional resources at varying levels of complexity and in multiple formats, many of which are freely available or accessible at minimal cost. Teachers can integrate these resources with self-developed instructional materials to better accommodate students' diverse learning needs (Faishal & Ahmadi, 2025; Punggeti & Prijambodo, 2025b).

Fourth, differentiated instruction should be implemented gradually rather than attempting to apply all dimensions of differentiation simultaneously. Teachers may begin by focusing on a single form of differentiation, for example, process differentiation within one instructional component, and progressively expand their implementation as their knowledge, confidence, and instructional expertise develop (Nurhidayah et al., 2023). This incremental approach enables teachers to refine their instructional practices through continuous reflection and practical experience before addressing the full complexity of differentiated instruction. Fifth, assessment systems that support differentiation should be strengthened, particularly through the development of diagnostic assessment instruments capable of identifying students' learning needs

accurately and efficiently. Portfolio-based assessment represents one effective approach for documenting students' learning progress and individual needs in a comprehensive manner (Iskak et al., 2023). The development of valid and reliable assessment instruments that measure the four dimensions of learning needs, cognitive development, learning profile, learning readiness, and learning interests should therefore become a priority to ensure that learning needs analysis can be conducted systematically and continuously. Finally, consideration should be given to reducing student-to-teacher ratios or providing teaching assistants to facilitate more intensive individualized support. Overcrowded classrooms substantially limit teachers' capacity to conduct individualized learning needs analysis and implement differentiated instruction effectively. Collectively, these six strategic recommendations provide a comprehensive foundation for realizing differentiated instruction that is genuinely responsive to the diverse learning needs of students in Indonesian elementary schools.

Conclusions

The results of the study indicate that the learning needs of elementary school students are a multidimensional concept that is not only determined by academic ability but also influenced by aspects of cognitive development, learning styles or profiles, learning readiness, and learning interests that interact to form the unique characteristics of each student. Literature analysis confirms that these four aspects are the main foundation in the implementation of differentiated learning as proposed by Tomlinson through the differentiation of content, process, product, and learning environment. The integration of Piaget's cognitive development theory, Vygotsky's ZPD, and Tomlinson's learning profile concept provides a comprehensive conceptual framework to explain how learning needs analysis can be translated into adaptive learning strategies. On the other hand, this study also shows that the implementation of differentiated learning in Indonesian elementary schools has received policy support through the merdeka curriculum, but still faces various challenges, such as limited teacher competency in meeting learning needs, limited time, high student heterogeneity in one class, and limited learning facilities and infrastructure.

This study provides a theoretical contribution by integrating various perspectives on student learning needs into a single conceptual framework that connects cognitive development, learning readiness, learning interests, and learning profiles as the basis for implementing differentiated learning in elementary schools. Practically, the results of this study can serve as a reference for teachers in designing diagnostic assessments, mapping student learning needs more systematically, and developing differentiation strategies appropriate to individual student characteristics within the context of the merdeka curriculum. However, this study has limitations because it uses a narrative literature review approach that relies on interpretation of available literature without direct empirical verification in the field. Furthermore, the resulting synthesis is still influenced by variations in context, research design, and sample characteristics of each study analyzed, requiring caution in generalizing the findings.

Based on these limitations, further research is recommended to conduct empirical studies using quantitative, qualitative, and mixed methods approaches to validate the conceptual framework generated in this study in various elementary school contexts in Indonesia. Future research should also develop and test learning needs analysis instruments with high validity and reliability so that teachers can use them as a basis for developing differentiated learning. Furthermore, further studies can be

directed at developing a differentiation implementation model based on learning needs analysis that considers the use of digital technology, regional characteristics, and the socio-cultural conditions of schools, thus providing more applicable recommendations for improving the quality of learning in elementary schools.

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